Lessons Learned from Uganda's Gender Mainstreaming Policy in the Road Sector.

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Uganda has made significant advances in the empowerment of women in political, economic and social spheres. In road transportation, policies were adopted for fostering the integration of gender issues in the sector but their implementation has not been consistent. There are knowledge gaps in understanding how gender is addressed in road projects and how relevant actors in the transport sector (i.e., ministries; institutions; and partners) can encourage gender mainstreaming. The present paper summarizes key road sector and gender policy documents in an effort to evaluate the effectiveness of the gender policy. Despite Uganda's national gender policy commitments in the road sector, more could be done to increase women's participation and empowerment by strengthening the implementation of existing policies. The review surveys the main policy instruments developed in the country and makes recommendations on the factors required for improving the implementation of national gender policy commitments in the road sector. The review will also seek to raise awareness on the policy provisions and the institutional mechanisms necessary for taking gender into account in the planning and programming of road sector activities. The review concludes that a more integrated approach is needed between transport departments, various government tiers and implementing units to strengthen the institutional dimensions.

1. INTRODUCTION

Transport plays a key role in accessing economic resources, education, health and other elements necessary for enhancing women's empowerment. In the Sub-Saharan Africa region, like in many other developing regions, women's mobility is constrained by limited transport supply but also by social factors that can reduce women's access to the outside world.

Gender sensitive policies in transportation have been prepared in several African countries. Some countries have also enacted gender-sensitive constitutional provisions and have promoted the establishment of gender focal points in line ministries (IC Net 2004). Countries that have integrated measures in national transport policies to reduce gender inequality and improve the socio-economic and political status of women have often included women and other vulnerable groups as part of the government task forces to oversee gender and transport policy coordination and by having sizeable representation of these groups on village, ward and district committees and road boards.

A good practice example of legal and policy provisions and a supportive institutional structure at national and district level for mainstreaming gender equality is Uganda, where road sector programs and projects have continuously addressed gender mainstreaming (DANIDA 2006). A gender management plan was developed to mainstream gender in the Ministry of Transport, focusing on stakeholder's capacity, the development of a communications strategy and a monitoring system. Data and information collected are used in implementation of policy, guidelines formulation. Funding has also been made available for awareness raising, capacity building and establishing gender sensitive procedures.

Gender policy in Uganda is particularly important considering the high transport burden facing women. It is estimated for example that 67 percent of the rural women walk for more than 30 minutes to a clean water source, an activity which is sometimes performed more than once per day. Likewise, the average distance travelled to collect firewood averages more than 4 km suggesting a time burden for women who are often associated with this responsibility.

Over the years, Uganda has formulated and enacted various policies and legislation, respectively, intended to promote gender equality and women's empowerment. However, commitment to mainstream gender at the national level is not sufficient to guarantee that gender issues will be addressed in transport policies and projects. Gender awareness needs to be increased at all levels of government to ensure that national gender policy is incorporated in transport policies and planning. The review recommends areas where gender policy can be strengthened.

2. GENDER POLICY IN UGANDA

Uganda's approach to gender issues, including in transportation, has been a leading example for other countries to follow. Uganda set an example of the type of legal and policy provisions, including the necessary supportive institutional structure at national and district level, for mainstreaming gender equality into policy-making. The Government adopted a National Gender Policy (NGP) in 1997, and its revision in 2007, confirmed the country's commitment to take actions that will bring about more equal gender relations. The policy supports that all Government policies and programs, in all areas and at all levels, are consistent with the long-term goal of eliminating gender inequalities. The policy gives a clear mandate to the Ministry of Gender, Labour and Social Development and other Line Ministries to mainstream gender in all sectors. It sets priority areas of action at the National, Sectoral, District and Community levels with all levels of planning, resource allocation and implementation of development programs redressing gender imbalances and acting with a gender perspective. The ultimate objective of this policy is to lead to a society that is both informed and conscious of gender and development issues and concerns.

In transport specifically, Uganda's 2001 draft "White Paper on Sustainable Maintenance of District, Urban and Community Access Roads (DUCAR)" outlined a strategy for addressing gender issues in the transport sector and institutionalizing labor-based technology in road works. The DUCAR recommendations were integrated into the 10 year rolling plan for Road Sector Development Program of April 2002. A gender management plan was developed to mainstream gender in the Ministry of Transport, focusing on stakeholders' capacity, the development of a communications strategy and a monitoring system. Data and information collected were used in

implementation of policy, and guidelines formulation. Funding was also been made available for awareness raising, capacity building and establishing gender sensitive procedures.

Uganda also adopted a National Development Plan (NDP) which outlines a broad strategy for promoting gender equality that includes the development of an action plan for promoting action in all spheres and transforming mind-set, negative attitudes, and negative cultural practices. It identifies several areas of action that includes awareness campaigns on gender issues for mining communities; tackling gender-related land issues; and adherence to reproductive health rights especially for women and girls.

3. METHODOLOGY AND SCOPE OF THE REVIEW

The review assesses the experience and performance of Uganda's road sub sector in mainstreaming gender over the past five years. The review focuses on the various measures taken by the Government to implement its national gender policy commitments and reviews the effectiveness of implementation in the past five years, with a particular focus on the national policy environment for women's empowerment and gender equality as it relates to the transport sector, and specifically the road sub-sector. Another aspect is the extent to which the national gender commitments have been translated into transport policy and practice including planning and budgeting, procurement, as well as capacity building in the government, agencies and the creation of specific training programs such as the Mount Elgon Training College [METC]. The extent of women's employment share in the roads subsector was also reviewed, particularly in road works and labor-based work and the impact on their income and empowerment;

Table. Summary of issues addressed in focus group discussions

Key Actor/Institution	No. consulted		Issues explored
	F	M	
Ministry of Works and Transport [MoWT]	1	7	How gender is incorporated in the following: • Transport/road sector policies • Transport/road sector strategic investment planning • Transport/road sector annual planning and budgeting BFP and MPS • Road sector procurement, contracting etc. • Transport/road sector information management system • Transport/road sector institutional structure
Ministry of Finance, Planning and Economic Development [MoFPED]	1	2	• Gender responsiveness in resource mobilization and allocation • Gender sensitivity of budget monitoring
Ministry of Gender, Labour and Social Development [MoGLSD]	2	0	• National policy environment for women's empowerment and gender equality as it relates to the transport sector, and specifically the road sub-sector. • Gender equality bills, laws, policies, strategies and implications for the

			road sub-sector
Ministry of Local Government [MoLG]	1	0	• Gender in the transport sector service delivery
Uganda National Road Agency [UNRA]	0	5	• Gender considerations in development and maintenance of national roads • UNRA procurement, contracting etc. • UNRA information management system • UNRA sector institutional structure
Uganda Road Fund [URF]	1	1	• Gender considerations in financing road maintenance
Mount Elgon Labour-based Training Centre [MELTC]	1	6	• Gender sensitivity of curriculum and training material • Gender representation in training participants over past five years: contractors, staff and workers
District Local Governments	0	4	• Gender considerations in development and maintenance of district and community access roads
Development partners	1	5	• Gender dimensions in financing the road sub-sector
Contractors and consultants	2	6	• Gender sensitivity of road project implementation, supervision and reporting
Contractors' and consultants' staff	3	12	
CSOs	3	3	• Gender responsiveness of transport policy engagement • Gender activism and advocacy in the road sub-sector
Total	***16***	***51***	

The review included four dimensions:

- discussing with focus groups made of relevant national and local transport expertise the implementation challenges at the government level.
- reviewing national gender relevant documents was to supplement the gender assessment
- discussing with focus group discussions that included women and men living near road project areas
- a semi-structured travel questionnaire was administered to a sample of women and men working in Kampala to elicit information on gender dimensions in urban public transport from the perspective of road users.

Table. Demographic characteristics of survey respondents

	Women		Men		TOTAL	
	No.	%	No.	%	No.	%
Sex	99	51.6	93	48.4	192	
Age Group						
>18	7	7.1	11	11.8	18	9.4
18-65	87	87.9	74	79.6	161	83.9
<65	5	5.1	8	8.6	13	6.8
Marital Status						
Single	13	13.1	28	30.1	41	21.4
Married	45	45.5	62	66.7	107	55.7
Divorced	21	21.2	0	0.0	21	10.9
Widowed	7	7.1	1	1.1	8	4.2
Separated	13	13.1	2	2.2	15	7.8
Young children?						
YES	67	67.7	62	66.7	129	67.2
NO	32	32.3	31	33.3	63	32.8

4. GENDER POLICY IN ROAD SECTOR

The Government of Uganda's commitment to gender equality in the road sector is demonstrated through the adoption of several important policy including Uganda's Gender policy,
The National Development Plan (NDP)

Guidelines for Mainstreaming Gender into the Road Sector. In 2008, the MoWT published a Gender Policy Statement, the approved operational framework for addressing gender inequalities and advancing women in the road sub-sector. The MoWT also published "Guidelines for Mainstreaming Gender into the Roads Sub-Sector [2008] to operationalize the Policy Statement. The Guidelines present a step-by-step "what to do" and include questions as well as checklists in the form of indicators. The checklists are intended to be used as the internal tools for monitoring gender compliance of the sub-sector policies, plans, programmes and budgets.

Despite the publication of the Guidelines, the review revealed that the Policy Statement and Mainstreaming Guidelines have had limited application. This could, in part, be attributed to the inadequate dissemination. While the documents were prepared in 2006, they were published in 2008. Furthermore, the MoWT embarked on systematic dissemination, largely through workshops for local governments, in FY 2012/2013. This process has, however, been halted on account of government's restrictions on cash advances to cater for costs such as transport reimbursement and subsistence allowances.

Amongst the challenges identified as to the non-implementation of gender in the sector is the lack of technical capacity. The other is that the Policy Statement is not prescriptive and that while it sets useful standards for addressing gender in the road sub-sector, there is no mechanism for enforcement of compliance.

The National Development Plan. The National Development Plan (NDP, 2010) is the overarching progressive policy development framework and medium-term planning tool. The NDP specifies Uganda's strategic direction, development priorities and implementation strategies over the planning period. It guides the formulation of policy and implementation of Government programmes through sector wide approaches [SWAps] and a decentralized system of governance. The NDP [2010] prioritises gender amongst the seven most binding constraints

which must be addressed in order to stimulate growth in the country. The NDP is implemented through 16 sectors including works and transport as well as social development of which road and gender equality are sub sectors, respectively.

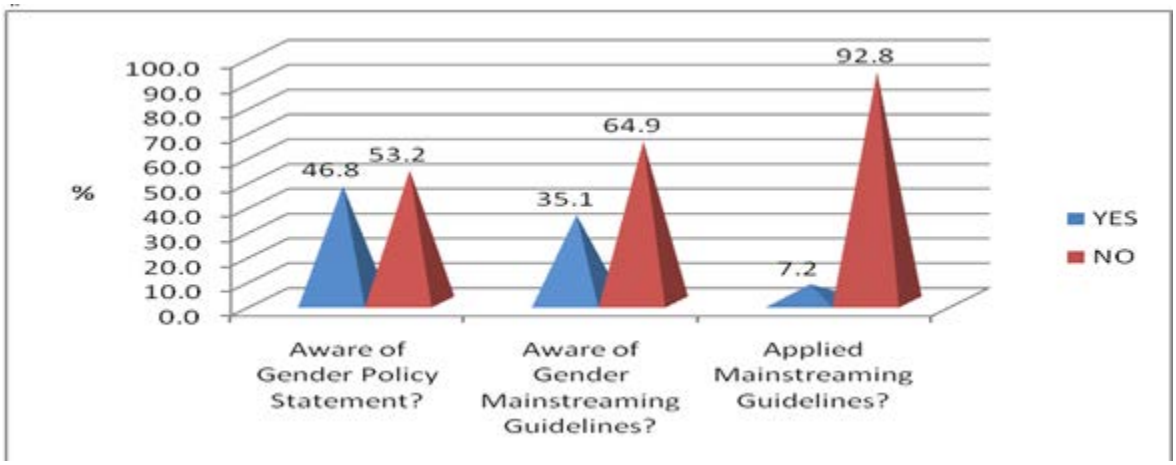


Figure 1. Knowledge and Application of Gender Policy Statement and Gender Mainstreaming Guidelines for the Road Sub Sector [n=101]

Gender equality in decentralised local governance. At the sub national level, the MoGLSD is decentralized into district and sub county Community Based Services [CBS] departments which support all sectors in community mobilization and participatory planning to ensure that Government programmes respond to the needs of the citizens. The CBS department is also responsible for sensitizing and educating the communities about their social responsibilities.

On an annual basis, the Ministry of Local Government [MoLG] grades local governments based on their performance in management and delivery of services as a way of promoting, amongst other things, downwards accountability.1 Gender mainstreaming is one of aspects for which performance measures are specified. Each of the aspects is accorded equal weight in the overall assessment. Where a local government performs well in respect to any of the performance indicators, it is rewarded with an additional 20 percent funding. Those which perform poorly are penalized by receiving 20 percent less than the local development grant allocation.

[1] MoLG. Assessment Manual of Minimum Conditions and Performance Measures for Local Governments. September 2011

The Non-Motorized Transport Policy. The Non Motorized Transport Policy launched in 2012 acknowledges that whereas men, women, children and the elderly are all pedestrians, most means of transport in Uganda are owned and operated by men. Furthermore, that in some parts of the country, negative cultural traditions inhibit women from riding thus excluding them from the productive benefits that bicycles can offer. The Policy states that Government recognizes that men and women have equal rights to own and use bicycles and that gender discrimination will be actively discouraged. The Policy commits the Government to undertake research in order to:

General Specifications for Road and Bridge Works. The MOWT general specifications for road and bridge works document is the basis of preparing bills of quantity [BoQs] for national road projects, the activities a contractor is obliged to undertake. The specifications include a section on occupational health and safety, HIV and AIDS as well as gender. The specifications state that a contractor shall comply with laws, statutory regulations, policies, rules and byelaws on gender equality including the Local Governments Act, the National Gender Policy and the Social Development Sector Strategic Investment Plan. The contractor is obliged to prepare a Gender Management Plan [GMP] including details of how they will recruit women and men as well as "addressing the specific gender working and living needs in the road construction environment".

Discussions with road project contractors and consultants indicated compliance to these specifications albeit with different interpretations and results. One of the biggest constraints is that while gender is one of the items in the BoQs, the contractors tend to price it as low as they can and then spend as little as they can get away with in the bid to maximize profit. This could be addressed through making it a provisional sum. That way, it would be equalized and would no longer be a competitive item for the contractors to estimate in their bids. The other challenge is that gender responsiveness is not a certifiable item as is the case with environment, for instance. If the contractor does not comply, all they lose is the negligible amounts allocated to gender. According to UNRA, a number of contractors are willing to lose that money rather than address crosscutting issues.

5. GENDER IN ROAD PROJECTS

The implementation of Uganda's national gender policies and their effectiveness can be assessed in the context of projects.

Identification and design. The EU Country Strategy Paper and National Indicative Programme 2008-2013 commits all development partners active in the sector to provide support to the GoU to ensure that both road sector institutions and contractors address gender issues through inter alia Gender Management Plans [GMPs]. As a result, projects are evaluated based on a social impact assessment that needs to be undertaken as part of a feasibility study that proposed measures which were incorporated in the design to secure traffic safety for pedestrians and bicycle users. In the context of the on-going Mbarara-Ntungamo-Kabale-Katuna road link of the Northern Corridor Route, gender was identified as one of the aspects that needed to be addressed in order to guarantee the sustainability of the project.

Implementation and supervision. Other issues related to implementation exist. In order to comply with the contractual obligation of addressing cross-cutting issues, the contractor recruited non-engineering firms to support it. The project consultant's team includes and environmental specialist as well as a community liaison officer. The contractor prepared the mandatory GMP outlining the gender equality actions, with clear indicators, to be given due consideration during the execution of the project. The GMP includes a Common Bargaining Agreement [CBA] specifying the terms and conditions of employment and rates of pay mutually decided upon by both the contractor and the workers' union: the Uganda Building Construction, Civil Engineering, Cement and Allied Workers' Union.

Besides the periodic gender awareness creation for the local project staff, the GMP commits the contractor to report on gender sensitivity in: i] Job advertisement, recruitment and promotion; ii] Representation in leadership positions; iii] Addressing sexual harassment; and iv] Working conditions and facilities.

Challenges to promoting gender mainstreaming and equality. Most [83%] respondents identified inadequate capacities as the key challenge to promoting gender equality and women's empowerment in the sub-sector. As a result, sub-sector institutions do not collect, analyse and

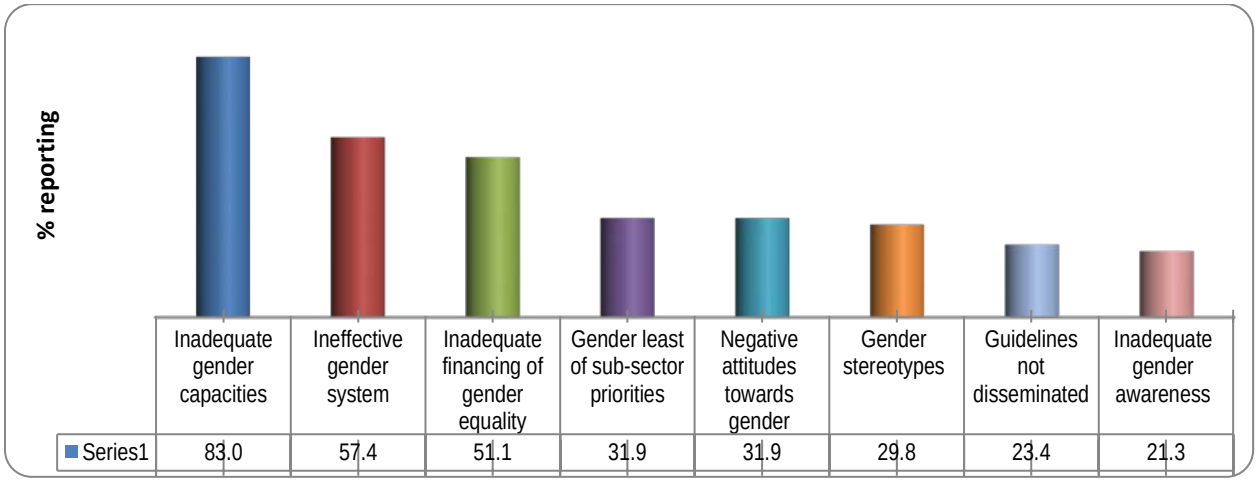
utilize gender disaggregated data to inform planning, budgeting, performance monitoring as well as technical auditing. The only institutionalised form of gender capacity building has been through the MELTC but as the foregoing sub-section suggests, this has benefitted only a few people and none of them from the MoWT. Only 14.9 percent of the respondents indicated that they had undergone gender training.More than 30 percent of the respondents attribute this to the fact that while gender is regarded as a cross-cutting, it is the least valued amongst the sub-sector priorities. In addition, nearly 60 percent of the respondents believe that the gender mainstreaming set up in the sub-sector is ineffective.

While the GFP set-up in the MoWT has achieved some results, the designated officer is at the lowest rank [U3] of the middle management level suggesting limited influence to strategic decision making. The ELU is strategically positioned under the Construction and Quality Assurance Department but the challenge is the compartmentalization of gender. Addressing gender in the sub-sector is perceived to be the sole responsibility of the GFP, and to some extent, the Quality Assurance Division under Department. Accordingly, the GFP does not effectively engage with and, therefore, impact on other departments namely: i] Roads and Bridges; ii] Transport Services and infrastructure; ii] Transport Regulations; and iv] Mechanical Services Engineering. Additionally, whereas gender equality is categorised as a cross cutting issue, there are no demonstrable links with other issues. Instead, there is a separate section on gender in all the documents reviewed, which further marginalizes it.

The majority of the gender equality gains achieved in the country can be greatly attributed to CSOs engaging the Government for responsive policies, laws, investment plans, budgets and service delivery. The challenge is that there is limited CSOs activism in the road subsector which is perceived as being “too technical and something to do with only engineers”. The two oldest CSOs in the sub-sector have been lone voices for decades. The First African Bicycle Information Organization’s [FABIO] focus is on the promotion of the use of non motorized means of transport [NMTs]. The National Forum Group, the Uganda chapter of the International Forum for Rural Transport and Development [IFRTD], engages policy for improved rural mobility and access. The Uganda Building Construction, Civil Engineering and Allied Workers’ Union is involved in collective bargaining for [permanent] road workers’ rights largely based on the

national Employment Act. A relatively new entrant in the field is the Uganda Road Sector Support Initiative [URSSI] established in 2009 to facilitate modern road transport and urban planning practices in the country.

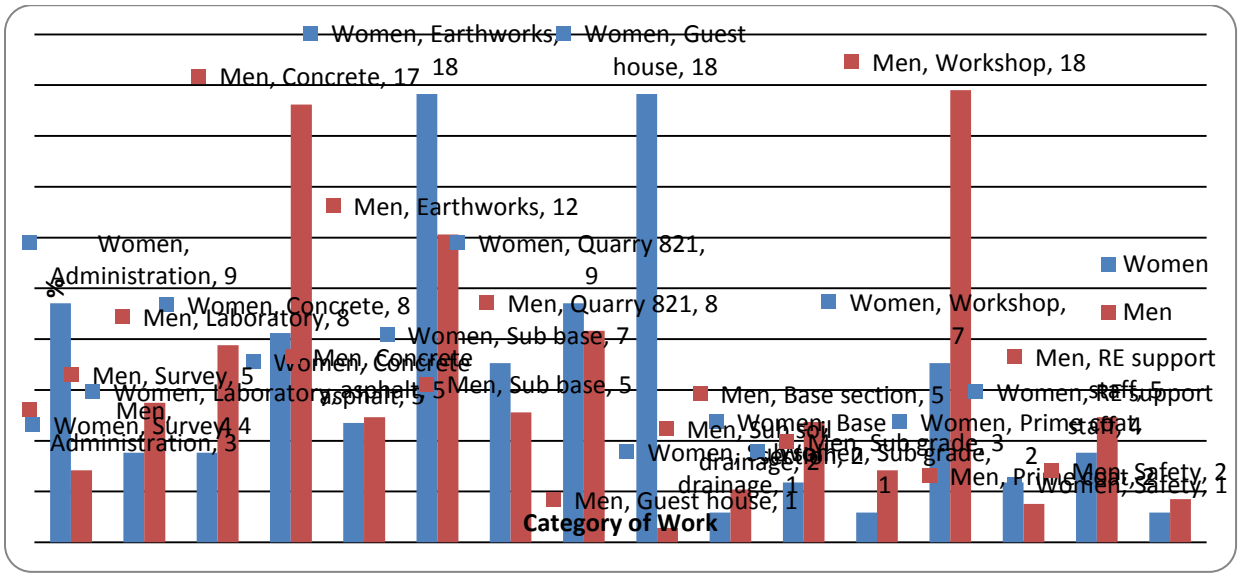
Figure 9: Perceived Challenges to Promoting Gender Equality in the Road Sub-Sector [n=47]



Source: Gender Capacity Needs Assessment Survey, 2013

Emerging Impact of the Road Project on Gender Equality. By March 2013, women constituted 13 percent of the total contractor workforce of 1578. An analysis of where they are positioned showed that as with the road sub sector institutions, showed that women are employed in the contractor's guest house as cooks and cleaners and in works. In contrast, the majority men are employed in the mechanical workshop as well as in concrete works.

Figure 10: Occupational Segregation in Mbarara-Lyantonde Road



Source: RCC. Health, Safety and Environmental Monthly Report. Mbarara-Katuna Road Project. April 2013

6. CONCLUSIONS AND RECOMMENDATIONS

The adoption of gender policy instruments is critical for implementing gender equality results in transport projects. An integrated approach is often needed between departments and implementation units to is however necessary to deliver gender equality results.

Uganda has a relatively good framework for promoting gender equality and women's empowerment. This is reflected in the gender responsive constitution, the NDP as well as its national gender, decentralisation, human resource and fiscal policies. To promote gender mainstreaming in the road sector in a sustainable manner, it will be important for the country and others to review their national process and identify specific areas that are slowing gender mainstreaming efforts.

Institutional Mechanisms for Gender Mainstreaming. Uganda has multiple institutional mechanisms for promoting gender equality and women's empowerment. These include the MoGLSD, the EOC and gender focal points in MDAs at national and local governments' levels. Even so, there is a critical institutional drawback reflected in the apparent weak coordination

between the MoGLSD and the MoWT[2] and the related weaknesses in actively influencing road sub-sector policy.

The findings of the field study pointed to the differences between rural as well as urban women's and men's mobility patterns and access needs. Women are less skilled, experience time poverty and have restricted access to means of transport. Many walk and carry their burdens. Due to their relatively lower incomes, urban working women experience catastrophic payments for transportation.

The study established that public transport and road travel spaces are gendered. More women than men reported personal safety and vulnerability as an issue of concern which influenced their decision of whether, when and where to travel using what means of transport. Further, whereas men prioritized lack of regulation resulting into high transportation costs, for women it is issues such as sexual harassment and long commuting. Furthermore, that culturally sanctioned stereotypes about women's and men's work and ability persist. These limit women's potential to participate in and benefit from the road sub-sector.

Implementing National Gender Equality Policy Commitments in the Road Sub-Sector.
There has been progressive improvement in promoting gender equality in transport policy and strategic investment planning. Amongst other things, the MoWT has a Gender Policy Statement as well as Guidelines for Mainstreaming Gender in the Road Sub-Sector. These have, however, not been fully disseminated to the sub-sector institutions and actors. Accordingly, they have not effectively translated in annual planning and budgeting suggesting that investments in the road sub-sector may not be benefitting women equitably with men.

There are mixed levels of gender sensitivity in the transport policy oversight tools which are used in the implementation, supervision and monitoring of road improvements. The specifications for the national roads make it a contractual obligation to address some aspects of

[2] As an example, the MoGLSD was not aware of the MoWT Gender Policy Statement and Mainstreaming Guidelines.

gender in construction and rehabilitation projects. There is no specific tool for promoting gender mainstreaming in the maintenance of national roads.

Whereas the MoWT road manuals incorporate some aspects of gender they are not applied uniformly across the district road network due to the multiplicity of guidelines from the different funding agencies. In addition, there are various institutional and regulatory weaknesses which compromise the effective incorporation of a gender dimension in the road sub sector institutions. These include lack of accurate, relevant and appropriate sex and gender disaggregated data for proper sector planning and general lack of awareness and application of the MoWT Gender

Application of Gender Equality in Road Projects. Contractors of road development projects typically employ sub-contractors to facilitate compliance to gender equality requirements. This has seen an improvement in the proportion of women employed as well as some changes in the gender sensitivity of the working environment. However, not all sub-contractors have effected meaningful change. This is because the approach used does not challenge the status quo: the conditions that have led and continue to lead to gender inequalities in transport. Rather, an attempt is made to find space for women within existing opportunities.

One of the key findings from the field is that there is stagnation in the promotion of gender equality in labour-based road works. This is particularly so for district roads where there is a potential risk of reversal of the gains achieved under past gender responsive programmes. This is partly attributed to a shift from project funding modalities to sector budget support.

Strengthening the implementation of national policy. In terms of recommendations, the review suggests that the Gender Policy Statement and Mainstreaming Guidelines should be mainstreamed in a manner that clarifies the concept of 'gender mainstreaming' as it relates to the sub-sector. The Gender Policy will likely be enforced through regulation and/or putting in place an incentive mechanism.

In this context, the establishment of a Gender and Transport Policy Working Group led by the MoGLSD could also help assess progress, identify gaps and devise collaborative strategies to

implement the MoWT Gender Policy Statement and Mainstreaming Guidelines. Annual technical audits could also help identify gender equality provisions necessary to be incorporated in prequalification, bidding and contract documents – this needing to be done in a provisional sum rather than competitive BoQs item (e.g. 1% of project cost) and by setting realistic targets that link project components with objectives and through the establishment of monitoring systems that assess and monitor gender data.

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GLSL. Occupational Health & Safety and HIV & AIDS Monthly Report. September 2011

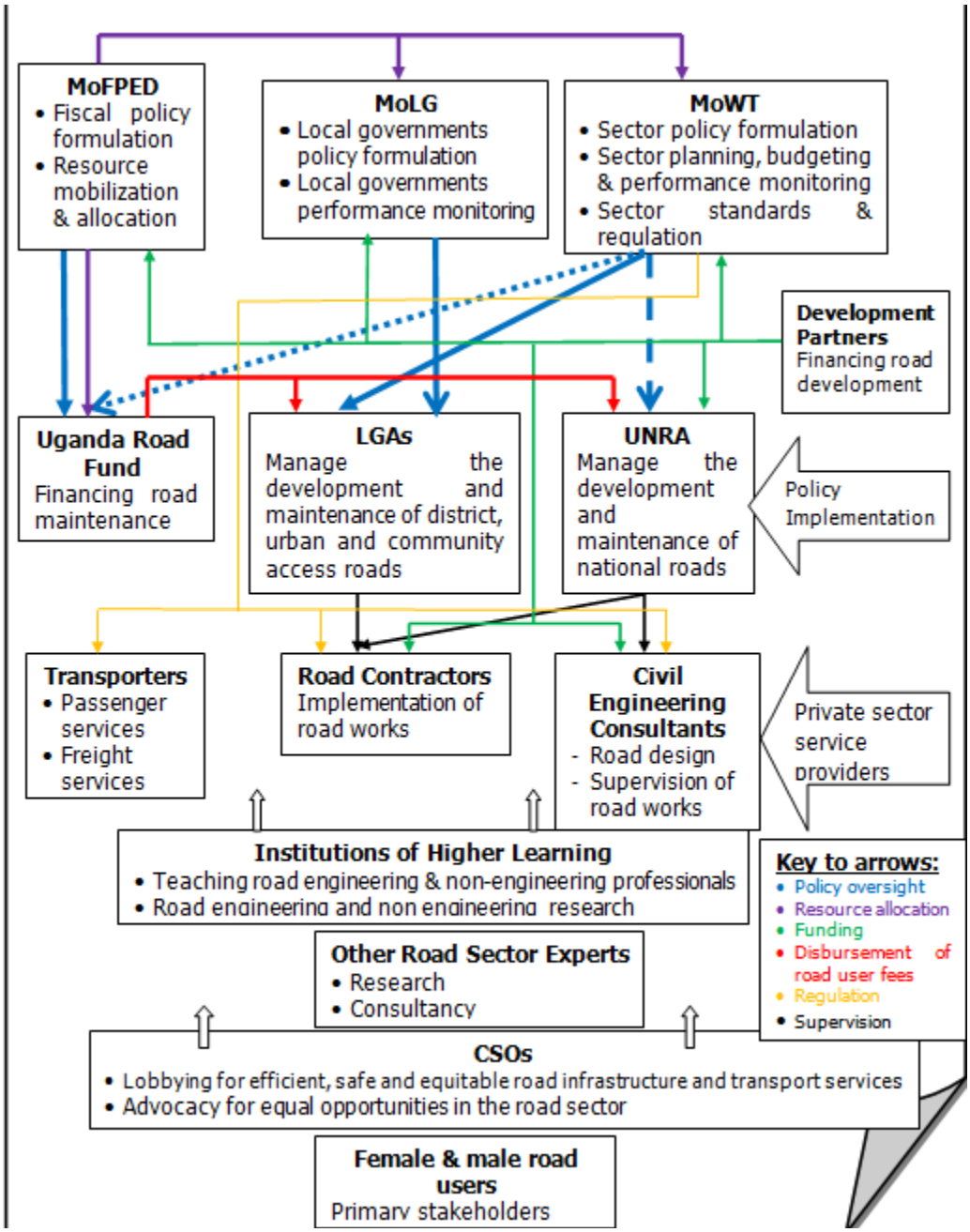
GLSL. Occupational Health & Safety and HIV & AIDS Monthly Report. August 2011

GLSL. Occupational Health & Safety and HIV & AIDS Monthly Report. July 2011

. **Annex 1**: Road Sub-Sector Policies, Sector Strategic Investment Development Plan and Budgets

	Level of Gender Sensitivity	Status of Implementation of Gender Equality Provisions
Legislation/Regulation		
Uganda Road Traffic and Safety Act [1998]	Silent on gender.	N/A
Uganda National Road Authority Act [2006]	Provides for affirmative action for women's representation on UNRA board.	Fully implemented
Uganda Road Fund Act [2008]	Provides for affirmative action for women's representation on URF board.	Defined quota of one third women's representation on board not always achieved.
Traffic and Road Safety [City Bus Services] Regulations [2011]	Silent on gender.	N/A
Transport/Road Policy		
Transport Sector Policy and Strategy [2003]	- Works component gender responsive. - Silent on gender dimensions of transport.	Not implemented
Gender Policy Statement for the roads sub-sector [2008]	Outlines strategies and actions to promote gender equality in road sub-sector institutions and in road development and maintenance.	Yet to be fully operationalised
National Construction Industry Policy [2010]	Commits to various implicit and explicit measures to promote gender equality in road construction.	Not implemented
Non Motorised Transport Policy [2012]	Sensitive to, and promotes women's transport needs.	Recently launched
Draft Rural Transport Policy and Strategy [2013]	Makes policy commitments to address women's mobility and access needs in the prioritisation of rural transport improvements.	Not yet approved by Cabinet
Transport/Road Sector Strategic Investment or Development Plan		
Transport Sector Strategic Plan [2011/12-2015/16]	Completely silent on gender.	The Annual Sector Performance Report [ASPR] which operationalised the Strategic Plan includes indicators on gende4.
Draft Third Road Sector Development Plan [RSDP3 2012]	Provides a strong basis to strengthen the gender dimension in the identification, design, implementation, monitoring, supervision and evaluation of road sub-sector investment projects.	Still a draft
Annual Investment Plans and Budgets		
Works and Transport Sector Budget Framework Papers and Ministerial Policy Statements	- An attempt to plan for gender capacity building, gender sensitive M&E, and gender audits. - But planning and budgeting are not informed by a comprehensive gender analysis.	- Draft M&E to measure gender mainstreaming has been developed. - Gender Policy Statement and Mainstreaming Guidelines partly disseminated.

. **Annex 2**: Road Sector Institutions and Stakeholders



How equitable is access to transportation options?

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1 ABSTRACT

As an important social issue, equity of access to transportation options needs to be integrated in sustainable transportation assessment. Quantitative indicators and tools are needed to improve how well it can be accounted for in estimation frameworks. This paper aims to develop equity indicators using accessibility measures for various transportation modes. In order to recognize the value of diversity in transportation options, five transportation modes are examined, namely car, transit, bicycle, carsharing, and bikesharing. The Island of Montreal is used as study case. Using operational datasets and data from a regional travel survey, this study estimates unimodal and multimodal indicators based both on the availability of transportation and the intensity of service.Vulnerable population segments are defined based on gender, age, driving licence ownership, household characteristics, and car ownership. For the equity analysis, comparisons between population segments are conducted using the two-sample Kolmogorov-Smirnov statistical test and the Gini coefficient.Results show that younger and older people have a lower access to transit and bike networks. Women have a similar access than men to main networks, except for carsharing and bikesharing for which women are disadvantaged. Non-motorized households have a better access to non-car transportation modes.

2 INTRODUCTION

Social impacts of transportation policies, strategies, or options have typically been receiving less attention than environment and economic impacts. Social incidences of transportation have obviously been observed and discussed for many years, but the late appropriation of the sustainability concept by social experts as well as the high interest on factors such as GHG emissions, has delayed the production of significant and well-documented literature on the social pillar compared to the other two pillars of sustainability (economic and environment) (Boschmann & Kwan, 2008).

To fill a part of this gap, this study aims to enhance the estimation methods for the development of social indicators, focusing on a specific aspect of the social impacts of mobility: the equity of accessibility. The research wishes to contribute to the recognition of the importance of ensuring diversity of options in transportation systems, namely to improve equitylevels. In this perspective, it proposes equity measurement methods allowing to assess the spatio-temporal equity level of transportation systems. Equity indicators are applied to transportation options,

namely car, transit systems, bicycle, carsharing, and bikesharing. Equity is also examined within population segments based on gender, age, household structure, and other attributes.

This paper is structured as followed. First, background elements are presented with respect to social aspects of sustainability and equity assessment. The general methodology is then explained, including definition of indicators and data sources. Then, results are presented in two parts: on the one hand, results from unimodal indicators are presented and on the other hand, those from the multimodal analyses are exposed. Finally, results and the formulation of indicators are discussed, with emphasizes on challenges regarding further developments for indicators assessing the equity of accessto transportation options.

3 BACKGROUND

3.1 Social component of sustainable development

The social component of sustainable development is gaining recognition in general but also in the domain of transportation and mobility (Geurs, Boon, & Van Wee, 2009).For instance, the impacts of transportation and travel behaviours on health and well-being, security and safety as well as equity and accessibility are starting to be addressed.Some social impacts are making a shy entrance in the research and planning discussions but there is still limited formal definitions and indicators that can actually be pragmatically estimated.Geurs et al. (2009) suggest these gapsare linked to many elements, such as :

- Subjective concepts that lead to unclear definitions, and
- A lack of demonstrations and recommendations on how to estimate the indicators, which leads to a lack of methods, tools, and techniques for systematic assessment.

3.2 Equity: definition and indicators

Equity is probably one of the key concepts that can contribute to a better understanding of the social impacts of decisions (Boschmann & Kwan, 2008) and to the pragmatic inclusion of this sphere in sustainability analysis. Social justice and fairness are common terms also used for equity.Equity typically refers to the "*distribution of impacts (benefits and costs) and whether that distribution is considered fair and appropriate*" (Litman, 2013). Equity includes many underlying concepts and is loaded with subjectivity. These characteristics make the concept ambiguous (Boschmann & Kwan, 2008) and it leads to a multiplicity of definitions, perspectives, theories, and mathematical formulations. Therefore, there is no agreement on a common definition.Overall, current thinking is based on two main philosophical perspectives:

- Utilitarian perspective, forming the basis of the standard Cost-Benefit Analysis (Van Wee & Geurs, 2011). Its main principle is to maximise the overall surplus of productivity (Bonnafous & Masson, 2003).
- Egalitarian perspective, arising from Rawls' (1971) theory of justice. It defines some underlying concepts: identical base for all (the same minimal or maximal threshold for everyone), equality of chances (same type of people should have equal chances), and social inclusion.

Equity is also often divided into two main notions: horizontal and vertical equity. The formeris about equal treatment of people in unequal positions: people receive and use what they pay for. The latter refers to social inclusion and aimsto favour the most disadvantaged people so they can have more benefits. Litman (2013) divides vertical equity in two types with respect to (1) income and social class and (2) needs and ability(being able to drive for instance).Therefore, equity can be explored from various angles when evaluating current transportation situation or projects:

- Distribution of individual and collective economic costs such as tolls(Szeto & Lo, 2006) and affordability of automobile travel;

- Distribution of burdens or negative impacts of transportation, namely theexposure to air pollution, noise, and the risks from transport of hazardous materials(Feitelson, 2002);
- Distribution of accessibility and social exclusion resulting from inaccessibility (Preston & Rajé, 2007);
- Distribution of financial benefits from an improved accessibility, such as the house annual rent or the value of owned homes (Rodier, Abraham, Dix, & Hunt, 2010).

On these topics, indicators need to be proposed and discussed in order to develop better understanding and consistent assessment practices (Litman & Brenman, 2012).

3.3 Accessibility: definition and indicators

This paper focuses on the equity of access to transportation options.Access is of great importance because it is "*a necessary prerequisite to fully participate in society and to fulfill life opportunities*" (Martens, Golub, & Robinson, 2012). The study of the differences in accessibility levels and equity shouldalso help to design the transport investment programs (Golub & Martens, 2013). As for equity, there is no common definition of accessibility because of its subjectivity. Dalvi & Marin (1976) proposes "*the ease with which any land-use activity can be reached from a location using a particular transportation system*".Accessibility assessment mainly adopts: (1) a location perspective that is interested in thepotential interactions between locationsor (2) an individual perspective that focuses on the opportunities available to a person in a dynamic context.Therefore, studies on equity of access are usually based on:

- A spatial perspective, usually from zonetozone (Bonnafous & Masson, 2003; Caubel, 2007; Golub & Martens, 2013; Leck, Bekhor, & Gat, 2008) and
- A population group perspective, usually based on level of income (Caubel, 2007; Golub & Martens, 2013; Rodier et al., 2010).

Accessibility measurements used in equity studies are usually (1) based on a zone-to-zone travel time estimationor on reachable opportunities (often employment)within a fixed travel timeand (2) limited to two transportation modes, namely automobile and transit (Caubel, 2007; Golub & Martens, 2013; Johnston & Gao, 2009; Leck et al., 2008; Lei et al., 2012; Rodier et al., 2010).Shi & Wu (2010) and Szeto& Lo(2006) also address the equity among different generations.

Still, Van Wee & Geurs (2011) state that distribution effects and equity, and social exclusion for accessibility, are poorly addressed in transport appraisal in general. Litman & Brenman (2012) recommend to orient further equity research in order to recognize the value of transport system diversity. Moreover, Van Wee & Geurs (2011) propose to focus on accessibility using slow modes (biking, cycling) and on differences in local land use characteristics and transport facilities.

4 METHODOLOGY AND DATA SOURCES

FIGURE1 presents the general methodology for this research. First, population segments selected for the experimentations are defined. Then, accessibility and equity analyses are conducted. Those components are further described below.

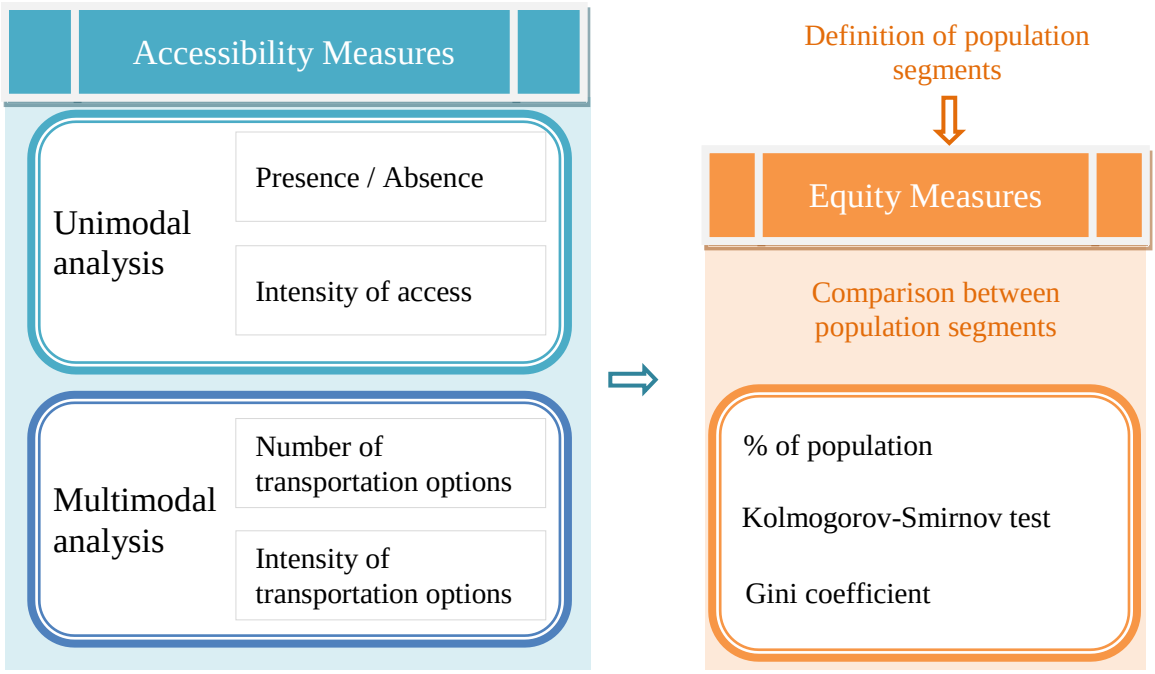


FIGURE1. General methodology

4.1 Concepts and definitions

4.1.1 Population segments

The population segmentation for comparison of access to various transportation networks focuses on vulnerable groups. Vulnerable people (in which women are typically over-represented) or households are defined as typically less fortunate or having constraints regarding the use of a car. Factors often related to transportation disadvantages include low income, no driver license and/or car, physical disability, etc. (Litman, 2013). For instance, young people under 18 years old as well as seniors developing disabilities cannot possess a driving license. Moreover, single parents, women, and single seniors tend to be less fortunate, and therefore car ownership and use is less affordable for them. People with no access to a car in their household rely either on other people (dependency relationship) or on other transportation modes. Since some components of vulnerability are correlated with age and gender, segments based on these available attributes are investigated. The population segments examined in the paper are:

- People-based segmentation:
  - Gender: Men / Women
  - Age groups:
    - Teenagers aged 12 to 15 / Other people
    - Children of 17 years old or less / Adults of 18 years old or more
    - People of 65 years old or more / People of 64 years old or less
  - Driving license: People owning a driving license / People without drivinglicense (excluding people less than 16 years old)
- Household-based segmentation:
  - Car ownership: Households with at least one private vehicle / Households without private vehicle
  - Single seniors: Households of elderly people (65 years old or more) living alone / Other households
  - Single parents: Households with one adult (18 years old or more) and one or more children (17 years old or less) / Other households

4.1.2 Accessibility indicators

Accessibility is addressed as the individual physical possibility to access a transportation network (or mode).The transportation system accessibility is directly related to the ability of someone to reach destinations depending on the possibility to use only one or a multiplicity of transportation modes. As shown in TABLE 1, both unimodal (for each transportation mode) and multimodal (for all modes combined) indicators are developed.

4.1.2.1 Unimodal indicators

The access to a specific transportation network is measured with the quantity of service within a circular zone around the home location. The radius of the circle varies with the transportation mode, as presented in the indicator #1 of TABLE 1.TABLE 1 also enumerates the three accessibility indicators used for the unimodal analysis:

- The first accessibility indicator (#1) is the presence or absence of the transportation mode in the home location neighborhood, notwithstanding intensity of the service;
- The second indicator (#2) is the intensity of service, for which units differ from one transportation mode to another. For car and bike, the quantity of service is measured with the length of roads or paths into the home surroundings. Transit service is quantified with the number of run-stops during 24 hours on a typical weekday. Access to carsharing service is estimated with the sum of vehicles available at every station near the home location. Finally, bikesharing service is assessed with the sum of docking stations available in every stations near the home location.

It could be very interesting to add the pedestrian network. Unfortunately, the boardwalk network and pedestrian paths were not available for this study. Also, walking is a much more flexible mode and it can be very comfortable even without the presence of specific infrastructure depending on the urban context.

4.1.2.2 Multimodal indicators

The accessibility indicators for multimodal analysis aim to represent the diversity of transportation options in the surrounding of the home location. Also presented in TABLE 1, the two proposed indicators are:

- The number of transportation options (#3) : Count of all transportation modes that are available in the neighborhood of the home location (refer to indicator #1);
- The intensity of transportation options (#4): Sum of thecategorical values assigned to the intensity of access (refer to indicator #2), for all transportation modes. The categorical value is an effort to use a common unit for all the networks using a categorization from 0 to 4. The null value reflects the absence of the transportation mode. Values 1 to 4 correspond to the quartiles of the distribution of the intensity of access (refer to indicator #2).

4.1.3 Comparison approach and equity analysis

The equity analysis is a comparison of transportation access between groups. According to the accessibility indicators, different comparison methods are applied:

- Percentage ofpopulationwith different levels of access (Accessibility indicator #1).
- Two-sample Kolmogorov-Smirnov Test: A non-parametric statistical test that compares the distributions of the accessibility indicators between groups(Accessibility indicators #2, #3, and #4).
- Gini coefficient(Accessibility indicators #2, #3, and #4):
    - For a specific population segment:assess the fairness of access within a specific population segment. Gini coefficient is based on Lorenz graph, which illustrated the relation between the cumulative share of income and the cumulative share of

population from the lowest to the highest income (Yitzhaki & Schechtman, 2012). Here, the income is replaced by the accessibility indicator. A low value (near 0) indicates an equal distribution of access, and a high value (near 1) indicates an unequal distribution of access.

- Comparison between two population segments:the group with the smaller Gini coefficientis more equally distributed than the other one.

TABLE 1: Accessibility indicators

		Transportation Network				
		Highway	Transit	Bicycle	Carsharing	Bikesharing
	Data sources	Canada Census	GTFS	Open Street Map	Communauto	Montreal Municipality
	Year	2006	2011	2012	2008	2012
Id	**Indicator**					
UNIMODAL INDICATORS						
#1	Presence of a transportation mode (within thisspecific distance)	1 km	500 m	500 m	750 m	300 m
#2	Intensity of access	Km of roads	Run-stops in 24h (weekday)	Km of roads	Vehicles-stations	Docks-stations
MULTIMODAL INDICATORS						
#3	Number of transportation options	Number of available transportation modes (refer to #1)				
#4	Intensity of transportation options	Sum of the categorical values for intensity of access for all transportation modes. The categories from 1 to 4 are based on the quartiles of the distribution of intensity of access (refer to #2)				

4.2 Data sources

The research relies on various data sources:

- The 2008 large-scale Origin-Destination household survey is conducted among 4% of the population in the Greater Montreal Area.For this research, this dataset provides information on the spatial dispersion of the population. This travel survey is weighed using the 2006 Canadian Censuspopulation so it can be used for statistical inference.
- The highway network is derived from the road network provided by Census Canada (2006).
- GTFS files (General transit files specification) describe the transit network, both with respect to geometry (spatial location of stops) and schedule; this is used to estimate exposure to transit (availability of a stop as well as intensity of service).
- The bicycle network is derived from the network available on open street map.
- The number of vehicles available at each carsharing parking lot is based on a carsharing administrative dataset provided by Communauto for 2008.
- The dock availability for each bikesharing station comes from a single day extraction (2012) from the bikesharing system operated by the municipality of Montreal.

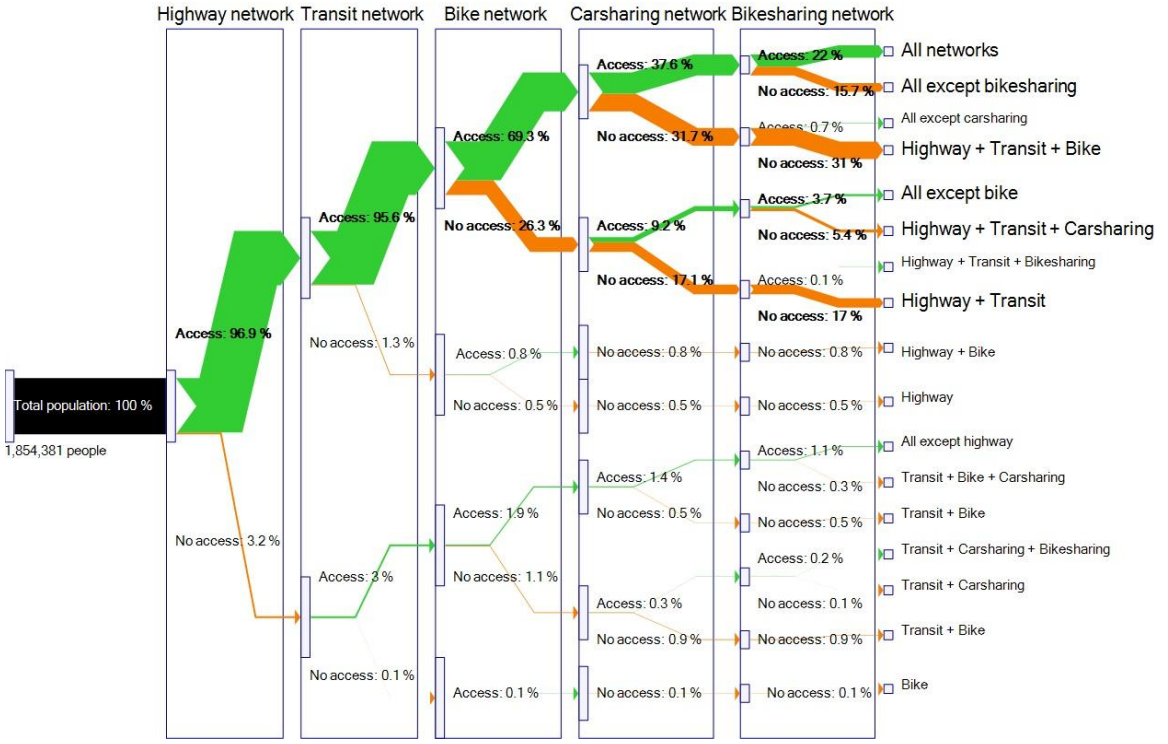
5 RESULTS

Estimations were conducted for the Island of Montreal using the indicators and segments described previously. Results are now presented.

5.1 Unimodal indicator #1 - Presence of a transportation mode

Globally, 97% of the population has access to the highway network, 97% to the transit network, and 72% to the bicycle network. For the shared modes, only 48% and 28% have access to respectively carsharing and bikesharing services.

Results are summarised in FIGURE 2. Using a tree shape, the first part of this figure presents the percentage of the whole population having access to different networks, respectively highway, transit, bicycle, carsharing and bikesharing. The larger branch relates to population having access to highway, transit and bicycle networks (31 %), followed by all networks (22 %). Other important branches are the group having access solely to highway and transit (17 %) and the group having access toall modes excluding bikesharing (16 %). The second part of FIGURE 2 shows some trends between population segments. A lower share of women (15% to 18%) than men (21% to 24%) have access to all networks. Rather, a higher share of women only have access to highway and transit (18% to 21% compared to 16%-17% for men), and to highway, transit, and bike networks (34% to 37% compared to 30%-31% for men). These differences are greater for adults, and lower for teenagers.



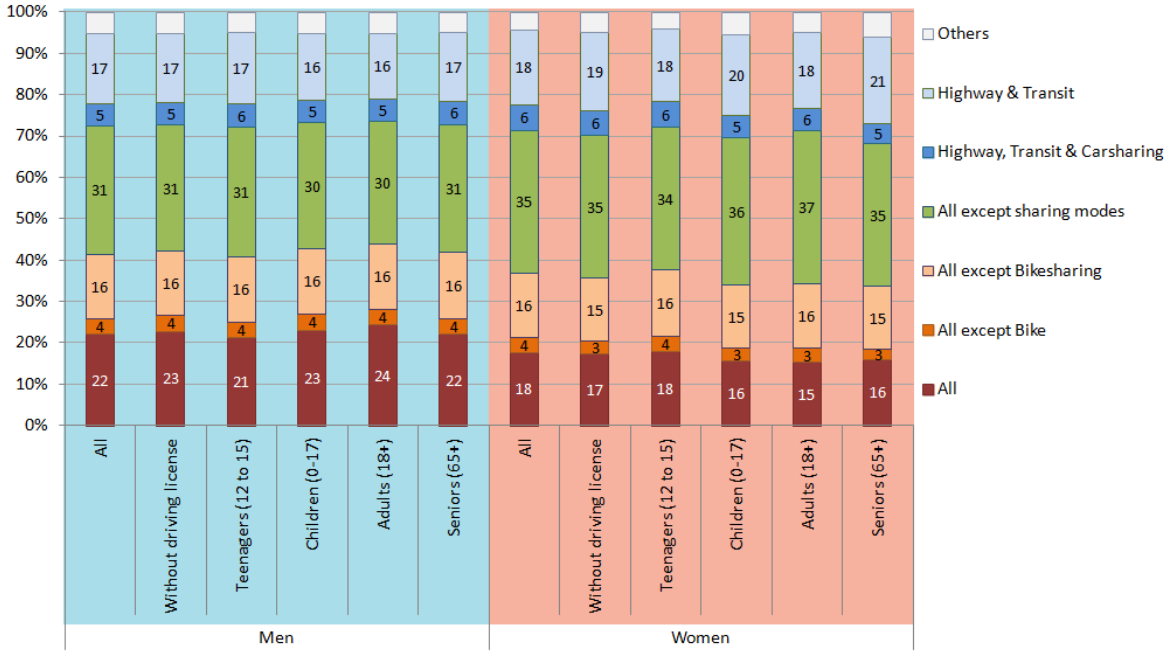


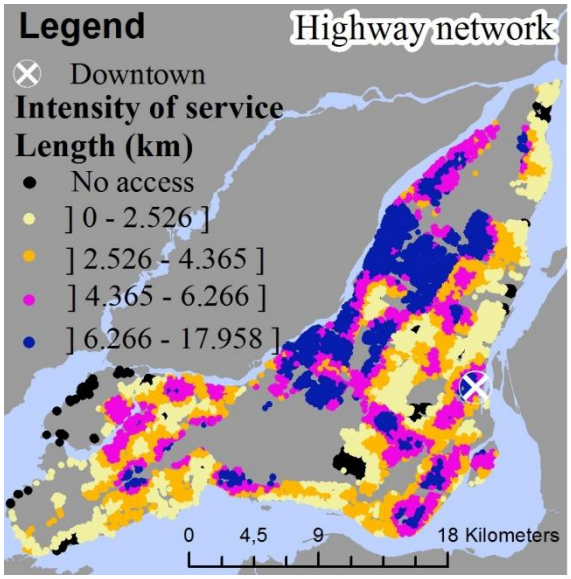
FIGURE 2: Percentage of access to various transportation networks for total population and various population segments, for men and women

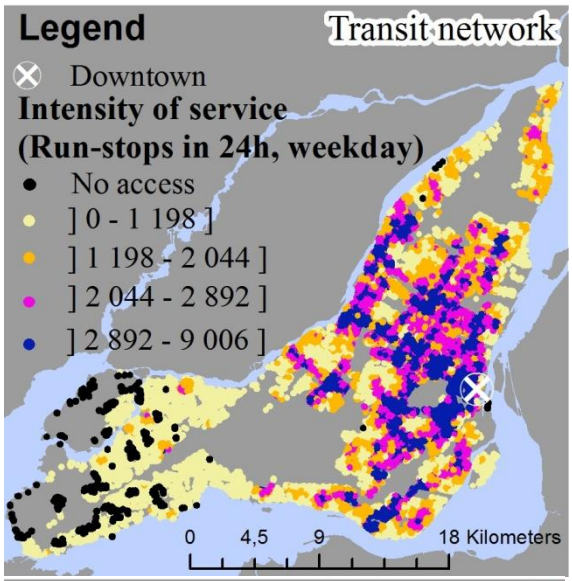
5.2 Unimodal indicators #2: Intensity of access

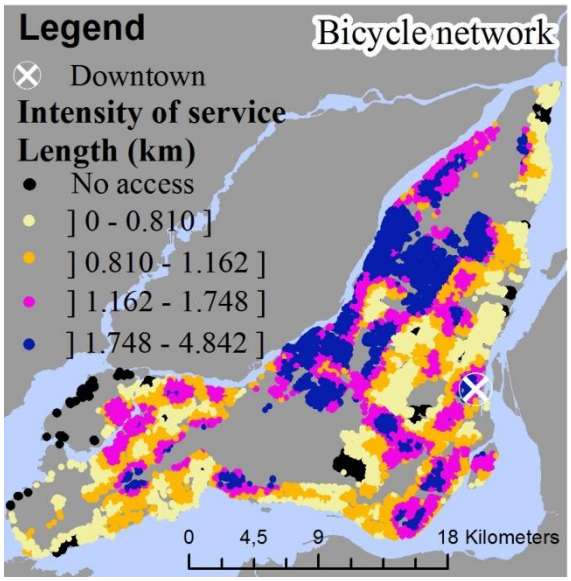
Maps in FIGURE3 show the intensity of service for each transportation mode. It properly reflects previous trends, and sometimes provides more insight into them. First, highway and transit networks are much more spread over the area. Highways are more available in the north part of

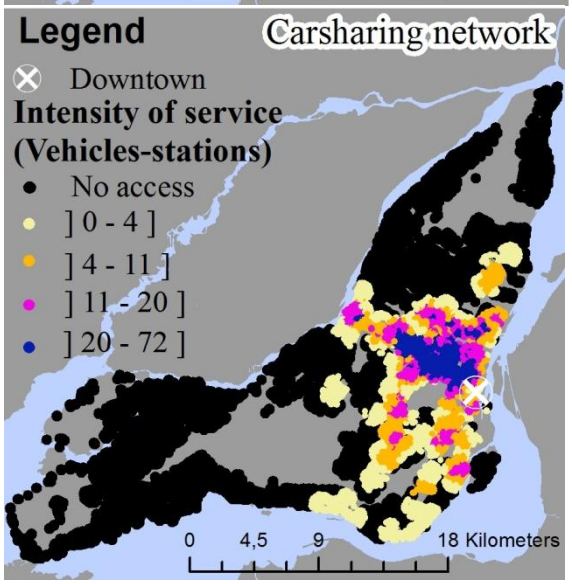
Montreal. Transit servicesare less available in the western part of Montreal, and more available near downtown. The bicycle network is denser near the central area, but is also available all along the shoreline surrounding the island. Both recreational and commuting bike networks are accounted for. Carhsaring and bikesharing networks are concentrated in the central part of Montreal, the carsharing network having a broader coverage than the bikesharing one. There are many areas without shared services.

These spatial trends explain some differences in the access of the population groups. For instance, the central part of Montreal has a high density of population, but tends to have more single people, less families, and especially more single men. Families tend to locate in more suburban areas, which explains why children and teenagers have a lower access to shared services.









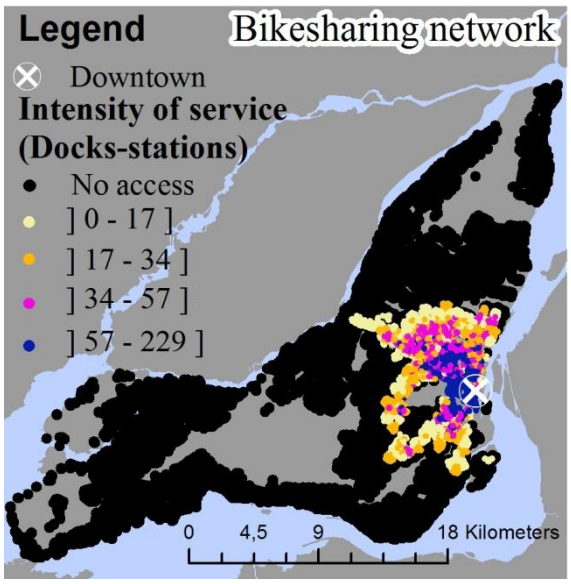


FIGURE3: Cartography of the intensity of access to highway, transit, bicycle, carsharing, and bikesharing network respectively

5.2.1 Examples of comparisons and detailed results

For illustration purposes, aninteresting example of equity comparisonsis explainedin details:comparison of access to transit using the intensity of access (indicators #2) between non-motorized and motorized households. Results and graphs are shown in FIGURE4.

Significant differences can be observed between these two groups. In the cumulative distribution of households, the non-motorized curve is way under the motorized curve. This means that non-motorized have a higher access to transit. Results from the two-sample Kolmogorov-Smirnov (K-S) statistical test show a combined p-value smaller than 0.05, which rejects the null hypothesis on identical distributions. Therefore, there is a significant difference between the two groups. The K-S test also indicates that non-motorized households have a higher transit access (P-value equal to 1 forthe non-motorized group). Gini coefficient is about 0.3, which is near a null value meaning an almost equal distribution within the population group. Lorenz graph illustrates these trends with curves near the straight line. Since the Gini coefficientis higher for motorized households, we can conclude that transit access is less equally distributed within motorized households than within non-motorized households.

Motorization of households, access to transit service

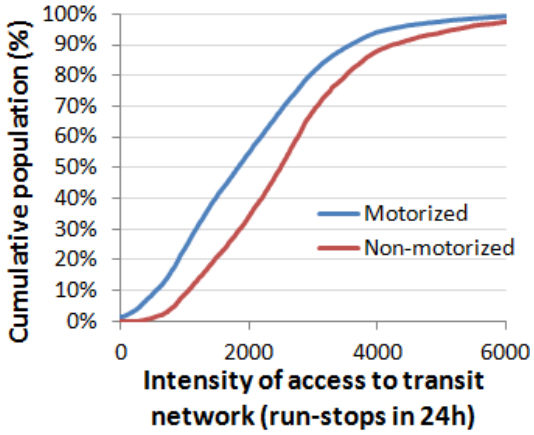
Two-sample Kolmogorov-Smirnov Test

Groups	D value	P-value	Corrected
Motorized	0.2107	0	
Non-motorized	0	1	
Combined K-S:	0.2107	0	0

Gini coefficient

Motorized = 0.343
Non-motorized = 0.275

Cumulative distributions



Lorenz curves

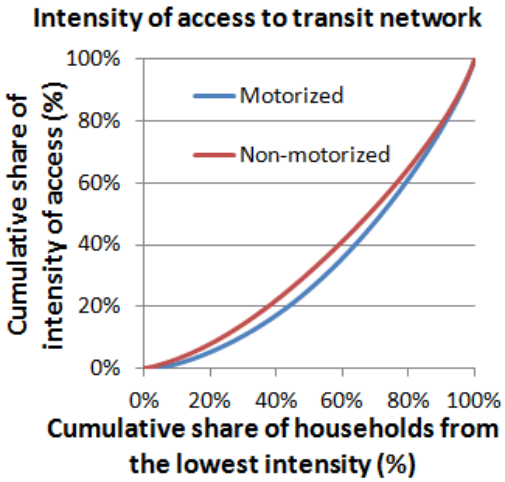


FIGURE4: Comprehensive results for the equity analysis of the motorization segmentation and its access to transit

5.2.2 Synthesis of comparison analyses

Other analyses have been conducted and are summarized inTABLE 2. The following statements explain how to readTABLE 2:

- [Kolmogorov-Smirnov (K-S) column] Does one of the two groups has better access to a transportation network?
  - [=] No: K-S test shows no difference between groups
  - Yes: K-S test shows statistical difference
    - [≠] Without identifying which group has better access.
    - [>] Group 1 (G1) has better access.
    - [<]Group 2 (G2) has better access.
- [Gini column] According to Gini coefficient, is the access equally distributed within a group?
  - [Gini Values]Gini coefficient for G1 and G2.
  - [Gini Difference] Gini value of G1minusGini value of G2. Ifthe difference is higher than 0.01, than G1 is more unequally distributed than G2.Ifthe difference is smaller than -0.01, thanG1 is more equally distributed than G2.

TABLE 2: Results of the comparison analyses for different population segments

PEOPLE			Comparison analyses			
				Gini		
Group 1 (G1)	Group 2 (G2)	Network	K-S	G1	G2	Difference (G1 - G2)
Men	Women	Highway	=	0.344	0.341	0.003
		Transit	=	0.342	0.338	0.004
		Bicycle	=	0.547	0.550	-0.003
		Carsharing	>	0.798	0.807	-0.009
		Bikesharing	>	0.875	0.885	**-0.010**
Children (less than 18 years old)	Adults (18 years and older	Highway	>	0.343	0.342	0.001
		Transit	<	0.356	0.336	**0.020**
		Bicycle	<	0.577	0.542	**0.035**
		Carsharing	<	0.839	0.794	**0.045**
		Bikesharing	<	0.909	0.873	**0.036**
Teenagers (12 to 15 years old)	Other people	Highway	=	0.343	0.342	0.001
		Transit	<	0.365	0.339	**0.026**
		Bicycle	<	0.568	0.547	**0.021**
		Carsharing	<	0.847	0.801	**0.046**
		Bikesharing	<	0.918	0.780	**0.138**
Seniors (65 years and older)	Other people	Highway	>	0.342	0.342	0.000
		Transit	≠	0.326	0.342	**-0.016**
		Bicycle	<	0.554	0.547	0.007
		Carsharing	<	0.827	0.797	**0.030**
		Bikesharing	<	0.908	0.875	**0.033**
Driving license	No driving license (16 years and older)	Highway	<	0.342	0.343	-0.001
		Transit	<	0.350	0.300	**0.050**
		Bicycle	≠	0.537	0.557	**-0.020**
		Carsharing	<	0.807	0.763	**0.044**
		Bikesharing	<	0.880	0.859	**0.021**
HOUSEHOLDS						
Single seniors	Other households	Highway	>	0.338	0.343	-0.005
		Transit	≠	0.317	0.327	**-0.010**
		Bicycle	<	0.538	0.530	0.008
		Carsharing	<	0.797	0.767	**0.030**
		Bikesharing	<	0.885	0.851	**0.034**
Single parents	Other households	Highway	=	0.352	0.342	**0.010**
		Transit	=	0.297	0.326	**-0.029**
		Bicycle	=	0.543	0.532	**0.011**
		Carsharing	=	0.771	0.774	-0.003
		Bikesharing	=	0.856	0.858	-0.002

Motorized	Non-motorized	Highway	>	0.341	0.344	-0.003
		Transit	<	0.343	0.275	**0.068**
		Bicycle	<	0.539	0.516	**0.023**
		Carsharing	<	0.820	0.665	**0.155**
		Bikesharing	<	0.894	0.769	**0.125**

Interesting observations can be formulated:

- Men vs Women: According to K-S test, women have lower access to carsharing and bikesharing than men. This confirms previous results from indicator #1, namely that women have a lower access to "All network" and a better access to "Highway and transit" and "Highway, transit, and bicycle". Also, Gini coefficients are similar for men and women, which means distributions within groups are similar.
- Children vs Adults: Children(less than 18 years old)have a lower access than adults to all networks except highways. This latter difference is probably small since it is only confirmed in the K-S analysis. Moreover, among these services, children are less equally distributed than adults (Gini value being slightly higher for children). Globally, teenagers have similar trends then children.
- Seniors vs Others: Seniors are disadvantaged in their access to carsharing, bikesharing,and bicycle networks. Gini values indicate that seniors are more unequally distributed than others among shared networks. For transit network, K-S results show differences in groups with no conclusion on which group is favored.Gini values indicate seniors are more equally distributed than others among transit. Moreover, seniors have better access to highway. The single senior householdsegmentation shows similar trends as the senior people segmentation.
- Single-parent households vs Others: According to the K-S statistical test, single parents households are not significantly different from other households. Though, Gini coefficient shows some difference between single-parent households and others.
- Driving license or not: People with no driving license (16 years and older) are favored in their highway, transit, and shared modes access. They are a little disadvantaged in their bicycle network access. For bicycle network, K-S tests show differences in groups without concluding on which group is favored.
- Motorized households or not:Motorization of households is the segmentation feature which shows the major differences between groups. Non-motorized households have better access to transit, bicycle, and shared networks.According to the K-S results, non-motorized have lower access to highway.

Notwithstanding the population segmentation, Gini values are about 0.34 for highway, 0.35 for transit, 0.55 for bicycle, 0.80 for carsharing, and 0.88 for bikesharing. This means that highway and transit are almost equally distributed among population. This confirms what was observable in the maps showing the extent of the various transportation networks. Shared services are much more concentrated in the central parts of Montreal, which translates into a Gini coefficient near one, indicating that these modes are unequally accessible to the residents of the area. Bicycle network is also unequally distributed, but in a smaller way.

6 MULTIMODAL INDICATORS

The same analyses are conducted for the multimodal indicators, which are the number of transportation options and the intensity of transportation options.

6.1 Multimodal indicator #3 - Number of transportation options

The number of transportation options is the count of networksavailable in the home neighborhood. The map in FIGURE 5confirms that the diversity of transportation modes is higher

in the central part of Montreal, with 4 or 5 different networks accessible (red). The map also shows areas of the island with only 1 or 2 networks available (green). Probably because of the recreational bicycle network which surrounds the island, the shoreline offers more diversity (yellow) than some inland areas (green).

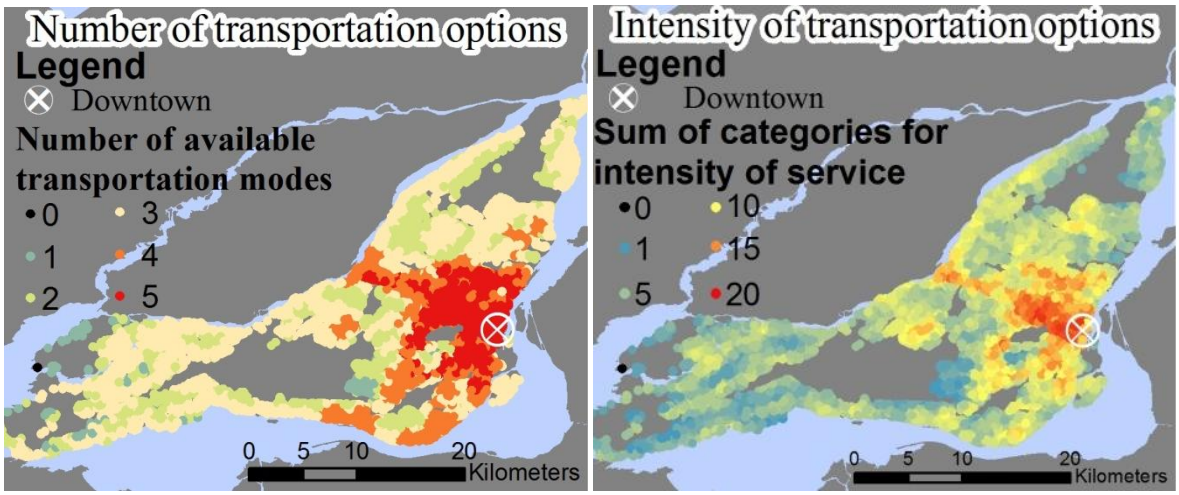
The table in FIGURE 5 summarizes the comparison analyses. Results from the K-S test and the cumulative distributions show that children, teenagers, women, and seniors as well as seniors living alone are disadvantaged in their access to transportation modes. Inversely, people without driving license and non-motorized households have access to a more diversified set of transportation options. Single parents are neither favored nor disadvantaged. These results are globally consistent with the unimodal comparison analyses.However, for some population segmentations, trends were opposite for different transportation modes. For instance, seniors were favored in their access to highways, but disadvantaged in their access to bicycle and shared modes. These opposite trends may reduce, or even cancel, the differences between groups in the multimodal index.

Gini coefficient is about 0.1, which means the number of transportation options is almost equally distributed among population. However, Gini coefficient appears to be very little sensitive for various population groups. The only population segmentation for which the difference between segments is higher than 0.01 is motorization. Motorised households are less equally distributed than are non-motorized with respect to the number of transportation options.

6.2 Multimodal indicator #4 - Intensity of transportation options

The multimodal indicator of intensity of transportation options (#4) is the sum of the categories of intensity of access for all the five networks. The right map in FIGURE 5provides even more insights that the one relying solely on counts of options (Indicator #3, left map in FIGURE 5). The central area with a high transportation diversity is smaller and much more concentrated.

Results from the comparative analyses, summarized in the table ofFIGURE 5, are quite the same as for the number of transportation options. Gini value is about 0.2, which represents an almost equal distribution within the population. Differences between groups are the same as for the number of transportation options, except for people without driving license and single parents households, which are more equally distributed among transportation networks (difference in Gini value higher than 0.01).



411

PEOPLE			Comparison analyses			
Group 1	Group 2	Transportation options index	K-S	Gini		
				G1	G2	Difference (G1 - G2)
Men	Women	Number	>	0.137	0.138	-0.001
		Intensity	>	0.243	0.239	0.004
Children of 17 or less	Adults of 18 or more	Number	<	0.144	0.136	0.008
		Intensity	<	0.239	0.241	-0.002
Teenagers aged 12 to 15	Other people	Number	<	0.141	0.137	0.004
		Intensity	<	0.241	0.241	0.000
Seniors of 65 or more	Other people	Number	<	0.138	0.137	0.001
		Intensity	<	0.235	0.242	-0.007
Driving license	No driving license	Number	<	0.137	0.138	-0.001
		Intensity	<	0.246	0.224	**0.022**
HOUSEHOLDS						
Single seniors	Other households	Number	<	0.133	0.130	0.003
		Intensity	<	0.234	0.238	-0.004
Single parents	Other households	Number	=	0.132	0.131	0.001
		Intensity	=	0.227	0.238	**-0.011**
Motorized	Non-motorized	Number	<	0.137	0.101	**0.036**
		Intensity	<	0.240	0.214	**0.026**

412 **FIGURE 5: Cartography and synthesis of comparison analyses for the number of**
413 **transportation options and the intensity of transportation options**
414

415 ## 7 CONCLUSION

416 With these measures, this research helps to understand the equity level of access to transit and
417 other transportation options. The vulnerability of women is explored through this concept of
418 equity. It definitely can assist in identifying locations and population segments requiring
419 particular attention and where transportation supply needs to be adapted.
420

7.1 Discussion about results

Children and teenagers, as well as some elderly segments, have a structural dependency towards alternative modes due to their inability to drive. Hence, stakeholders shouldaim to supply them with better access to alternative options, namely to transit, walk, and bike networks. It would increase their travel independency while reducing some extra travels that other family members have to provide to fulfill travel needs of others. Unfortunately, the analyses show opposite trends: children are disadvantaged in their access to transit and bike networks, and are favored in their access to highway. It is definitely linked to the fact that families typically live further from the central areas of Montreal. The same logic can be applied to seniors and their necessity of having a better access to the transit network, which is not a reality according to the analyses.

Stakeholders shouldalso wantto facilitate access to non-car networks to non-motorized households.The same objectives could be aimed for people without driving license, except for carsharing access which requires a driving license. Such trends are observed with the comparison analyses, but at a lower degree for the people with no driving license. In fact, these trends partially are related to the auto-selection phenomenon: non-car users intentionally choose to live in neighborhoods with well-developed non-car transportation services (as long as the housing price is affordable). An exception is for bicycle network access: people without a driving license are not more exposed than other groups. This could help develop a bicycle improvement strategy.

Finally, women seem to have similar access than men to main networks, except for shared modes for which they are disadvantaged.Women should not be disadvantaged compared to men: they must be at least equally if not favoured with respect to their modal accessibility if they are in a vulnerability position, which is more often the case than for men (low income, with children, etc.).

7.2 Limits and perspectives

7.2.1 Accessibility measures

An absence of differences between population groups in cumulative distributions is not a guarantee of equity of access: a change in the accessibility measure could change these results. For instance, the level of congestion or the number of highway entries instead of the length of roads may change the spatial distribution and then give different results in the comparison analyses. Therefore, the methodology of estimation for every transportation network needs to be studied in order to understand how it impacts the indicator. The use of more dynamic indicators (measures that reflect hourly variations of service for instance), may also be helpful to better indicate the level of service of the infrastructure for a specific network. For instance, congestion data could be integrated for the access to highway network and hourly availability of shared bikes could be used to assess bikesharing access. And this could be linked to typical spatio-temporal patterns of mobility of population segments (instead of solely looking at home location) in order to assess accessibility to transportation options at places and in times when and where people need to travel.

Moreover, the type of bicycle lane could be identified and integrated into the accessibility indicator. For instance, recreational network is tortuous and aligned with the shoreline and commuting network is straight and along the arterial road network. Studies could investigate which network really increases the access to activities and opportunities. This could be an avenue to better describe the intensity of service of bicycle network.

7.2.2 Multimodal

First, the selection and the definition of each network entering in the index estimationareof great importance because it influences the index values. The number and the choice of networks included in the count or sum of transportation options influence the valuesof the index. For

instance, transit network could be decomposed into two networks, one for bus which is well-extended on the island and one for subway which is concentrated in the central part of Montreal. Therefore, thismodification would change the index ina way that emphasizes theactual results in the central part of Montreal.

Secondly, the accumulation of all networks involves the sum of opposite trends from different networks. This may result in a constant value of the index and make it impossible to observe the existing differences.

As illustrated in the maps, the number of transportation options is less comprehensive than the intensity of transportation options. However, the results from comparison analyses are quite similar and may not justify a much more comprehensive index such as the intensity of transportation options. Therefore, the number of transportation options is easier to calculate and may be enough for the comparison analyses. Other calculation methods than sum or count for the cumuli of networks should be tested.

7.2.3 Comparison analyses and equity measures

7.2.3.1 Kolmogorov-Smirnov test

The two-sample K-S test is particularly helpful to identify relevant differences between population groups. The cumulative distributions only illustrate results from this statistical test. Though, sometimes, results show significant differences between groups without identifying which one is disadvantaged. This situation seems to appear when cumulative curves of the two groups are crossing.

7.2.3.2 Gini coefficient

Gini coefficient and Lorenz curves are interesting. For instance, this index could be used to assess the evolution of the equity of distribution within a specific population group before and after some implementations for a transportation network. However, it is difficult to determine for which variation of the Gini value we can consider a difference between groups is significant. For instance, we defined that the threshold for a significant difference between groups was 0.01. More studiesand statistical tests on the Gini coefficient should be performed in order to indicate if it is an appropriate index for this kind of study.

Gini values for indexes are lower than all the values for transportation networks taken individually. It seems that the indexes tend to make everyone equal, bringing therefore its value near 0 and the curve near the straight line.

7.2.3.3 Perspectives

Finally, a comparison analysis that includes the needs and the mobility behaviors would be very interesting. For instance, we could compare the hourly mobility behaviors on a typical weekday for various vulnerable population segments, and then compare it to the hour variability of every network supply. Such a comparison could highlight whether transit or bikesharing service is adapted for vulnerable groups.

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Sex differences in cortical thickness in first-time DWI offenders: a preliminary MRI study

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Running head: Sex differences in first-time DWI offenders

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Figures: 2

Abstract

Background: Driving while impaired by alcohol (DWI) is a persistent yet preventable public health problem. Recent evidence indicates an increasing number of females engaging in DWI behaviour and distinct sex-based trajectories, though sex-based analysis is infrequent in DWI research, especially with respect to role of cognitive processes. The current study investigated associations between sex, cortical thickness analysis using high resolution Magnetic Resonance Imaging (MRI) and psychological functioning in DWI offenders. It was hypothesized that male offenders possess brain features consistent with impaired executive control, while female offenders show more signs of alcohol misuse and psychological dysfunction.

Methods: 31 male and 16 female DWI offenders, and 31 male and 31 female non-DWI drivers were recruited. All subjects underwent T1 high resolution MRI scanning and cortical thickness analysis using the CIVET pipeline and assessment on sociodemographic, alcohol misuse, impulsivity, and psychological adjustment.

Results: Male DWI offenders,compared to male non-DWI comparators, showed reduced cortical thickness in the posterior and ventral anterior cingulate cortex, the parahippocampal gyrus and anterior insula, areas associated with decision making, error monitoring and emotional processing. Female DWI offenders, compared to their female non-DWI comparators, showed no signs of structural anomalies, butstronger signs of alcohol misuseand depression and anxiety-related dysfunction.

Conclusions: These preliminary results suggest that sexual dimorphism contributes to the heterogeneity of the DWI offender population, the trajectory to DWI behaviour, and the uncertain effectiveness of generalized approaches to prevention.

Key words: Driving while impaired, driving under the influence, sex, alcohol, magnetic resonance imaging, executive control, personality.

Introduction

Anemerging neuropsychological literature into DWI indicates that DWI offendersare likely to show compromisedexecutive control when sober[1, 2]. Specific shortcomingsin decision-making, inhibitory control, working memory and emotional information processing have been detected [3-6]. Suchfunctional limitations, and the brain featuresthat accompany them, have been observed inother risk-taking groups including problem gamblers, substance abusers and sexual risk takers [7-12]. In addition, acute alcohol intake may magnify their influence on risk taking[13].

Most of the above observations have been made in male DWI offenders. On the whole, the preponderance of DWI convictions among the male driver population [14] has limited investigation of female DWI.Nevertheless, recent evidence indicatesnot only an increase infemale DWI behaviour[15-17], buthints at distinct sex-based trajectoriesas well. Younger age, and greater sensation seeking, aggression, reward sensitivity, and disinhibitionfrom acute alcohol consumption have been associated with male DWI [13, 18-21], while alcohol misuse, intrapersonal and interpersonal maladjustment, and susceptibility to alcohol's psychomotor-impairing effects may characterize female DWI[17, 22-24]. These findingsimply thatmale DWI offending reflectsexternalizing behaviour fromreducedexecutive control, while female DWI is consonantwithpsychological dysfunction. No DWI studyhasverified this possibilitythrough objective measurement ofbrain morphology related to executive control.

The present studycompared male and female first-timeDWI (fDWI) offenders with their same-sex non-DWI comparators on cortical thicknessmeasured by MRI across the cerebrumand on measures of psychological functioning. We hypothesized thatmale fDWI offenderspossessmore cortical thinningin the PFC and hippocampal regions. We further hypothesized that female offenders would show greater signs of psychological dysfunction. If these hypotheses were supported, a strong rationale for a sex-based approachfor both understanding and preventing DWI behaviour would emerge.

Methods

Study sites The Douglas Hospital Addiction Research Program (DHARP) was the main study site. MRI data acquisition was performed at the Montreal Neurological Institute (MNI), and MRI data analyses were undertaken at the Douglas Brain Imaging Research Consortium facility. All sites are affiliated with McGill University.

Participant inclusion/exclusion and recruitment Participant recruitment was drawn from a larger longitudinal study investigating the role of neurobiological factors in the transition from fDWI to recidivism status. ForfDWI offenderrecruitment, inclusion criteria were: i) age 18 to 44; ii) a fDWI conviction within the previous 24 months with no subsequent DWI arrest; and iii) consent for access to their provincial driving record. For non-DWI driver recruitment, inclusion criteria were: i) ages 18 to 44; ii) a valid driver's license; and iii) a DWI-free driving record. For all participants, exclusion criteria were: i) reading skills of less than 6^{th} grade level (either in French or English); ii) significant medical contraindications; iii)large torso or head tattoos(a risk for MRI); and iv) being under the acute influence of alcohol or drugs during laboratory visits. Study participation was solicited by advertisements in local newspapers, Facebook® and the DHARP's webpage.Pamphlets were also placed in correspondence to offenders fromQuebec's

designated re-licensing authority. Ethics boards of both the Douglas Hospital and MNI Research provided ethical approval and oversight of all recruitment, informed consent and experimental procedures.

Procedures When study candidates telephoned the laboratory, an initial interview was conducted to establish eligibility based upon inclusion/exclusion criteria. On arrival to the laboratory, eligible study candidates were asked to present picture identification and proof of DWI status. Candidates then received Informed Consent forms to read, discuss and clarify any questions of the protocol, and sign if acceptable. Participantsthen underwent:i) a Breathalyzer® test;ii) medical examination by a research nurse and a clinical evaluation by the team's research physician (JT) to confirm study inclusion if the nurse detected any signs of medical risk or substance-induced intoxication;and iii) sociodemographic, alcohol, drug and psychological assessment. MRI of participants, if consented to as a separate facet of the overall protocol, occurredduring a separate sessionwas carried out within 14 days of the initial session.

Measures

MRI acquisitionand cortical thickness analysis MRIs were acquired on a 1.5-T Siemens SonataVision (Siemens, Malvern, Pennsylvania). Participants were scanned with a high-resolution T1 three-dimensional magnetization-prepared Flair sequence (slice thickness = 1 mm isotropic; repetition time = 22 ms; echo time = 9.2 ms; flip angle=30°). Cortical thickness analyses were completed using the automated analysis pipeline developed at the Montreal Neurological Institute [25]. All images were corrected for non-uniformities and registered into standard stereotaxic space [26]. The corrected and registered MRI scans were then segmented into gray matter, white matter and cerebrospinal fluid using a neural-net classifier [27]. Laplacian anatomical segmentation was used to determine white and gray matter surface boundaries using a surface deformation algorithm [28], which yields 40,000 vertices of linked gray and white matter surfaces. Cortical thickness was then computed as the distance between the linked gray and white matter vertices. Once completed, individual cortical thickness data were smoothed using a blurring kernel of 20 mm.

Sociodemographicsand psychosocial functioning Information about age, marital status, education, and employment was obtained using the Addiction Severity Index (ASI) [29, 30].

Substance use severity and diagnosis The Michigan Alcoholism Screening Test (MAST)[31] provided a index of lifetime alcohol problem severity and related negative consequences, while the Alcohol Use Disorder Identification Test (AUDIT)[32]screened for alcohol problems in the previous 12 months. The Drug Abuse Screening Test (DAST)[33]provided a index of drug problem severity. The Timeline Followback protocol (TLFB)[34] measured the frequency of risky drinking days over the previous 180 days. The structured, computer-assisted Composite International Diagnostic Interview (CIDI) [35] provided diagnostic classification of alcohol and drug use disorders.The ASI provided family history of alcohol problems. A Breathalyzer® test detected recent alcohol use.

Personality and Psychological Characteristics The Barratt Impulsivity Scale version 11 (BIS) [36] measured three impulsivity dimensions: cognitive, behavioural and planning. The Sensation Seeking Scale (SSS-V) [37, 38], validated 19-item questionnaire, measured three

dimensions: i) thrill and adventure seeking; ii) experience seeking; and iii) disinhibition and boredom susceptibility. The Millon Clinical Multiaxial Inventory III (MCMI) [39, 40]provided validated information regarding probable Axis I and/or Axis II disorders, specifically anxiety, dysthymia, depression, and antisocial traits. Its validity index providedan indicator of respondent test taking attitude.

Analytic strategy

MRI data Logistic regressions were performed at every vertex, with cortical thickness as the dependent variable and recidivism status as the independent variable for only male subjects, only female subjects and all subjects combined, in three separate analyses. All regressions were controlled for age and handedness. All cortical thickness results were thresholded by applying the false discovery rate at a q value of 0.05 [41] and only considering results that met the criteria of being $F > 6.0$.

Sociodemographic and psychometric data T-testswere used with continuoussociodemographic and psychological variables to detect group differences between male and female DWI offenders and their non-DWI controls. In the case of significantly non-normally distributed data, Mann-Whitney U statisticwas used for continuous data. Group differences on categorical data were detected by tests of independence.Alpha for all inferences was set at $p < .05$.

Results

Sample recruitment Figure 1 describes the participant recruitment from a larger study from which the present sample is drawn. Full data for the present study were collected from 31 male fDWI offenders and 31 male non-DWI comparators and 16 fDWI offenders and 31 female non-DWI comparators. Some difficulty in recruiting female fDWI offenders was encountered due to a relatively fewer calls (13%) compared to the male offenders (33%).

Sociodemographics Table 1 summarizes the sample sociodemographic characteristics. Analyses to detect group differences found only one: male non-DWI comparators were more likely to be cohabitating with their partners than the male DWI offenders (χ^2 (1) = 6.27, p = .012).

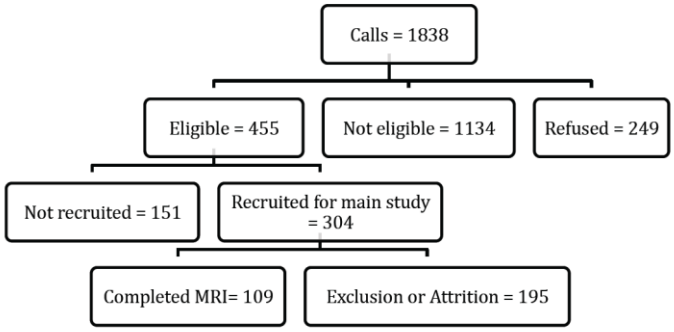
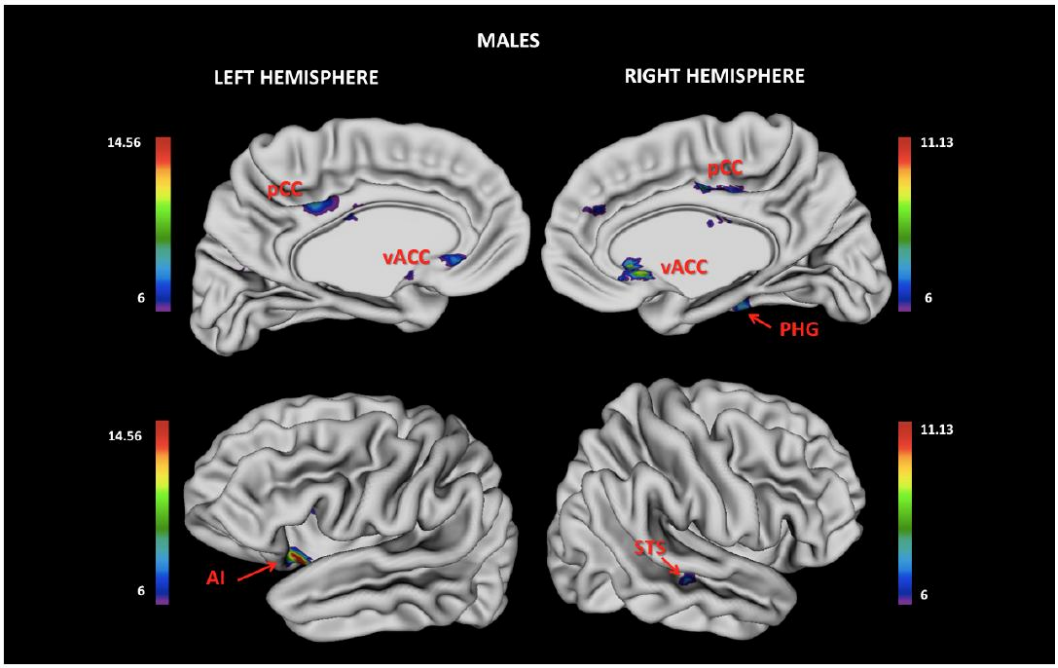


Figure 1. Recruitment flow chart from initial call, screening for eligibility, recruitment, attrition and completed data collection.

	Male				Females			
	Non-DWI (n=31)		fDWI (n=31)		Non-DWI (n=31)		fDWI (n=16)	
	M (%)	SD	M (%)	SD	M (%)	SD	M (%)	SD
Age	30.0	8.0	28.5	7.0	30.8	7.7	32.6	8.8
Education (years)	14.5	2.8	13.9	2.8	16.1	2.4	15.4	2.3
Annual Revenue								
≤ $11,999	(30.0)		(32.3)		(22.6)		(12.5)	
$12,000-29,999	(30.0)		(29.0)		(35.5)		(43.8)	
$30,000-$49,999	(26.7)		(32.3)		(35.5)		(37.5)	
≥ $50,000	(13.3)		(6.5)		(6.5)		(6.3)	
Marital Status								
Married or cohabitating	(40.7)		(19.4)		(25.5)		(25.0)	
Occupation								
Working full time (≥35h)	(58.1)		(61.3)		(45.2)		(62.5)	
Working part-time	(12.9)		(3.2)		(19.4)		(6.3)	
Student	(29.0)		(25.8)		(32.3)		(25.0)	
Unemployed	(0.0)		(9.7)		(3.2)		(6.3)	
Right handedness	(80.6)		(80.7)		(93.6)		(93.8)	
Substance Use								
AUDIT	5.7	5.9	7.4	4.5	3.5	3.4	6.4	
MAST	4.4	7.1	9.7	7.5	3.5	5.7	15.6	
DAST	1.2	1.6	1.9	3.0	0.8	1.4	1.6	
Substance Use (last 90 days)								
Alcohol use days	23.5	33.8	48.7	40.5	22.8	30.4	35.3	
Risky drinking days	4.0	7.1	10.3	11.6	4.5	7.1	7.6	5.3
Cannabis	9.4	26.9	7.8	21.9	7.4	22.5	9.1	11.8
Alcohol Dependence (lifetime)			(25.8)				(56.2)	
Family history of alcohol problems			(64.5)				(56.3)	

Table 1. Sociodemographic and substance use characteristics of male and female fDWI offenders and their non-DWI comparators.

Figure 2 depicts differences on cortical thickness between male fDWI offenders versus their non-DWI comparators. Significant differences ($p < .05$) between the fDWI offenders and their non-DWI comparators were found laterally in the right hemispheric regions of the superior temporal sulcus of the temporal lobe ($F = 7.75$, $r^2 = 0.11$), medially in the right hemispheric regions of the ventral ACC ($F = 9.54$, $r^2 = 0.13$) and posterior cingulate cortex ($F = 8.86$, $r^2 = 0.12$), and the parahippocampal gyrus ($F = 7.89$, $r^2 = 0.11$). Laterally in the left hemisphere, differences were found in the anterior insula ($F = 14.49$, $r^2 = 0.19$), while medially in the left hemisphere, differences were detected in the posterior cingulate cortex ($F = 9.07$, $r^2 = 0.12$) and ventral ACC ($F = 8.44$, $r^2 = 0.11$). The x y z MNI space coordinates for these findings are shown in Table 2. In females, no significant differences in cortical thickness were found between fDWI offenders and their non-DWI comparators.



pCC= posterior cingulate cortex
AI = Anterior Insula
STS = superior temporal sulcus
vACC = ventral anterior cingulate cortex
PHG = parahippocampal gyrus

Figure 2. MRI of cortical thickness in male first-time DWI offenders (n = 31) versus their male non-DWI comparators (n = 31).

Substance Use The lower portion of Table 1 summarizes group substance use characteristics. In males, fDWI offenders, compared to their non-DWI comparators, reported significantly greater proportion of risky drinking days (i.e., ≥5 standard drinks for males; $U = 280.00$, $p < .01$) via the TLFB, lifetime symptoms and consequences of alcohol misuse via the MAST ($U = 186.50$, $p < .001$), and symptoms and consequences of alcohol misuse in the past year via the AUDIT ($U = 337.0$, $p = .04$). In females, fDWI offenders, compared to their non-DWI comparators, reported more symptoms of lifetime symptoms and consequences of alcohol

Region	x	y	z	F	p
Left					
Posterior cingulate cortex	-3.2	-23.9	40	9.0	<.01
Subgenual anterior cingulate cortex	-2.6	27.5	-8.8	9.3	<.01
Anterior Insula	-31.3	13.2	-17.1	14.6	<.001
Right					
Subgenual anterior cingulate cortex	2.6	16.5	-5.3	10.2	<.01
Posterior cingulate cortex	5.8	-7.6	39.9	8.9	<.05
Parahippocampal gyrus	29.7	-35.7	-25.0	7.2	<.05
Superior temporal gyrus	53.9	-29.4	-6.0	7.3	<.05

Table 2. Significant differences in cortical thickness between fDWI offenders (n=31) and controls (n=31) in male subjects (region, MNI space coordinates, effect size).

misuse than controls via the MAST (U = 65.00, p < .001), and symptoms and consequences of alcohol misuse in the past year via the AUDIT (U = 151.50, p = .03). Direct comparison betweenmale and female DWI offenders revealed females reporting more alcohol symptoms and consequences than males on the MAST (U = 158.00, p = .04) but not on the AUDIT or DAST. Analyses of family history of alcoholism failed to detect sex differences in the proportion of male versus female fDWI offenders identifying one or more family members (parents, grandparents, aunts, uncles, siblings). Test of independence indicated that female offenders were significantly more likely to have had a lifetime alcohol dependence diagnosis than the males ($\chi^2(1) = 4.24$, p = .04). Of those fDWI offenders with a diagnosis of alcohol use disorder, a significant sex difference on mean age of onset was detected with males reported younger age (M = 22.63, SD = 7.01 vs. M = 32.56, SD = 7.81; t(15) = 2.74, p = .02).

Personality and psychological adjustment Table 3 summarizes the means and standard deviations of participants' scores on the BIS, SSS-V and the clinical subscales MCMI. On the BIS, female fDWI offenders reported more motor impulsivity than their non-DWI comparators (F(1, 45) = 5.84, p = .02). No differences were detected on cognitive and non-planning impulsiveness. In the males, no differences between fDWI offenders and their non-DWI comparators were detected. No differences on the subscales of the SSS-V between fDWI offenders and their non-DWI comparators were detected in either males or females.

On the MCMI, preliminary analyses were conducted on data from the validity subscales, namely social desirability and disclosure. Analysis revealed a high probability of test invalidity in three fDWI and three non-DWI male participants, and in no fDWI and seven non-DWI female participants. These cases were removed from subsequent analyses of clinical subscales. Analyses then compared fDWI offenders and their non-DWI controls on validity-adjusted scores. In themales analyses revealed a significant difference on the anxiety disorder scale (U = 291.0, p = .03) with fDWI offenders reporting more severe characteristics. In females, significant differences between fDWI offenders and their non-DWI comparators were found on the dysthymic (U = 149.5, p = .03), anxiety (U =149.5, p = .03), and antisocial (U = 126.0, p < .01)

scales, and a trend for significance on the depressive scale (U = 166.0, p = .06) scale; female fDWI offenders consistently reported more severe characteristics on these measures.

	Males				Females			
	Control (n = 31)		fDWI (n = 31)		Control (n = 31)		fDWI (n = 16)	
BIS	M	SD	M	SD	M	SD	M	SD
Planning	23.84	5.70	24.32	3.93	23.90	4.04	25.88	4.00
Motor	22.94	6.87	21.71	3.81	20.35	3.13	23.00	4.29
Cognitive	17.55	4.08	17.35	3.00	16.61	2.73	16.88	2.47
SSS								
Thrill	6.90	2.87	6.61	2.75	6.03	2.40	6.00	3.03
Experience	6.58	1.88	5.90	1.80	6.58	2.06	6.88	2.09
Disinhibition	4.87	2.77	5.03	2.47	3.71	2.18	4.38	2.47
Boredom	3.26	2.24	2.74	2.39	2.51	2.06	2.94	1.91
MCMI*								
Dysthymic	24.80	30.91	24.69	26.98	13.16	23.90	31.00	30.91
Depressive	34.87	32.51	38.79	31.52	18.87	26.85	35.19	30.75
Anxiety	31.00	34.47	48.62	30.98	28.06	28.27	53.00	30.29
Antisocial	50.07	25.40	52.38	20.56	44.19	18.12	61.88	19.75

Based upon 28 male fDWI offenders and 28 male non-DWI comparators, 16 female fDWI offenders and 24 female non-DWI comparators, invalid tests removed. BIS: Barratt Impulsivity Scale; MCMI: Millon Clinical Multiaxial Inventory; SSS: Sensation Seeking Scale-V.

Table 3. Means (M) and standard deviations (SD) on personality and psychological characteristics of male and female fDWI offenders and their non-DWI comparators.

Discussion

In support of our first hypothesis, we found that male offenders compared to their male comparators showed evidence of reduced cortical thicknessthatwas notobservedin the female offenders. Affected regions werethe ventral anterior and posterior cingulatecortex and the ventral ACC, the parahippocampal gyrus and the anterior insula. These areas individually have been associated with executive controlandare also parts of thelimbic system involved in emotion regulation[42, 43]. This suggests involvement of both cognitive and emotional self-regulatory processes. In support of our second hypothesis, female fDWI offenders showed more signs of heavier alcohol misuse and greater psychological difficulties, but no detectable differences in cortical thickness.

Bothposterior and ventral divisions of the cingulate have been implicated in error detection and monitoring, reward-related processes, decision making, and inhibition[44, 45]. The posterior cingulate cortexis thought to serve multiple roles as a cortical hub integrating information across different brain networks. These include the control of responses to rapidly changing environments andgain-specificactivation, specifically evaluation of the positivevalenceof arousal throughepisodic and autobiographical memory, and salience detection related to reward[46][47].

Greater activation to alcohol cues has been seen in relation to disordered alcohol consumption, possibly indicating distortion of reward processes related to alcohol[48]. Moreover, posterior cingulateatrophyhas beenassociated with treatment refractoriness[49]. In driving simulation research, posterior cingulate activation,possibly related to spatial attention and monitoring,has been associated with driving speed [50].

The ventral ACC has beenassociated withidentification of the emotional significanceof environmental stimuli and the creation of affective states [51]. Its activation has been linked torisky decision-making in adolescents[52]. In pragmatic contexts, ACCactivity has been associated with relapse to criminal behaviour [53] and to weak appraisal ofdriving-relatedrisk[50]. In driving simulation research, ACC activity isattenuated by alcohol,resulting in alterations in driving speed [54]. The parahippocampal cortex, in particular the right parahippocampal gyrus, has been associated with encoding and maintenance processes of working and long-term memory, a key component of effective learning from past experience [55, 56].

Along with sex differences in brain morphology associated with executive control, sex differences in the anterior insula signal a possible role for emotional control in their offending. The anterior insula is posited to bean important node in the brain networks that underlies both emotional and cognitive control [57]as well as emotional decision making [58]- through the integration of information from the somatosensory cortex and limbic areas, and then by feeding this information to cognitive control areas such as the posterior cingulate cortex, the dorsal ACC, and the dorsolateral PFC. Deficits in decision-making under risk have been seen in male DWI offenders performing the Iowa Gambling Task [4, 6, 59, 60]. Another study has also found that reduced gray matter volume in the anterior insula was correlated with decreased interoceptive accuracy and subjective ratings of visceral awareness [61], processes related to the ability to translate bodily responses to stimuli (e.g., increased heart rate in response to threatening stimuli) to feelings (i.e., fear) [62]. Behaviourally, the anterior insula has been associatedwith decreased harm avoidance and anticipation of aversive events [63], anddisruption in decision making under risk [58, 64]. Finally,alcohol consumption blunts activation of the anterior insula to an emotional processing task [65], a finding that linksintoxication to decreased interoceptive awareness. Hence, structural weakness in this area and its behavioural correlates (e.g., risky decision making) could be further compounded by acute alcohol consumption.

Female fDWI offenders presentedwith significantly greater alcohol misuse, dysthymia and impulsive and antisocial personality traits, and trends for greater anxiety and drug abuse, differences not seen to same degree in the males. These sex differences are generally consistent with previous studies [66, 67]. Such findingshave led to a gender-based interpretation of the meaning of DWI behaviour, especially related to the role of alcohol.In males, heavy drinking is generally perceived as more socially acceptable, with DWI being an unintended or irresponsible consequence. In females, heavy alcohol use is frequently perceived as deviant behaviour anda maladaptive coping response to psychosocial, interpersonal and mood dysfunction[22, 68].

Additional exploratory analyses were undertaken to inform speculation about the origins of observed sex differences in brain morphology. Significantly earlier onset of alcohol dependence was detected in male offenders compared to female offenders (i.e., on average 22 years vs. 33 years respectively). Earlier maladapted alcohol consumption, especially in adolescence, are

associated withdisrupted brain development [69]. The present results are also congruent with mounting support for distinct female etiologic pathwaysto alcohol misuseand its consequences [70], with mood-relateddysfunctionplaying an antecedent role [67, 71].

Limitations This study presentsnovel yet preliminary MRI data on fDWI offenders, with some noteworthy limitations. Sample sizes were unbalanced, thereby potentially limiting statistical sensitivity to detect subtlergroup differences. This was particularly the case of female fDWI offenders who were less numerous, which could have resulted in less power in analyses in the females. The difficulty in recruiting female DWI offenders is known, and reflects not their under-representation in the DWI population, but possibly the greater stigma attached to female alcohol misuse [72]. The decision not to correct alpha level in repeated analyses was an attempt to reduce the possibility of Type 2 error in this preliminary study due to limited sample size. Relatedly, exclusion because of body tattoos may havelimited the representativeness of thesample to the population of DWI offenders. Finally, a DWI conviction as an index for group membership is confounded by several individual (e.g., socioeconomic status, the ability to retain competent legal representation) as well as environmental (e.g., regional laws and per se BAC criteria for DWI convictions, enforcement policies and vigour) factors [73, 74]. These circumstances vex the DWI research and may have influenced the representativeness of the present sample and the generalizability of the findings to other jurisdictions.

Conclusions The present study provides preliminary evidence for sexual dimorphism in the heterogeneity in behaviour observed in DWI offenders. Areas in males where cortisol thinning was uncovered are consistent with shortcomings in executive control capacities involving in reward-related processes seen in other neuropsychological studies. Female DWI seemed to follow a trajectory consistent with that frequently observed in female alcohol misuse, where alcohol misuse is an outgrowth of psychological dysfunction. These preliminary findings provide rationales for confirmatory replication of the results, and exploration of sex-specific approaches to DWI prevention.

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Gender Differences in Risky Driving while in the Presence of Young Passengers

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ABSTRACT

Men account for most of the traffic fatalities in the United States. Current data show, however, that the prevalence of women in fatal motor vehicle crashes is rising. This risemay reflect the increasingly complex roles that women play in our society, as well as changes in risk-taking behaviors. Although most male and female adult drivers are aware of safe-driving benefits, there are many factors that influencedrivers to participate in risky-driving behaviors. For many adult drivers, however, the presence of a child in the car may serve as a cue to engage in safe-driving behaviors. The aimsofthis study included assessing whether the presence of a child passenger in a vehicle cues adult drivers to adopt safe-driving behaviors and whether the driver's gender affected this association.In an effort to determine whether risk-taking behaviors by drivers of vehicles with child passengers have changed, we also estimated trends in the prevalence of alcohol-involved driving, speeding, and red light running and compared them with fatal crashes over time**.** We used the 1982-2010 Fatal Accident Analysis System. Only drivers who were at least 21 years old and transporting passengers aged 0-14 were included in the analyses. Results indicate that after taking all other variables into account, the presence of a child in a car does, in fact, have a protective effect on the likelihood of crashes. Interestingly, when looking at female drivers with fatally injured children, who were alcohol positive, running a red light, or speeding, we found that the percentage of women who were drinking and driving with children in the car showed a constant increase. Compared to men, the proportion of women who were drinking and driving with children in the car has increased over time, from about 30% in 1982 to 41.2% during 2006–2010. We observed similar increases over time for speeding and red-light running. Thus, our findings seem to confirm that although most drinking drivers are still men, and children play a protective role regarding traffic safety, female drivers have become increasingly involved in crashes when driving young children.

INTRODUCTION

Men account for most of the traffic fatalities in the United States (*1*).Current data show, however, that the prevalence of women in fatal motor vehicle crashes is rising (*2*).To a large extent, this increasemay reflect the evolution of social roles, in that women areincreasingly working outside the home..Nevertheless, ample evidence indicates that women are safer driversthan men (e.g., [*2-7]*) and tend to drive less (e.g., [*4, 8)*]).

Since the introductionof the automobile and because of social norms prevailing at the time, men traditionally drove more frequently, whilewomen worked at home to care for children and the household.However, as social norms changed, women's participation rate in the labor force grewand women's reliance on cars increased(*11, 12*).Yet, despite women spending more time at work and less time at home, many women continued to bear the main responsibility for housework, child care, and even elderly care(*13-17*).Such roles still prevailedover a decade later *(18, 19*). Not surprisingly, the total number of vehiclemiles traveled (VMTs) by women, as well as the frequency and length of the trips, has risen(*20*).

In addition to the increase in motor vehicle crashes (MVC)and vehicle miles traveled (VMT)among women, women may be engaging in riskierdriving behaviors, such as impaired driving. For example, recent research suggests that women currentlyare at greater risk of impaired driving than in previous decades (*21, 22)*. The Traffic Injury Research Foundation (TIRF; [*23*]) reports that driving-while-intoxicated (DWI) arrestsof women have climbed almost 30% from 1998 through 2007, and the proportion of males arrested for alcohol-related violations to females arrested for alcohol-related violationshasdecreased from 10to1 in 1980 to almost 3to1 in 2007 (*23*).

Because women remain the main transporters of children, and becausestatisticssuggest that women are increasinglyinvolved in crashes and increasingly exhibitrisky-driving behaviors, the issue of child endangerment may be of concern. In a recent study, Kelley-Baker and Romano (2014) found that the presence of a child induces adult drivers to take fewer driving risks. It is unclear, however, if the size of such an influence varies by driver gender.For example, compared with men, are women safer drivers for children?And have any gender-related differences evolved over time? As women'sroles in society,with increasing dual work and home demands, continue to approach parity with men's, any gender-based protective role that the presence of children may have hadon their adult driverscouldbe eroding.

The media has highlighted several stories involving mothers'endangerment of child passengers. For example, one extremely sensationalized story in 2009 reported that a Long Island, NY, woman with a blood alcohol concentration (BAC) twice the legal limit drove her minivan the wrong way on a highway and crashed head-on into another vehicle. She died instantly, along with her 2-year-old daughter, three young nieces, and the driver and passenger of the vehicle she struck. In 2011, a Pennsylvania mother veered off the side of the road and crashed, killing her 14-year-old son. Twobeer bottles, an empty vodka bottle, and prescription pills were found in the mother's van. These incidents are tragic, and they are not isolated.

Alcohol is not the sole factor that increases children's danger in vehicles. For example, speeding and red-light runningare also often identified as risk-taking or reckless driving behaviors.Although generally most studies show that women are more risk-averse then men(*24*), aswomen's roles in society change, their behaviors may also change and approach parity with men's. Rushingto work after dropping off kids, rushing to meetings, then rushing to pick up the kidscanlead to speeding, red-light running, and other risky-driving behaviors, which may be compounded by binge-drinking episodes at social eventsorheavy drinking related to stress or depression. Thus, children traveling with these drivers may be at increased risk.

Although most adult drivers are aware of safe-driving benefits (e.g., defensive driving techniques), factors such as stress, differences in personality traits, the performance of repetitive driving tasks, and theavailability of music or other distractions may entice driversto participate in risky-driving behaviors.We hypothesize that, for many adult drivers, the presence of a child in the car mayserve as a cue to engage in safe-driving behaviors.In this study, we began testing this broad hypothesis.

This study's aims includedassessing whether the presence of a child passengerin a vehicle cues adult drivers to adopt safe-driving behaviors.We first evaluated this by comparing fatal crash types (alcohol-involved, speeding, and red-light running) with the presence of a child in the vehicle.Second, we examined

whether the driver's gender affected this association.Finally, we estimated trends in the prevalence of alcohol-involved driving, speeding, and red-light running to crashes over time.

METHODS

Data Sources

Data used for this analysis came from the 1982–2010 Fatality Analysis Reporting System (FARS).Maintained by the National Highway Traffic Safety Administration (NHTSA), the FARS is a record system for all police-reported motorvehicle crashes on public roadways that result in the death of at least one road user within 30 days of the event.FARS provides detailed information about the driver's gender, age, level of alcohol consumption, and maneuvering skills.FARS also contains information about the number of vehicles involved in the crash and the number of passengers.The dataset provides information that allows us to confidently make inferences about trends at the national level and over time.

Given the extensiveness of the FARS data set, we limited oursample by excluding buses, farm equipment, snowmobiles, and construction vehicles.Only passenger vehicles, minivans, pickups, sports utility vehicles, and 15-passenger vans were retained.We also excluded drivers who were mentally challenged,who died as a result of a non-driving condition (e.g., from a heart attack), police chases, and nonmoving traffic violations.Although information on race/ethnicity is available in the FARS, this information comes from death certificates (i.e., it is available for fatally injured occupants only) and is available only as of 1999 (*25*).Therefore, race/ethnicity was not studied in this effort.The age, gender, and injury severity (if injured) of both drivers and passengers is, however, recordedin the database.

The FARS also records the drivers' BAC.However, only a fraction of the drivers are tested for alcohol consumption.In 1982, only 54% of the fatally injured drivers were tested for alcohol. That figure climbed to 65% in 2002 (*26*).For those with no actual measure available, the FARS provides imputed BAC measures developed using a multiple imputation technique by Subramanian (*27*).Because such imputation took into account some variables central to this study (e.g., the time of the crash and the presence of passengers in the vehicle), imputed measures of BAC were not included in this effort. Only vehicles in which the driver was tested for alcohol were considered.

Among all drivers in the data set (N = 1,501,589), a total of 148,365 fatal crashes involved at least one child aged 0–14 years.In 33,587 cases (21.8%), at least one of the drivers tested positive for alcohol.A total of 54,665 children were involved in these alcohol-related crashes; of these,10,877 (about 20%) were fatally injured.

For drivers transporting children, we included in our analysis only those aged 21 years and older who were driving at least one child younger than age 15 years. This ensured that the child (defined in this study as an individual 14 years of age or younger) was driven by someone old enough to be a parent or guardian (aged21 years or older)and reduced the chances that the driver and passenger were peers. Based on this criterion, wecreated a file in which each record representedone child 0–14, with each record containing information about the child (age, gender, seat belt use, seat position), his/her driver (age, gender, and BAC), and the crash condition (e.g., if speeding was a factor).Thus, if more than one child was in the vehicle, the driver and crash condition information wasrepeated for each of those children.

A total of 85,151 crashes involved a driver (aged 21 and older) transporting a child (passenger younger than 15 years old).A total of 147,321 children were in the file.About 30% of the crashes were single-vehicle crashes (25,764) and 70% were multiple-vehicle crashes (59,387).

Measures

Our study variables of interest included the following:

*Age.*There is ample evidence that driver age influences the likelihood of impaired driving (e.g., [*22, 28*]), with adolescents and the elderly being at a higher crash risk per miles driven than other drivers (e.g. [*29-32*].For drivers younger than age 21, crash risk is highly exacerbated by the presence of other teenagers in the vehicle (e.g., [*33*]); thus, to avoid confounding the risks associated with teens driving teens with that of adults driving children (the focus of this study), only drivers aged 21 and older transporting a child

(passenger younger than 15 years old) were included in this study.To systematize the analyses, the following age categories were examined for drivers:21–25, 26–45, 46–65, and 66 years and older.

Gender.There is also ample evidence that gender affects the overall likelihood of engaging in risky-driving behaviors (e.g.,*[2, 30, 34*]).The role ofdriver gender and its contribution to the crash risk of achild passenger is suspected (*33*), though severely understudied. We hypothesize that women driving children will be more protective (take fewerdriving risks) than their male counterparts.

Crash type and time of day.There is also ample evidence that single-vehicle crashes, particularly at night, are more closely associated with impaired driving than any other crash type (e.g.,[*35,22*]).It would be logical to presumethat both crash type and time of day would affect (mediate and/or modify) the association between driver, children, and drinking and driving.However, drivers of children could be expected to follow driving patterns differingfrom those in the general population, thusmaking the association between single-vehiclecrashes and alcohol noticed in the general population of drivers disappear.To explore this possibility, we examined crashes as they occurred in the daytime (6:00 AM to 7:59 PM) and at nighttime (8:00 PM to 5:59 AM).

Alcohol.As mentioned, we limited our analyses to lab-tested BAC measures only.We examined drivers atBAC>.00, with child passengers.

Risky-driving behaviors other than alcohol.Impaired driving is not the only way by which drivers can endanger children.In this effort, we examine drivers' speeding and failure to obey a traffic signal (e.g., red light, stop, or yield).We identified speed-related crashes as suggested in the FARS Analytic Reference Guide[(*36*); page V-81].As such, the comparison group was established by drivers with the proper "Driving Condition Factor" (until the year 2008) or using the variable SPEEDREL (for 2009 and 2010).Following the FARS' handbook suggestions, we also used the "Driving Condition Factor" code to identify drivers who failed to obey a traffic signal.

ANALYSES

We first used descriptive statistics to estimate and compare the contribution of the studied factors to alcohol-positive, speeding, and red-light-running violations. We estimated 95% confidence intervals tomake those comparisons and to examine the role ofmale and female adult drivers of various ages, and crashes that occurred at daytime and at nighttime, on crashes that occurred while driving with a child.Next, we applied logistic regression to account for the simultaneous contribution of all explanatory variables to the likelihood of involvement in an alcohol-positive, speeding, and red-light-running crash while driving a child aged 0–14 years.Of special interest was the examination of the gender and "presence of a child" variables.Finally, we examined trends: annual variations in alcohol-positive driving, speeding, and red-light running prevalence among adult drivers with a child in the car at the time of the crash. We used SAS version 9.3 for these estimates.

RESULTS

Table 1 shows the bivariate associations between the variables of interest.More specifically, Table 1 shows the gender, age, time of day, being alcohol-positive, speeding, and red-light running at the time of the crash, and the distributions for three alternative types of driving situations at the time of the crash: driving alone (with no passenger), driving with at least one child, or driving with a passenger aged 15 years or older.

Almost 48% of drivers involved in a fatal crash while transporting a child younger than age 15 were women (although not shown in Table 1, this percentage goes up to 51% when considering only drivers of children from birth to 8 years old), most driving in the daytime (85%).This prevalence rate was higher than for all women drivers in the FARS file (women represented 34% of all fatal crashes). This might reflect the roleand responsibilities of women as primary caretakers and as transporters of children.

Although not shown in Table 1, of all the drivers tested for alcohol, approximately 22% were alcohol positive (20% BAC≥.08), with 35% being women.When we compared these figures to those specific for the three driving situations depicted in Table 1 (driving alone, driving a child, driving with a passenger aged15 years or older), driving with a child played a protective role regarding alcohol involvement, in that only about 10% of the drivers transporting a child were alcohol positive—a prevalence

significantly lower than that registered for drivers driving alone (25%) or with a passenger aged 15 or older (26%).The presence of a child wasalso found to have a protective impact on speeding (13% driving with a young child, 19% alone, and 22% with a passenger aged 15 years or older), but not as dramatically with red-light running (5% across all three situations).

TABLE 1.Fatal Crashes:Distribution of Driver and Situational Characteristics when Adult Drivers (Aged 21 Years Old or Older) Were Driving Alone, Driving with a Child (Age 0-14 years old), or with a Passenger Aged 15Years or Older

		Driving alone	Driving with a child	Driving with a passenger 15+
N		928,183	148,365	425,041
Gender	Male	69.4% 69.3% 69.5%	52.4% 52.2% 52.7%	72.1% 72.0% 72.3%
	Female	30.5% 30.4% 30.6%	47.5% 47.2% 47.7%	27.8% 27.6% 27.9%
Age	21-25	18.1% 18.0% 18.2%	15.2% 15.0% 15.3%	23.8% 23.6% 23.9%
	26-45	44.4% 44.3% 44.5%	68.5% 68.2% 68.7%	42.0% 41.8% 42.1%
	46-65	23.1% 23.1% 23.2%	13.5% 13.3% 13.7%	20.6% 20.4% 20.7%
	66+	14.4% 14.3% 14.5%	2.9% 2.8% 3.0%	14.4% 14.3% 14.5%
Time of day	Daytime	69.9% 69.8% 70.0%	84.6% 84.4% 84.8%	66.1% 65.9% 66.2%
	Nighttime	30.1% 30.0% 30.2%	15.4% 15.2% 15.6%	34.0% 33.8% 34.1%
Alcohol positive	Yes	25.0% 24.9% 25.1%	9.8% 9.6% 9.9%	26.1% 25.9% 26.2%
Red light running	Yes	5.2% 5.2% 5.3%	4.8% 4.7% 4.9%	5.4% 5.3% 5.5%
Speeding	Yes	19.0% 18.9% 19.1%	13.2% 13.0% 13.4%	21.9% 21.8% 22.0%

Driving alone, driving with a child, and driving with a passenger 15+ denote a driver with no passenger, with a passenger aged 0-14 years old, and with a passenger 15 years old or older, respectively. Alcohol-positive denotes a driver with a BAC > .00. Daytime and nighttime correspond to the 6:00 AM to 7:59 PM, and 8:00 PM to 5:59 AM time periods, respectively.

Table 2 shows the outcome of the logistic regressions. These results confirm that certain well-known factors, such as gender, age, and time of day, play a role in traffic safety and that women and drivers aged 46 years and older wereless likely to be involved in an alcohol-positive, speed-related, or red-light running episode at the time of the crash compared to men and younger drivers aged 26–45.However, drivers aged 21–25 were more likely to be involved in any of these three types of crashes than drivers of any other age group.Interestingly, women appear to be overrepresented in red-light-running crashes.The time-of-day variable shows that most crashes tend to occur at daytime. The dual driver's gender and child passenger interaction shows once more that, compared to men, female drivers are more likely to be found driving a child aged 0–14, but less likely to be driving a passenger aged 15 years old or older. Table 2 also shows that, as can be observed in Table 1, even after taking all other variables into account, the presence of a child in a car has a protective effect on the likelihood of any of the three types of crashes under consideration.

TABLE 2.Logistic Regression Modeling the Likelihood of the Driver Being Alcohol-positive Speeding, or Running a Red Light at the Time of the Fatal Crash

	Alcohol-positive	Speeding	Red light running

Effect	Estimate	SE	Estimate	SE	Estimate	SE
Intercept	-1.755	0.005	-1.709	0.004	-2.845	0.007
Gender (Ref. Male)	-	-	-	-	-	-
Female	-0.300	0.004	-0.136	0.004	0.075	0.005
Age (Ref. 26-45)	-	-	-	-	-	-
21-25	0.708	0.005	0.751	0.005	-0.067	0.008
46-65	-0.163	0.006	-0.261	0.005	-0.235	0.008
66+	-1.041	0.009	-0.804	0.008	0.554	0.007
Time of the day (Ref. Nighttime)	-	-	-	-	-	-
Daytime	-0.928	0.003	-0.361	0.003	0.122	0.005
Presence of a passenger (Ref: Alone)	-	-	-	-	-	-
Child	-0.654	0.008	-0.240	0.006	-0.006	0.010
Passenger 15+	0.294	0.005	0.162	0.005	0.022	0.007
Dual Interactions						
Female * Child passenger	0.078	0..008	0.162	0..006	0.066	0..009
Female * Passenger 15+	-0.042	0..005	-0.099	0..005	-0.039	0..007

Alone, child, and passenger 15+ denote a driver with no passenger, with a passenger aged 0–14 years old, and with a passenger 15 years old or older, respectively. Alcohol-positive denotes a driver with a BAC > .00. Daytime and nighttime correspond to the 6:00 AM to 7:59 PM, and 8:00 PM to 5:59 AM time periods, respectively.

The evolution of these behaviors over time is examined next. Figure 1 shows the annual evolution of the percentage of drivers with fatally injured children who were alcohol positive, running a red light, or speeding. The prevalence of drinking and driving for the three types of drivers under consideration(i.e., drivers who are alone, with a child aged 0–14, or with a passenger aged 15 years orolder) decreased sharply until the mid-1990s, when it leveled off. This pattern mimics that of the general population of U.S. drivers, which also registered an initial decrease followed by a leveling off since the mid-1990s (e.g., [*37*]). The changes over time were minimal for red-light running and speeding.

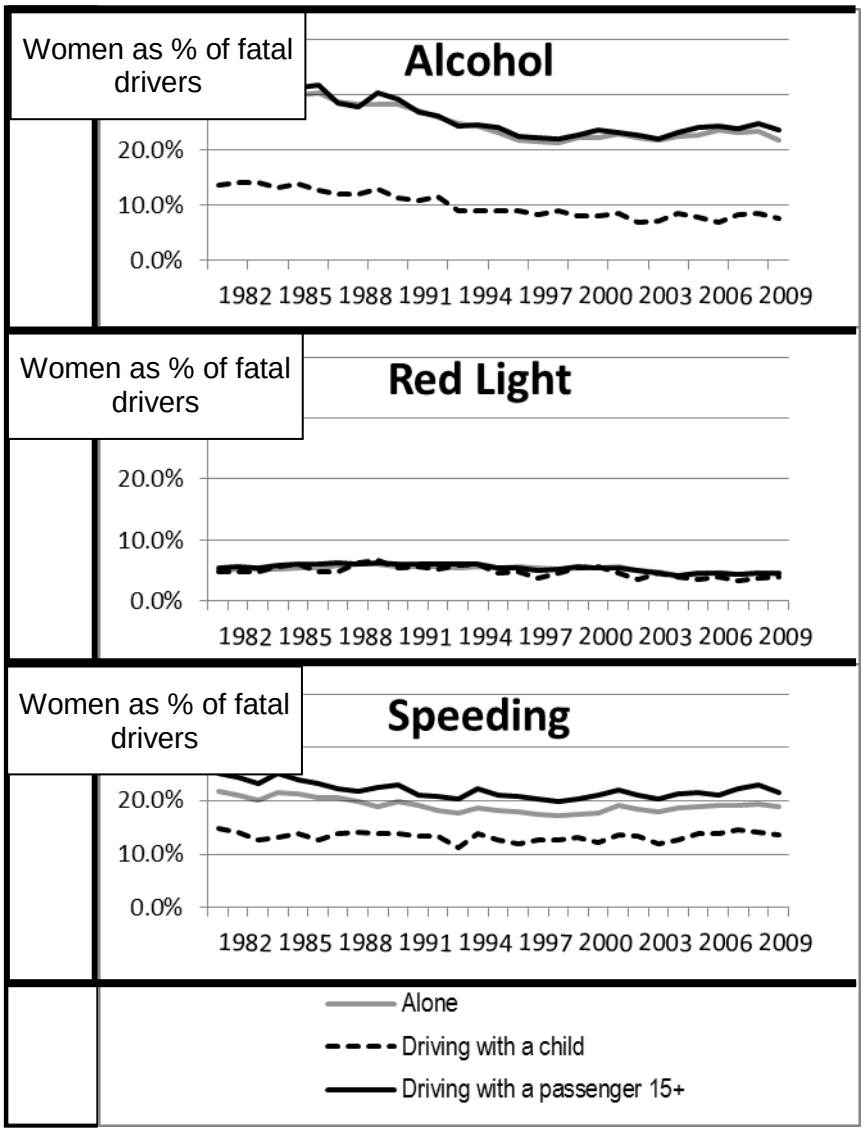

FIGURE 1.Annual Percentage of Drivers Who Were Alcohol-positive, Speeding, or Running a Red Light with Fatally Injured Children,1982–2010

Figure 2 focuses on the relative prevalence of women and men in different types of crashes. Displayed are drivers who were alcohol positive, as well as those running a red light, or speeding, and it shows the percentage of those drivers who were women. While the annual proportion of women who were drinking and driving while driving alone followed a pattern mimicking that of the general population of U.S. drivers (i.e., an initial reduction with posterior leveling off), the percentage of women who were drinking and driving with children in the car showed a constant increase. Although not included in Figure 2, we also estimated a 95% confidence interval (CI) for each annual prevalence estimate and used the CI to test the significance of the parameter evolution. Compared to men, the proportion of women who were drinking and driving with children in the car has increasedsignificantly over time, from 31.9% on average between 1982–1986, up to 41.2% during the 2006–2010 period. Significant increases over time in the prevalence of women with children were also observed for speeding (from 45.5% in 1982–1986, to 51.6% in 2006–2010) and red-light running(from 50.8% in 1982–1986, to 60.4% in 2006–2010).Note, however, that Figure 2 also shows that the proportion of women in crashes where there was no child, also rose over time when

considering drinking and driving and red-light running crashes, but less dramatically (although statistically significantly).

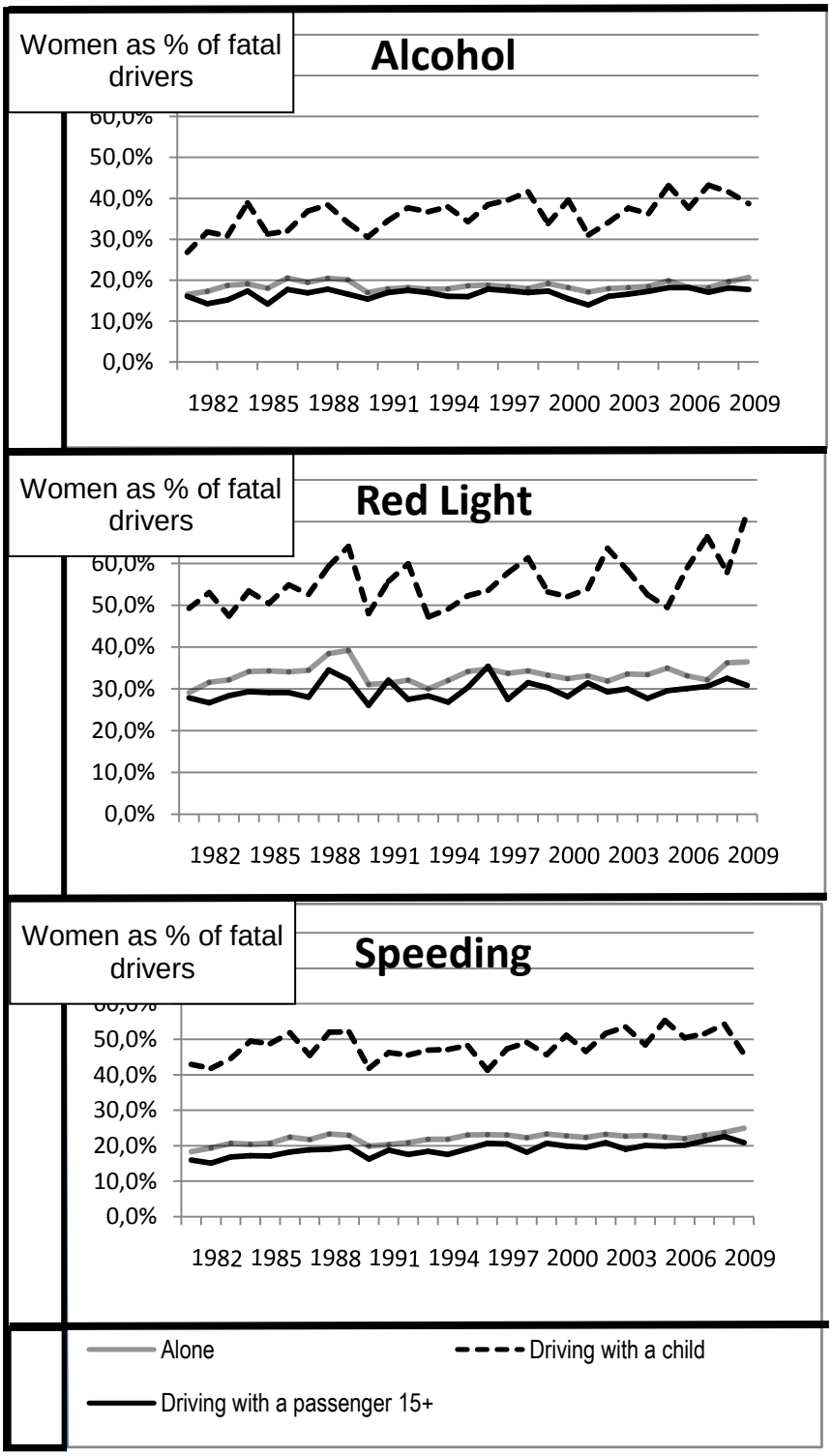

FIGURE 2. Annual Percentage of Female Drivers Who Were Alcohol-positive, Speeding, or Running a Red Light with Fatally Injured Children, 1982–2010

DISCUSSION

One aim of this study was to begin assessing if the presence of children in a vehicle cued drivers to adopt fewer risk-taking behaviors.To do this, we compared fatal crash types (alcohol-involved, speeding, and red-light running) with the presence of a child passenger in the vehicle.We then examinedwhether the gender of the driver affectedthis association.

The outcome of this effort confirmed that, in general, having a childin the vehicle does play a protective role for most drivers.As mentioned, although to some extent this "made sense" (i.e., parents/adults taking care of children), it has not been previously examined using any epidemiological study.Such confirmation that children do tend to elicit a positive behavioral response from their drivers should bring some relief to researchers and policy makers worried by media reports.

The evaluation of whether children play a protective role on their driver's behavior and whether that behavior varies by the driver's gender yielded less conclusive results.We found evidence that gender does play a protective role, but such a role seems to vary depending on the driver's age and the type of risky driving.Women and older drivers were less likely to be involved in alcohol-positive and speed-related crashes, compared to men and young drivers.However, we found evidence showing that, compared with men, women tend to be overrepresented in red-light running crashes.Clearly, although our study confirms that children do indeed play a protective role on their driver's behavior, such a role is not uniform, and it is more complex than initially postulated.In summary, we found that the protective role of children varies depending not only on the driver's gender, but also on the type of risky-driving behavior incurred by the drivers.

Given that women continue to be the main caretakers and oftenare the transport their children, and given the trend analysesfinding suggesting that womenare increasingly involved in crashes, the issue of child endangerment may be of concern.As noted in our results, compared to men, the proportion of women involved indrinking-and-driving crashes with children in the car has increased over time and similar increases over time were also observed for speeding and red-light-running crashes.Thus, our findings seem to confirm that although most drinking drivers are men, and children play a protective role regarding traffic safety, female drivers have become increasingly involved in all crashes, even those in which they aredriving young children.

It is unclear, however, if such an increase in crashes with female drivers is due to changes in risky-driving behaviors, driving exposure, or both as evident by the trend analysis also indicating a slight increase in crashes by women with no child was in the car. Evidence in the literature suggests that both driving exposure and changes in risk taking are responsible for this evolution (*2, 38*). Unfortunately, a limitation ofour analyses is that we can not adjust for crash exposure (e.g., by vehicle miles traveled or VMT) because information on VMT in the United States is provided by the Department of Transportation's National Household Travel Survey (NHTS), which occurs only about every 3–8 years, with little information on the VMT for drivers with children, and with no information on the VMT for drinking drivers (whohave been shown to follow patterns of driving different from other drivers). Because the limitations of the VMT database are central to this effort, we decided not to adjust our estimates by drivers' VMT.

It is important to note some additional limitations to this study. This study examines associations between the presence of children and some aspects of risky driving in fatal crashes. The analyses do not show causal relationships.This data set only accounts for fatal motorvehicle crashes, not cases of less severity. These data do not represent a random sample of persons driving on the roads, but rather a sample of those who were in fatal crashes. As noted, 46% of the drivers involved in a fatal crash while transporting a child are women, whereas women drivers are only involved in 34% of the fatal crashes in the FARS. However, to gain precision in our estimates, we only reviewed drivers whowere tested for alcohol. Therefore, the actual number of children's deaths and injuries due to drinking drivers islikely higherthan our counts.

The relevance of this effort should not be trivialized.Understanding traffic-related child endangerment is a timely need.It is the parent's or the adult'sjob to protect children, even in a vehicle. With speeding and other reckless driving behaviors on the rise, risk exposure for child passengers may increase as well.We cannot assume that women, the traditional caretakers, will continue to be the safer driversin

comparison to their male counterparts. Women are in more fatal vehicle crashesthan ever before, are driving more miles than in years past, and are engaging in more potentially risky behaviors (e.g., DWI).A recent study by Kelley-Baker and Romano (unpublished data), using FARS data spanning similar years as this study, found that,in the United States, 553 child passengers die each year in alcohol-related and reckless crashes in which the driver was old enough to be their parent. These figures do not appear to have changed despite improved vehicle technology and safety apparatuses.It may be time to consider addressing this concern and to design and implement effective interventions to prevent child endangerment from occurring. At the very least, it may be time to reexamine child endangerment laws.

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Dynamics of car ownership and its use in France since the seventies: A gender analysis

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ABSTRACT

Until mid 70's the motorization was increased in France by household equipment (most generally with one car per household), since then it's the multi-equipment of the households that also goes with the individualization of the car use. Our analyzes show the relationship between the pay employment and the motorization and the car use. Multi-adults (with a pay activity) households tend to be multi-motorized. In term of the car-use, the female still make less mileage than the male but the gap between gender tend to decrease with the young generation. Our analyzes are based on the French National Travel Surveys (FNTS). In the past, these surveys were conducted on five occasions between 1966 and 2007, giving five different pictures of mobility and car ownership for French households, allowing detailed analyses over the period 1973-2007 from the four most recent surveys, which were restored and standardized. The definitions and principles of these surveys have not been modified since the outset, which makes the measurement of structural changes easier.

INTRODUCTION

The diffusion of the household equipment in vehicles in the twentieth century explains part of the growth of the fleet. The demographic context in France also played a role in this evolution. For example, France's rural areas have witnessed a demographic upturn since the 1975 census (*1*). At first, it seemed that this movement affected only rural zones close to large towns. But the 1999 census revealed that there was also a positive migration balance towards isolated rural areas (*2*). Furthermore, it may be noted that the migratory balance has compensated the natural balance since 1975 (*1*).

Indeed, the increasing number of vehicles is also explained by the augmentation of: the number of households, the number of people of driving age and the rate of driving license holders. The dissemination of driving licenses according to gender and age and unequal access to driving licenses shall be dealt with.

By using a automobile more frequently to get to work and because it represents a large share of commuting trip in number and distance, we chose to examine the effect of evolution of the household motorization on trips from home to work according to gender.

Our analyzes are based on the series of the French National Travel Surveys (FNTS) conducted since mid 70's.

FRENCH NATIONAL TRAVEL SURVEY

The knowledge of mobility in France is in part based on National Travel Surveys (NTS). In the past these surveys have been conducted five times (1966-67, 1973-74, 1981-82, 1993-94 and 2007-08), which gives five snapshots of the situation regarding mobility and the car fleet for French households. The definitions and principles of these surveys have not been modified since the outset which makes the measurement of structural changes easier (*3*).

This survey is the only French survey of mobility of a compulsory nature, and which surveys people living throughout mainland France about their daily, regular and long distance mobility. The ENTD is the only national survey which describes all trips, regardless of their motivation, links, duration, mode of transport, the hour of departure and arrival, as well as the period in the years and the time of day. These surveys are conducted every 10 years by the Ministry responsible for transport with IFSTTAR (formerly INRETS).

The objective of the French NTS is the knowledge of households' trips and use of both public and private transport means. The NTS is the only survey in France that describes all household trips, whatever their purpose, length, mode, season or time of day may be. These surveys also emphasize the knowledge of the vehicle fleet, use and of individuals' access to public transport (including season tickets and discounted fares). These data are used in the present study.

THE DEMOCRATIZATION OF DRIVING LICENSE: MORE AND MORE WOMEN

In France, the number of people holding a driving license underwent rapid growth, from 17.3 million in 1973 to 39 million owners in 2007. The number of owners increased an average of 1.9% annually for men and 3% annually for women in the period 1973-2007. The driving license has now become an essential requirement for social and professional life (*4*), but not all people are equal in terms of obtaining a license. A low level of education, reduced activity, low incomes and the increase in prices of driving instruction in recent years may be considered as obstacles to obtaining a driving license. Gender inequalities are not to be excluded and have existed since the creation of driving license. If the introduction of the "certificate of capacity"[1] by the prefect of Paris Louis LEPINE in 1893 was once

[1] The terms "certificate of capacity" have been replaced by "driver's license" in 1922 with the appearance of the traffic police and the highway code

reserved exclusively for men[2], there are more and more women who have a driving license these last forty years: 38.9% of driving license holders were women in 1973 and 48.2% in 2007. Holding a driving license concerns generations: the younger the generation, the higher the number of driving license holders. But is the main cause of access to driving licenses is always to do with generational issues? Can we observe an age effect these last years?

Since the mid-sixties, the number of driving license holders has been on the rise. It was 41% in 1966 and doubled in 2007 to over 83% of people older than 18 years. The proportion of men holding a driving license is higher than women. About 70% of men held a license in1973 and over 91% in 2007. But the major fact concerns the difference in variation between genders: this has reduced over the years from more than 37 points in 1973 to 15 points in 2007. Just over 32% of women held a license in 1973 and over 76% in 2007. The rate of the total number of people with a driving license by age is still higher for men in all periods and all ages. Gender differences are tending to fade but men continue to represent the greater proportion.

The fact that only males are compelled to undertake military service may explain, in part, such a discrimination. During their service, young men could obtain a certificate of military conduct for free. This certificate was automatically converted into a driving license when the men returned to civilian life. After November 1997, marking the end of compulsory military service in France, a decrease in driving license holders for young men was pointed out especially among the poorest and those living in rural areas (*5*). We also recorded this phenomenon through the study of national transport surveys. Access to driving licenses increases at all ages for both sexes with time, with one exception however. Young men were less likely in 2007 to have their driving license in comparison to1993: down 1.6 point for men aged 18 to 24 and down 1.4 point for those aged 25 to 34.

A longitudinal study by gender clearly suggests that access to driving license has evolved various ways for both. The oldest cohorts of men are subject to a generational effect. The latter has given way to an age effect since the most recent cohorts merge (Figure 1). For the women (Figure 2), at same age, the curves of the most recent generations are above the previous one, showing an effect of generation: the rate of driving license by age increases at each age for each generation.

For men, the rate of people holding a driving license is now mainly influenced by an age effect rather than a generational effect. For women, this rate is still dominated by a generational effect. We can note, however, that gender differences in rates of driving by age tend to decline with the most recent generations. Longitudinal analysis also shows lower rates of driving license under 25 years: cohort 1960-69 at a rate lower than the cohort 1950-59.

[2] Women will have access to the certificate of capacity in 1897

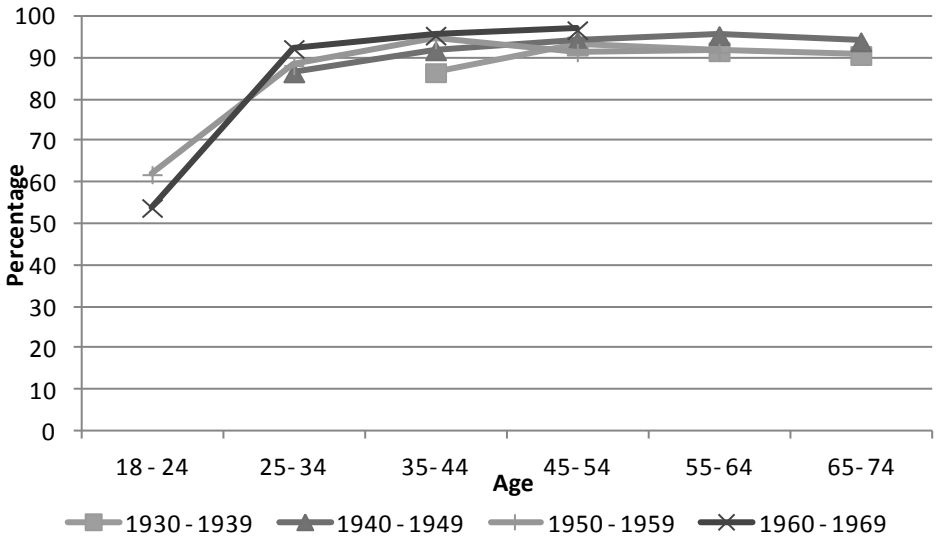

FIGURE 1 Changes in the rate of driving license holders by age and birth cohort, all surveys combined - Male

Sources: INSEE, SOeS, IFSTTAR-DEST, National Travel Surveys of 1973, 1981, 1993 and 2007.

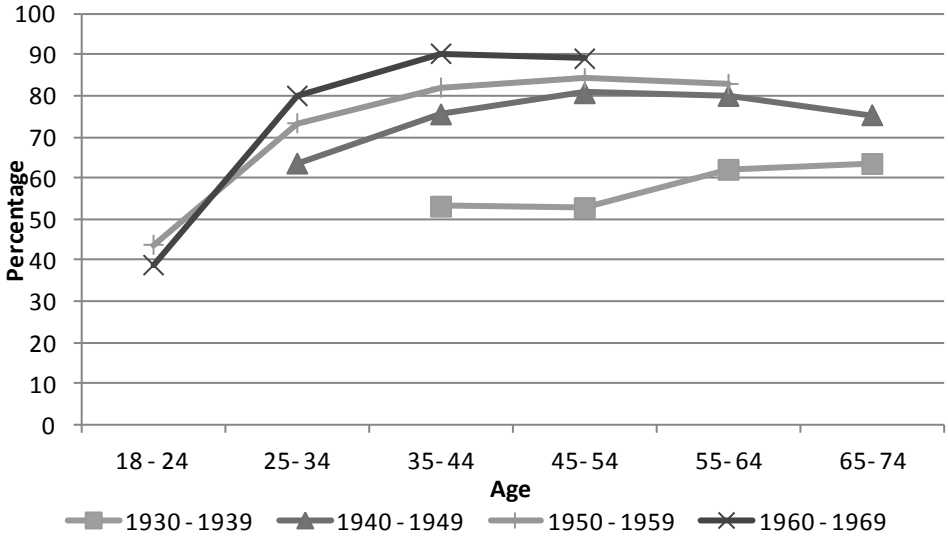

FIGURE 2 Changes in the rate of driving license holders by age and birth cohort, all surveys combined - Female

Sources: INSEE, SOeS, IFSTTAR-DEST, National Travel Surveys of 1973, 1981, 1993 and 2007.

The decrease in the age to obtaining a driving license and the increase in the proportion of driving license holders in recent decades are two phenomena that can be found for both genders. However, the amplitude of the phenomena is not the same for both genders. Men are more numerous to have their driving license and get it on average younger than women at all ages.

THE PAID EMPLOYMENT OF WOMEN PARTICIPATE TO THE MULTI-EQUIPMENT OF THE HOUSEHOLD

Cars have penetrated our lifestyle in the last century. The household motorization is marked by two major evolutions (Figure 3). The first is linked with the acquisition or not of a car by the household. In 1966, slightly more than half of households had a car. This proportion is more than 80% in 2007. The motorization had a strong growth in the 60s and 70s. The new generations have replaced progressively older generations who had less access to the car and driving licenses. The second evolution is linked

with the number of cars available in each household. The proportion of multi-car households increases continuously. In 1966, less than 6% of households had at least two cars. In France, the multi-equipment experienced its strongest growth in the 1970s. Today, more than a third of households have at least two cars.

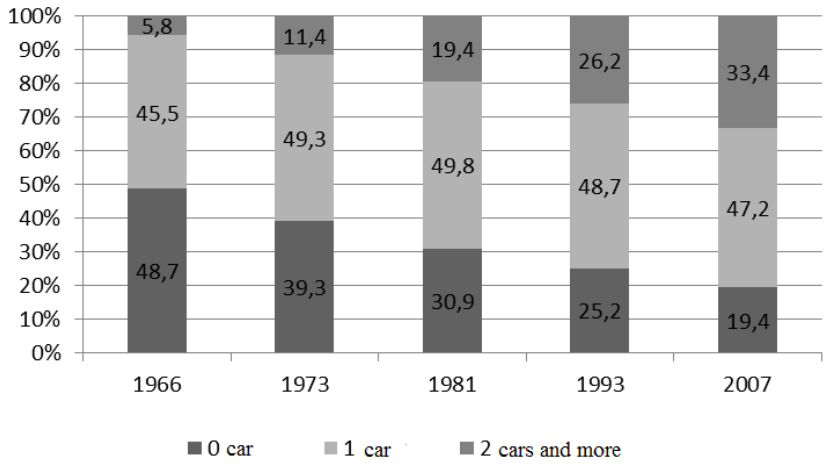

FIGURE 3 Evolution of car-ownership by households.

Source : INSEE, SOeS, IFSTTAR-DEST, National Travel Surveys of 1973, 1981, 1993 and 2007et (*6*)

The area of residence is the first cause of motorization of the household. The likelihood of having a vehicle is much lower than the residence area is densely populated (*7*). In 2007, the number of adults in the household and area of residence are priority elements taken into account by the household for having another vehicle in the household (*7*). The number of cars is more dependent on the number of assets in the household that the number of adults, the first having evolved over the past forty years. In 1973, 38% of households were composed of only one active against 29% in 2007. Two reasons explain this decline over time. Firstly, the increase of women on the labor foster the increase in the number of assets in the household (31% of households were composed of two assets in 1973 against 35% in 2007) and secondly, the proportion of households without assets increases due to the aging of the population (25% of households had zero assets in 1973 against 32% in 2007). The increase in paid employment of women and the urban sprawl participated in multi-household equipment.

In addition, the dual activity of the couple, and the remoteness of the place of home to work, have fostered the purchase of a car for the wife to manage activities at home and go to his workplace.

PERSONS ALONE ARE MORE AND MORE MOTORIZED

The larger the household the greater the average number of vehicles per household is important (Figure 4). Since 1973, the average number of cars per household, whatever its size, has increased. Over the period 1981 and 2007, the average number of cars per household has increased by 0.3 point for one-person households and 0.6 for those of two persons and three persons and more. However, given the initial levels, the single-person households have the highest growth rates between these 2 dates: 90% on the overall of the period against 63% for two persons households and 31% for larger households size.

Since 1973, the population of the single-person households has evolved[3], in the same time that the lifestyles, which may explain the significant increase of the average number of vehicles for these households.

The evolution of the ratio "number of vehicles" to "number of people in the household" shows that whatever the size of the household, cars are less used collectively by their members. We see the same result with the ratio "number of vehicles" to "number of adults in the household". The measurement of the occupancy rate[4] of vehicles for trips from Monday to Friday is also in decrease. With French National Travel Surveys, Quetelard (*8*) showed that this rate was stable in 1981 and 1993 with 1.32 persons per car, but decreased in 2007 with 1.22 persons per car. The car, which was previously a family transport mode, tends towards a use more and more individualized.

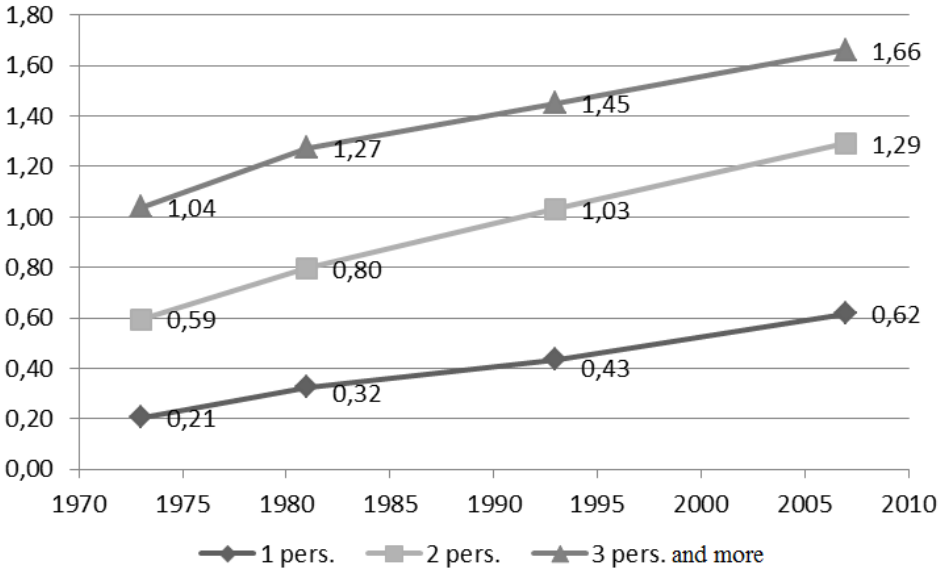

FIGURE 4 Average number of cars per household by household size at different period.
Source: INSEE, SOeS, IFSTTAR-DEST, National Travel Surveys of 1973, 1981, 1993 and 2007

The analysis of rate of car ownership per household type (Table 1) reveals two distinct groups: households with couple, where the rate of car ownership is much higher than one car (only since 1993 for childless couples) and households with one adult (single-person or single parent), where the rate of car ownership is less than one car per household.

When the household reference person is a woman, household is much less equipped with cars compared to a man (0.65 car by household against 1.40 for men in 2007). One reason is that the average size of households with a reference person "woman" is smaller compared to a reference person "man": 1.5 against 2.6 in 2007. 70% of woman at the head of their households live in a one-person household and 15% in a single-parent family, the latter being more motorized than women alone. It could be explained by the under-motorization of women in general and by an age effect. Women alone (because of widowhood in particular) are mainly older than 55 years. Even though their motorization increase with time and the renewal of generations, these women are less motorized compared to women alone aged between 25 and 54 years.

[3] According to national travel surveys, in 1973, the typical profile of a person living alone was a woman, her average age was about 60 years old, retired and widowed. In 2007, the typical profile of a single person is a female, her average age is over 54, active and single.
[4] The measurement of the occupancy rate is defined as the number of trips made by car divided by the number of trips made by car as a driver.

Table 1 Evolution of the rate of motorization per 100 households, according to the type of household.

	1973	1981	1993	2007
Person alone	20,6	32,5	43,5	61,7
childless couple	61,9	85,0	108,7	137,8
Couple with a child	100,9	125,8	148,7	174,4
Couple with 2 children	108,6	137,2	158,5	177,4
Couple with 3 children and more	104,6	128,7	142,4	168,6
One-parent family	NS	NS	80,9	91,6
Other cases	96,2	99,7	119,6	135,0
Ensemble	73,5	90,9	104,7	119,9

NS = not significant

Source : INSEE, SOeS, IFSTTAR-DEST, National Travel Surveys of 1973, 1981, 1993 and 2007

THE MOTORIZATION RATE ACCORDING TO THE HOUSEHOLD LOCATION

The motorization has increased for households in peri-urban areas, and predominantly rural area outside Ile-de- France with an annual average growth between 1981 and 2007 ranging from about 1% to just over 2% by area of residence (Table 2).

Outside Ile-de- France, households in predominantly rural areas are less motorized than households in peri-urban communes. This may be explained by the age structure of the population, which is the main cause. People with less than 65 years tend to live in more suburban communities and people with 65 years and over live predominantly in rural areas.

The distinction “downtown or suburban” and “rural town” brings us additional information: residents of rural communities have a motorization rate higher than the inhabitants of the inner city suburbs or whatever the dominant space. This is due to a lack of supply of transit services and more scattered in sparsely populated areas. The same goes for the Ile -de- France: the more we move away from Paris, more people are motorized. Our results result here what is called the “car dependency”.

From 1981 until now, the majority of households own only one car, whatever their area of residence. However, two exceptions: Parisians and inhabitants of suburban towns outside Ile-de-France. Parisians are those who have the least often a vehicle available in their household. Since 1990, Parisians seem to sell their vehicles. Almost 6 out of 10 households Parisians do not have a vehicle in 2007. Residents of peri-urban towns outside Ile-de- France have opposite strategy of household equipment in vehicles. From 1981 until now, they increased their rate of motorization. In 2007, it was more commom for peri-urban households to have two or more cars than only one. The main reason is that vehicles are in those areas necessary to reach work or facilities. Public transport networks are indeed less developed than in urban centers.

Households in the suburb of Paris has a motorization rate virtually unchanged since 1981: between 0.8 and 0.9 vehicles per household. The distribution of the number of vehicles per household is also , stable, nearly one-third do not have particular vehicle, half have a single vehicle and the rest of the households of two or more vehicles.

Area of residence plays an important role in household equipment in passenger cars. Over the population density of the area of residence is low, most often in households with a car or more. Household car ownership is also related to the supply of public transport available near the place of residence. This offer is decreasing as we move away from city center, so households tend to be equipped with one or more vehicles based on the distance of their residence from the city center (*9*). The engine also depends on household size, because the size of households living on the edge is larger than that of households residing in the center.

We also note since 1993 decrease of motorization rates in Paris and suburbs, as well as a slight slowdown in the spread of the automobile in greater Paris, and in small suburban towns outside Ile-de-France.

Table 2 Rate of motorization in private cars for 100 households according to the residential areas. (considering the same statistical zoning from 1999)

Residential area	1981	1993	2007	Average evolution 1981-93	Average evolution 1993-07
Île-de-France					
Paris	56,7	61,8	49,0	0,73 %	-1,64 %
Inner suburb	83,0	89,7	87,0	0,63 %	-0,22 %
Suburb	104,2	115,0	126,3	0,81 %	0,67 %
Urban area without the Paris area					
Pôle urbain					
Urban center	85,8	92,2	98,6	0,60 %	0,48 %
Suburb	102,0	115,7	131,0	1,06 %	0,89 %
Monopolarized town					
Urban center and suburb	104,0	123,9	153,1	1,47 %	1,53 %
Rural town	106,6	130,7	157,9	1,72 %	1,36 %
Multipolarized town					
Urban center and suburb	90,4	118,5	135,7	2,28 %	0,97 %
Rural town	93,5	123,1	157,7	2,32 %	1,78 %
Rural areas without the Paris region					
Urban center and suburb	90,4	105,8	116,5	1,32 %	0,69 %
Rural town	91,5	109,5	138,1	1,51 %	1,68 %

Field : All the households, private vehicles
Source : INSEE, SOeS, IFSTTAR-DEST*, French National Travel Surveys 1981, 1993, and 2007*

YOUNG SINGLE WOMEN MOTORIZED RUN THROUGH ON AVERAGE ALMOST AS MANY KILOMETERS THAT YOUNG SINGLE MEN MOTORIZED IN 2007

Between 1973 and 2007, the number of cars has increased substantially causing logically with him a strong increase in the circulation of the whole fleet (2.9% per year for the summation of the mileage of all cars) (Table 3), the most important increase of between 1982 and 1993 (4.1% per year). This increase has an impact on the average annual mileage per household and per household equipped. In contrast, the average annual mileage per car is subject to variations more or less strong. The oil crises of 1973 and 1979, causing the rise in oil prices, largely explain the lower average annual mileage per car between 1973 and 1982. The increase of mileage between 1982 and 1993 can be attributed to the decline in oil prices during the oil countershock occurred in 1986. But since 1993, we observe a decline in the average annual mileage per car which can be explained by the increase in fuel costs, but also by the development of multi-motorization, individualization of the vehicle and the number of types of use more and more restricts of the car.

Table 3 Evolution of the average annual mileage per car

Mileage ...	1973	1982	1993	2007
… of the whole fleet (billions of km)	149	197	305	390
… average per household (km)	8565	10111	13354	14683
… average per household equipped (km)	14109	14626	17848	18209
… average per car (km)	11659	11117	12751	12289

field : all cars (used and non-used) available in the households
Source : INSEE, SOeS, IFSTTAR-DEST, *French National Travel Surveys of 1973, 1981, 1993 and 2007*

Whatever the year, couples with child(ren) run through on average more kilometers than other types of households (Table 4). Then follow childless couples, one-parent families and persons alone (men alone run through an average more kilometers than women alone, and whatever the age). The low mileage observed for one-parent families and persons alone is due to the fact that the average takes into account the households non-equipped with a car. But these two types of households have the lowest rates of car ownership.

The distinction with the average kilometers per household equipped highlights several heterogeneous populations that the general average cache, especially among persons alone and one-parent families (Table 5). We see that one-parent families run through in average almost as many of kilometers than childless couples (except in 2007). In 2007, women less than 34 run through in average almost as many kilometers than men at the same age. With increasing age, the differences are more important. It could be explained by an age effect. Young women alone use more their car in 2007 than previous generations who had later a car in their household. Women under 35 years in 2007 will likely use more their car in the advanced ages than women 50 and more in 2007.

Table 4 Evolution of the average annual mileage per car, according to the type of household

Average mileage per household (km)	1973	1982	1993	2007
Person alone…	2466	3602	4962	6619
…Man	4927	6755	7609	8604
…Woman	1310	1962	3412	5295
…Man - Less than 34 years	10285	9459	9691	8585
…Man - Between 35 et 49 years	5208	9755	8761	9667
…Man -50 years and more	1993	3655	5572	7927
…Woman - Less than 34 years	5966	7331	6616	8080
…Woman - Between 35 et 49 years	4582	5428	8957	7859
…Woman - 50 years and more	412	681	1910	4037
Childless couple	6893	8670	12725	16072
Couple with child(ren)	12605	15156	20667	23408
One-parent family	5811	6988	10125	10816

field : all cars (used and non-used) available in the households
Source : INSEE, SOeS, IFSTTAR-DEST, *French National Travel Surveys of 1973, 1981, 1993 and 2007*

Table 5 Evolution of the average annual mileage per car, according to the type of household equipped with a car or more

Average mileage per household equipped (km)	1973	1982	1993	2007
Person alone…	12198	11409	11721	11364
…Man	12904	12975	13231	13148
…Woman	11122	9379	10201	9909
…Man - Less than 34 years	17909	15346	16095	14331
…Man - Between 35 et 49 years	10262	15348	14017	13865
…Man -50 years and more	8670	8965	10501	11957
…Woman - Less than 34 years	14744	11903	12495	13312
…Woman - Between 35 et 49 years	11875	9607	12872	11518
…Woman - 50 years and more	7312	6454	7955	8294

Childless couple	12221	12014	15150	17404
Couple with child(ren)	15080	16676	21938	24306
One-parent family	12210	12599	15349	14642

field : all cars (used and non-used) available in the households
Source : INSEE, SOeS, IFSTTAR-DEST, *French National Travel Surveys of 1973, 1981, 1993 and 2007*

COMMUTING TRIP: INCREASE IN THE DISTANCES[5] TO GET TO THE WORKPLACE

In France, seven out of ten assets work outside their municipality of residence in 2007, they were less than one in two in 1973. As a result, the average distance from home to fixed place of work has not stopped to increase. It was an average of 7.7 km in 1973 and 14.6 km in 2007, an increase of nearly 1.9% per year (Table 6). The strongest increase was observed between 1981 and 1993 with longer of distances traveled of 3.8% each year in average. Although women travel on average fewer kilometer to get to their place of work (they are more often employed in their municipality of residence), the distance that they cover has increased by 118% between 1973 and 2007 against 86% of men. The more frequent use of the car by women allows them to search a job in a remote distance from their home. The assets are looking for a job that matches their qualifications, training or professional choice in larger employment areas and therefore distant from their residence.

People living in Ile de France have always done more kilometers to get to their place of work that people living outside the Paris region. However, the differences are diminishing: people living in Ile de France goes 1 kilometer further than people living outside the Paris region in 2007, against 2-3 kilometers before 1981. In Ile-de-France, the Parisians have the shorter distances of trip (6.8 km on average in 1973 to 9.1 km on average in 2007), people living in large crown, the longer (13.3 km on average in 1973 to 20.4 km on average in 2007).

Table 6 Average distance to go from home to fixed place of work outside the home, in kilometers

	1973		1981		1993		2007	
	Man	Woman	Man	Woman	Man	Woman	Man	Woman
Île-de-France	10,3	8,3	12,4	9,7	16,3	12,0	17,4	13,6
	9,4		11,2		14,2		15,5	
...Paris	7,4	6,0	7,8	7,8	9,4	6,6	11,3	6,9
	6,8		7,8		7,9		9,1	
...small crown	9,9	7,4	10,7	8,6	12,1	10,0	13,5	10,5
	8,7		9,8		11,1		12,0	
large crown	14,2	12,2	17,0	13,1	21,7	16,9	22,7	18,3
	13,3		15,3		19,5		20,4	
outside the Paris region	8,3	5,0	9,7	6,5	17,4	10,5	16,0	12,9
	7,2		8,4		14,2		14,5	
All	8,7	6,0	10,3	7,3	17,1	10,8	16,3	13,0
	7,7		9,1		14,2		14,6	

field : assets with a job and a fixed place of work outside the home
Source : INSEE, SOeS, IFSTTAR-DEST, *French National Travel Surveys of 1973, 1981, 1993 and 2007*

The distribution of distances from home to the work place shows that between 1973 and 2007 short trips (less than 5 km) are becoming scarce in favor of longer. The proportion of employed men and women doing less than 5 miles to get to work was halved between 1973 and 2007. At the same time,

[5] The distance is defined as that which separates the home to the place of work, taking into account any detours made along the way (Madre & Maffre 1997).

the proportion of employed persons working 20 to less than 80 kilometers from home has doubled for men, and more than tripled for women.

The lengthening of distances from home to the work place is a consequence of the rarefaction of the model "live and work in the same city", actual for the last two decades of the twentieth century (*10*). According to the socio-professional category, the assets live more or less far from their fixed place of work outside the home. Farmers, followed by artisans, merchants and business leaders are those who are working closest to their home. Employees and laborers also travel fewer kilometers on average than executives and superior intellectual professions or intermediaries. By their more skilled jobs, they tend to be less evenly distributed over the territory that employees or laborers (*11*).

… BUT DURATIONS[6] OF DISPLACEMENT RELATIVELY STABLE

Although average distances to go to the work have greatly increased, the average lengths have remained relatively stable: their report indicates that trip speeds have increased. The massive use of the car for this type of trip is one of the main reasons for the stability of time means trips. In 2007, women are as numerous as men to use the car to get to the workplace (72%). In fact, the fastest modes of transport allow to "conquer" space: the more we live far from the centers (and our employment), the more we do kilometers (this is also valid for other mobility, since people live in less dense areas) and most often it is by car, and as a result, the more we consume, the more we emit pollutants and greenhouse gas emissions (*10*). In 2007, the average travel time from home to a fixed place of work is extended by more than 2 minutes compared with 1973 (Table 7). Men are most affected: between 1973 and 2007, the duration of their commuting trip has increased by 13.5%, against 7.6% for women. Women always take on average less time than men to reach their workplace. The average duration gap between the two sexes, which had tended to increase in 1981 and 1993, has reduced in 2007.

The distinction between people living in the Ile-de-France and those living outside the Ile-de-France highlights two heterogeneous populations that the general average cache. The people living in Ile-de-France take on average about 14 minutes longer than people living outside the Ile-de-France to get to work (for a time-budget stretched more than 75% for the first compared to the second). The longer times of transport for people living in the Ile-de-France (despite the distances similar to those observed for people living outside the Ile-De-France) are due to travel speeds more slow due to greater use of public transport and the difficulty of circulation in car[7].

Table 7 Average time to go from home to fixed place of work outside the home, in minutes

[6] Duration is defined as the time between leaving home and arriving at the place of work, including the waiting when changing modes of transport (*12*).

[7] Note however that in the case of the Ile-de-France, the difficulty of circulation is not homogeneous in terms of the density and thus of covered distance in Ile-de-France.

	1973		1981		1993		2007	
	Man	Woman	Man	Woman	Man	Woman	Man	Woman
Île-de-France	30,7	30,9	31,6	29,5	33,7	33,1	34,2	33,4
	30,8		30,6		33,4		33,8	
...Paris	31,0	28,0	28,1	26,4	30,0	31,0	31,1	30,9
	29,7		27,3		30,5		31,0	
...small crown	29,6	30,4	32,2	31,0	30,7	31,9	33,2	33,5
	29,9		31,6		31,3		33,3	
large crown	31,5	NS	33,2	32,3	36,8	35,2	36,4	34,2
	34,1		32,8		36,1		35,2	
outside the Paris region	17,6	15,9	17,9	16,4	20,8	16,9	20,2	18,6
	17,0		17,3		19,1		19,4	
All	20,4	20,3	20,9	19,8	23,6	20,8	23,1	21,9
	20,3		20,5		22,3		22,5	

field : assets with a job and a fixed place of work outside the home
Source : INSEE, SOeS, IFSTTAR-DEST, *French National Travel Surveys of 1973, 1981, 1993 and 2007*

WOMEN TRIPS PROFILES REMAIN PARTICULAR

Using the FNTS, we constructed a typology (Ascending Hierarchical Classification) based on the data collected from 18,632 randomly selected individuals (56,172,951 weighted individuals). These individuals were asked to give precise information about their mobility the day before being surveyed. In other words, all their movements (duration, motivation, mode etc.) were recorded. Crossing types of mobility behaviour with the gender then made it possible to establish the spread of different types of behaviour according to the gender.

There are thus a total of 55,949,000 weighted individuals who are representative of the whole of France.
The Ascending Hierarchical Classification carried out here allows five groups of individuals to be established which have similar behaviour in terms of mobility.

We have found 5 types of mobility. The types of mobility represented in the classification are as follows (all figures are expressed in averages):

- Individuals with very little mobility, who travel little and who have small distance budgets (Class 1);
- Individuals whose movements are similar to the national average (3 trips within the group, compared to the French average of 3.14 trips daily). These individuals travel at an average speed of 32.4 km/h, covering 5.3 km per trip (Class 2);
- Individuals whose movements are similar to the national average (3.14 trips per day, compared to 3.6 in this group), at a speed of 25.4 km/h, covering an average of 14.9 km per trip (Class 3);
- Individuals with high mobility (7.1 trips per day), but covering relatively short distances, compared to the number of trips (29.2 km per day) at a speed of 21.2 km/h (Class 4). The average trip of these individuals is 4.1 km;
- And, lastly Class 5, which includes individuals with greater mobility than the national average (5.5 trips per day), but covering larger distances (distance budgets being 133.6 km), at a speed of 57.7 km/h. The average trip for this group of individuals is 24.3 km.

Regarding these types of mobility, the literature, and results presented above, we may suppose that socio-economic differences between individuals cause different forms of mobility behaviour. Women, for example, are over-represented in Class 4 (58.14%, compared to 51.62% for the population as a

whole). This is a class in which most trips are carried out close to home. In contrast, men are over-represented in Class 5, which is characterised by relatively long and fast trips (56.2% of the class are men, compared to 48.38% of the overall population). That means that daily mobility patterns of women are different from those of man.

It is however interesting to notice that, even if we notice differences between women and men, the spatial characteristics does not seem to play such important role. Indeed, we may observe that all behaviour types are smoothed across the French metropolitan territory. It is also the case for people living in inner Paris, who are over-represented in the difference classes: 21.44% of Parisians belong to Class 1; 47.11% to Class 2; 20.22% to Class 3; 9.79% to Class 4; and 1.45% to Class 5 (altogether, inner-city Parisians made up 3.58% of the sample).

CONCLUSION

The increase in the number of women with a driving license is one of the consequences of the dissemination of driver's license. Their mobility behavior has changed over the last century.

Indeed, changing forms of employment and reintegration of women into the world of paid employment were a vector of mobility. The increase in the number of workers and the relocation of work outside the municipality of the place of residence increased the number of obliged trips. According to the National travel Survey 2007, 72% of men and women have used the car to make trips from home to work. The diffusion of driving license to women and growing access to a second car in the household (that women help to finance) participated in the massive use of the automobile.

However, even if mobility patterns of women have changed over the last decades, we observe that their mobility behaviours are not similar to those of men. We may explain this by job preferences, and the time dedicated to children cares. Further research may include a comparison of time-use surveys among men and women. Our results also highlight the important of differentiated transport policies for men and women.

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Gender Appraisal of Mobility Patterns and Instances of Exclusion for Working Population in Delhi

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ABSTRACT

Internationally many studies have brought to light the differences in mobility patterns of men and women but the nature and scale of differences however depend on continent, country, culture and context. Studies examining these differences are still scarce in India. The paper is based on an ongoing study undertaken by Central Road Research Institute (CRRI) and School of Planning and Architecture (SPA), Delhi. The project aims to understand if mobility differences, among male and female workers, are symptomatic of gender based transport exclusion.

The first part of the study explored how key mobility indicators vary for men and women belonging to the formal workforce. Comparisons were also made for respondents across the entire socio economic spectrum to understand how the interaction of gender and income impacted mobility. The second part of the study used these findings to diagnose instances of transport related exclusion among the female workforce of Delhi.

The study found that on an average, female respondents had limited access to private modes of transport, used slower modes of travel and their work-home distance was significantly less. Interestingly, these differences between males and females were found to be more significant in lower and middle-income households. The study also concluded that a cocktail of exclusions due to lack of time, opportunity, affordability, security and poor geographic location exists against women. These forms of exclusions, originally discussed by Church et al *(1)* are interlinked and debilitate women, especially in lower and middle-income groups, from pursuing a better career.

INTRODUCTION

An increasing body of evidence suggests that men travel differently than women across the world. Various studies conducted worldwide have established that women travel differently than men (*2,3*). It is well known through studies conducted in UK, US and Sweden that travel patterns for women are more complex as trips made by women are shorter, more frequent and may include chaining in line with their diverse roles. However, these differences vary from continent to continent and culture to culture. In developing countries, these trends remain more of a tacit understanding, with evidence trickling in slowly. Rosenbloom and Fraissard (*4*) articulate

> 'Our review of gender and travel in developed and developing countries reveals two versions of the same story, across time and space, women often have unequal access to better transport services, display very different travel patterns, and face more fear and anxiety in traveling than do comparable men. These differences reflect both cultural values and norms and the heavier family and sustenance obligations that women often assume or are assigned.'

In developing countries, inequality between genders is evidently higher and so is the importance and absence of transport options. The role of urban women in India is changing and about one fifth of them are engaged in paid work (*5*). International evidence suggests that when women take up paid work, the responsibilities at home do not get shared. Instead, their role expands and they end up taking a wide array of responsibilities both at work and home. While this situation may be easier to navigate for women who are better off financially, economically weaker women may be more severely excluded than their male counterparts. In India, a fast developing nation, with its ever-increasing gap between the rich and the poor it would be safe to assume that mobility patterns would also vary greatly across the economic spectrum. Research by Anand (*6*) and Roy (*7*) has brought to light issues related to gendered mobility of the economically weaker women. There is, however, a dearth of a comprehensive study of mobility of Indian women ranging from all economic classes, comparing them to their male counterparts. This study, through extensive surveys, will try to bridge that gap. This study attempts to question the 'obvious facts' regarding gendered mobility in urban India, specifically Delhi. In order to draw a fair comparison across genders, the study is limited to men and women with fixed income and jobs. The first part of the study checks if there is a significant difference between males and working females regarding- trip lengths, travel time and mode choice for their work commute?

The second objective of the study was to unravel if and how transport related exclusions might be affecting working women in Delhi. The study questions how gender and economic status, together, create exclusionary circumstances for women. This exclusion puts the leashes of 'paucity of time', 'commute distance' and 'safety concerns' on the career of women and limits their choices in several ways. These dimensions of transport based exclusion have been discussed in detail in the paper.

BACKGROUND

Transportation Needs of Women

In a study of an informal settlement in Delhi, Anand & Tiwari (*6*) concluded that 'women of lower-income households experience greater transport deprivations as compared with men.' She goes on to explain that these women are 'time poor' as they shoulder all household responsibilities and also use the most ineffective modes of travel. Roy (*7*) explores the 'relationship between gender, poverty, and spatial disadvantage'. She studies the case of the domestic workers of Calcutta for whom a ticketless daily commute in an overcrowded train is the only way to survive. These women, captive users of inefficient modes, form a substantial part of the informal workforce and earn the lowest wages. They are informal workers who shoulder all the responsibilities at home, do a full day worth of backbreaking work to earn a livelihood and then take the long way home, dragged into a vicious trap. They are the worst affected in this environment and, most importantly, often do not have a choice. However there is another set of women whose capabilities are not so severely debilitated. Some of these women own private

modes of travel or aspire to do so while they make their way home in a bus or metro. These women who have fixed formal jobs and incomes, are the subjects of this study. Some of these women may even have substantial support in household duties with the availability of cheap labour from the previously discussed set of 'poor women'.

A recent study reports that Delhi has a car ownership level of 157 cars per 1,000 population, the highest in India (*9*). With average trip lengths catapulting upwards and sexual crimes against women being reported everyday in Delhi use of public transport is challenging for women. Although improvements in public transport are trickling in, several problems such as lack of last mile connectivity, poor walking environment (*10*), and inequitable allocation of road space take the sheen off the sustainable options. Hence a lot depends on how these working women wield their CHOICE to buy a car, soon or in the near future or never. Car ownership, the great middle class aspiration, is increasingly being seen as a 'necessity' in Delhi. In such an environment are working women see a car as the ultimate saviour of their honour, freedom and quality of life, making them more likely than their male counterparts to acquire one?

Gendered Mobility and Exclusion

Transport inequality and associated exclusion form a very important pillar of transportation research today. In her work Lucas (*11*) discusses how transport disadvantage and social disadvantage interact directly and indirectly to create a situation where certain services, life chances, goods, decisions or social networks are inaccessible to certain groups thus creating instances of social exclusion. She talks about the role played by National Travel Surveys in identifying transport inequalities and link them back to poverty and backwardness. India, unfortunately has no system of National Travel Surveys debilitating serious and consistent research in this subject. Church et al (*1*) provide a conceptual framework for social exclusion and transport and group all factors into seven categories. The following section attempts to understand which of these factors could be applied for gendered mobility research in Delhi.

Physical Exclusion

Design of vehicles, fixed infrastructure and information barriers may not be usable by certain groups. Church explains that this usually affects people with serious physical limitations, cognitive disabilities or language problems. As an example, the overcrowded buses of Delhi certainly present a serious test of muscle during peak hours often leaving women at a loss.

Geographical Exclusion

This type of exclusion occurs when people residing in isolated, peripheral or inaccessible locations find it difficult to participate fully in the socio-economic sphere. Lack of access to cars and a rickety public transport system could debilitate women from travelling far enough to take part in desired activities. Hence home to work distance could be considered an indicator of this type of exclusion.

Exclusion from Facilities

This type refers to the distance of key facilities such as shops, schools, health care or leisure services from where a person lives prevents their access. This type of exclusion is a function of urban planning, access to private mode of transport and affordability for other modes.

Economic Exclusion
Certain groups may find travel unaffordable hence limiting their chance to access opportunities and facilities. If household and personal income patterns and expenditure priorities are studied in detail there could be a few important lessons in economic exclusion of women.

Time-based Exclusion
This is probably the most discussed factor regarding transport exclusion in gender studies. It is a tacit understanding in India that women shoulder majority of the household and child care duties. While some women may opt to hire support, in form of cheap informal 'maids' or domestic workers, others grind woefully through the day. Either way these responsibilities reduce the time available for travel hence creating a scenario of time poverty. This factor of exclusion may vary for women across the socio-economic spectrum and will be studied in detail in this paper.

Fear-based Exclusion
This is where fears for personal safety prohibit the use of transport services and public spaces. This factor is of specific relevance to our case study city of Delhi. There is a need to understand if the fear of venturing out at a certain time of day or using a certain mode of travel is seriously affecting the personal or professional lifestyle of women.

Space Exclusion
This type of exclusion occurs where certain parts of city are inaccessible to certain groups. With the increasing role of private participation in development of public and quasi public spaces in Delhi this is an emerging issues for those who 'do not fit in'. Gender inequalities have limited impact on such factors.

In case of Delhi, geographic exclusion, economic exclusion, time based exclusion and fear based exclusion are specifically important.

METHODOLOGY

In all 3000 respondents were surveyed across Delhi. A team of twelve surveyors visited various types of offices and establishments and conducted one to one interviews with the respondents. Offices and establishments of all types such as schools, hospitals, corporate offices, public offices, colleges, markets, salons etc were chosen for survey spread across all the districts of Delhi. On an average 70% of the people approached agreed to participate in the survey.

Gender and income were the two key dependent factors considered in this study. Monthly household income was used as an indicator as it gives the better picture of the economic status of an individual, especially in case of married couples. The income categories chosen were as follows:

<Rs 10,000
Rs 10,000-25,000
Rs 25,000-50,000
Rs 50,000-80,000
Rs 80,000-150,000
>150,000

During analysis and discussion income categories up to 25,000 Rupees per month have been referred to as lower income category, 25 – 80,000 Rupees per month as middle-income category and over 80,000 Rupees per month as higher income category. This categorization has been done in accordance with the norms prevalent in economic research in the country. For comparison across six income categories and both the genders, all samples were divided into twelve subcategories. Equal number of samples was used for each subcategory to ensure a representative sample, reducing the sample size to 2400, from 3000. This may have led to under representation of lower and middle-income group and over representation of the high-income groups. Similarly there may be an over representation of women in the survey sample. Of the total number of 2400 samples, 1200 samples were collected for males and females respectively. When possible care was taken to choose respondents from all subcategories in each office.

To avoid any bias in transportation connectivity, development density, policing activity and perceptions regarding security, data was collected from all nine districts of National Capital Territory of Delhi. In order to tap workers with varying travel needs workplaces with fixed and flexible work hours were selected. All age categories ranging from 15 to 65 years were adequately represented in the sample. The survey was conducted using a very detailed questionnaire for the purpose of a wider research project. Only certain data items, as detailed below, were used for the purpose of this study.

Personal and Family Characteristics
- Age/Sex
- Monthly Household Income
- Private Vehicle Ownership
- Driving License Ownership
- Woking hours-flexible or fixed
- Time spent on household chores

Travel Characteristics- for Home to Work One Way Trip
- Home Location
- Work Location
- Mode Used
- Commute Distance
- Commute Time

Perceptions About Security
- Locations or modes perceived as unsafe, instances of harassment,
- Willingness to travel alone after dark
- Precautions taken by respondents
- What improvements would make the respondents feel safer.

Others
- Does the length and quality of commute affect your quality of life?
- Have you declined/never tried for a job due to commuting distance?
- Do you plan to buy a car in the next one year /two years/five years/(never)?

EMPIRICAL RESULTS: DIFFERENCES IN MOBILITY PATTERNS AND EXCLUSION

The comparisons in select mobility indicators have been made across the twelve gender and income sub-categories to understand travel trends across the socio economic spectrum for men and women. Any significant differences have been tested as symptoms of the four types of exclusions being discussed. In some cases, the causative factors behind these exclusions; whether cultural or policy-based; have also been discussed. The study tries to take the work of Church et al (*1*) forward by analyzing how some of these exclusions may be linked with one another.

Difference in access to private modes

The access to private modes is a contentious issue. On one hand private modes are actively discouraged in planning discourse and to some degree in practice in India. On the other, even with a major overhaul of the bus system and a rapidly increasing metro network, private modes do actually promise more comfort, security and time efficiency in Delhi. Without doubt access to private modes is an 'opportunity' many in Delhi strive for. Church et al emphasize the low car availability of low-income households as a major factor in their inability to access goods and services and participate fully in society. Studies by Buhr (*12*) and Heine and Mautz (*13*) prove on the basis of qualitative studies that the car allows women to achieve more autonomy, which is often a precondition for women to do any work besides their family work. The study compares car ownership, car use and number of driving license holders between male and female respondents.

Mode Usage

In the study modes were divided into three categories:

- Private- including cars and two wheelers.
- Public- including bus, metro, auto,
- Non motorized transport (NMT)- including pure walking and cycle rickshaw trips.

A comparison of the mode usage for home to work trip across the gender and income categories revealed the following (see Figure 1):

- The use of private modes goes up for the higher income categories for both genders. Within all income categories, the percentage of women using private modes for home to work travel is significantly less than men.
- The difference in private vehicle use between men and women in the lower and middle-income groups is noteworthy (see Figure 1).
- The use of public transport is significantly less among males across all income categories.
- There is a marked difference in public and private mode usage due to the interaction of gender and income category, income being the stronger influence. A two way ANOVA test returned very strong evidence corroborating that income affects the use of public modes ($F=127.6$, $p=0.0005<0.05$). The test result also returned strong evidence suggesting that gender affects the use of public modes ($F=15.6$, $p=0.011<0.1$). Similar significant results were seen for the use of private modes.
- Use of non-motorized modes including walk and rickshaw trips is very low for both genders but marginally higher for women.

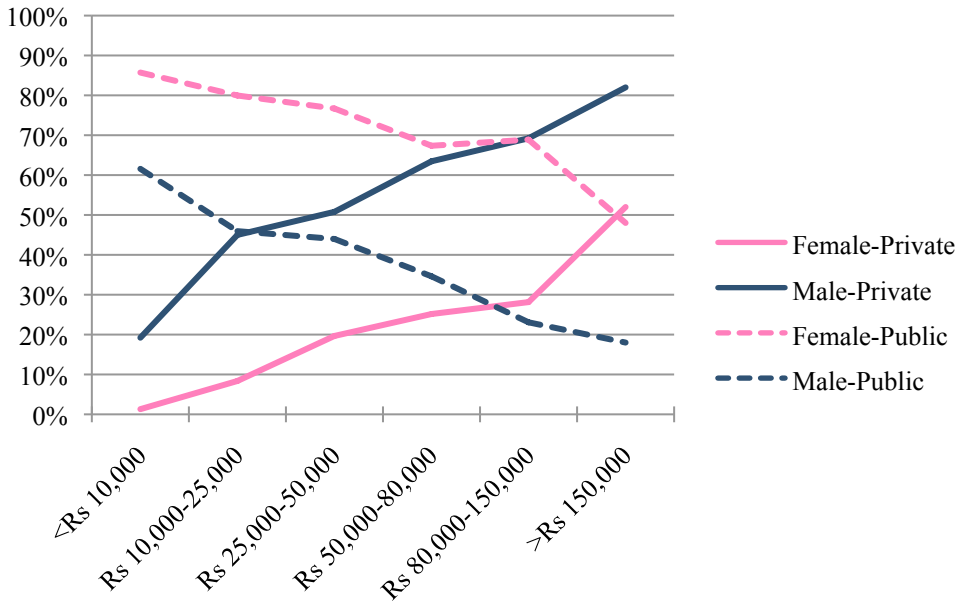

FIGURE 1 Mode Used For Home to Work Trip

Detailed analysis revealed that higher percentage of private mode use among men could also be linked to higher use of two wheelers. The use of two wheelers is very high among males in the income categories ranging from Rupees 10,000 to 80,000 per month. Use of two wheelers by women is very low. In Delhi, most of the two wheelers driven by men have engine sizes ranging from 100 cc to 500 cc. These motorcycles are affordable, easy to ply through traffic and ideal for a time and fuel-efficient long commutes. The 'feminine' version of two wheelers, called scooties, have engine sizes ranging from 100cc to 200cc. Interestingly, not many women, in Delhi, use these scooties for their commute. These scooties are very popular among women in smaller town and cities across India and provide women with mobility and freedom. The survey revealed that young women considered scooties unsafe, unsecure and uncomfortable for commuting in Delhi. Hence, these women prefer to use public transport and graduate to using cars when they want to use a private mode of transport.

Car Ownership vs Car Use

Literature suggests that access to private mode of transport could be considered as an opportunity, specifically for women. This part of the study compared if women from car owning households had equal access to cars for their work commute. 65% of males from car owning household used cars as their commuting mode. On the other hand, only 26% of women from car owning households used it for their daily commute, on an average. These figures indicate that in car owning households, men are the primary users of the private vehicles. In many car owning households women, even those who work and contribute to the household income, may be deprived of its use.

Driving License

The table below showing percentage of respondents with valid driving licenses reinforces the findings of the modal share displayed by the two gender categories. The following points can be concluded

- A Two Way ANOVA test reported very strong evidence that both income ($F=20.35$, $p=0.002<0.01$) and gender ($F=21.6$, $p=0.006<0.01$) affect the likelihood of owning a driving license.
- Significantly lesser women own a valid driving license, especially in the lower and middle-income categories.
- On comparing figure 1 and figure 2 we find that of all the driving license holders, only 2 in 7 women use cars for their work trips on an average. On the other hand, among males 2 in 3 male driving license holders use cars for their work trips.

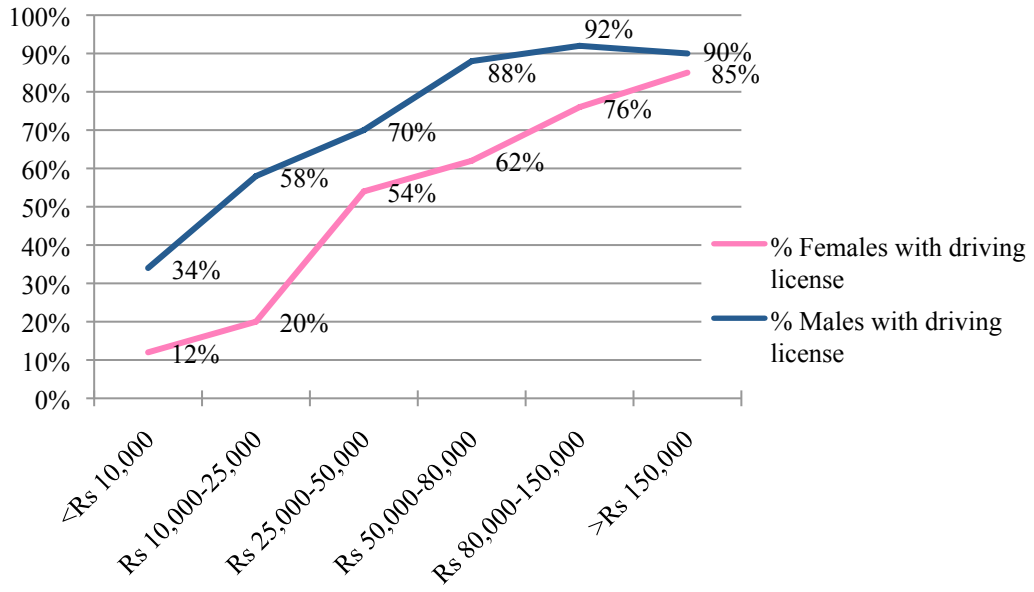

FIGURE 2 Respondents With a Valid Driving License

Exclusion due to lack of opportunity

As discussed earlier access to private modes of transport could be considered an opportunity in a city like Delhi where the public transport system is significantly lacking comfort, safety and flexibility. The three indicators analysed above suggest that working women in Delhi do not have equal access to this opportunity due to various reasons. These findings resonate the trends reported by Rosenbloom et al (*4*). In the lower income categories, it was seen that men found 'motorcycles' as their passport to cost effective and flexible mobility. The same was not true for women. In most tier-2 cities of India, scooties are the increasingly popular mode among working women. Hence, would it be too far fetched to say that the hostile nature of traffic in Delhi and rising rate of crimes against women are all acting together to keep Delhi women away from accessing a cost effective and environment friendly mode of transport?

Even in households that could afford car ownership, only a quarter of women respondents used it for their work commute. On the other hand more than two third of the men from car owning households were the primary car users. Data revealed that especially in lower and middle income

households, which have single car ownership, men seem to be claiming right to the car. These working-women, contribute financially to running the household, but when it comes down to 'who will take the car today?' they end up commuting by bus. It can be concluded that these women suffer from exclusion from the opportunity to have a smoother, safer and quicker ride home.

Difference in Travel Time

On computing, average one way commute distance and travel time across gender-income subcategories the following observations were made:

- In case of both gender categories, monthly household income has a very significant impact on the average travel time per kilometer. As the income goes up, travel time per kilometer goes down (Figure 3). A two way ANOVA revealed very strong evidence showing the interaction between income and average travel time per kilometer ($F=5.2$, $p=0.002<0.01$- 99% confidence).
- The travel times for study exclude time taken for trip chaining stops. Hence, on combining the findings of figure 3 and figure 1, we can safely conclude that any difference in travel time per kilometer is dependent upon the mode used and time taken for interchange.

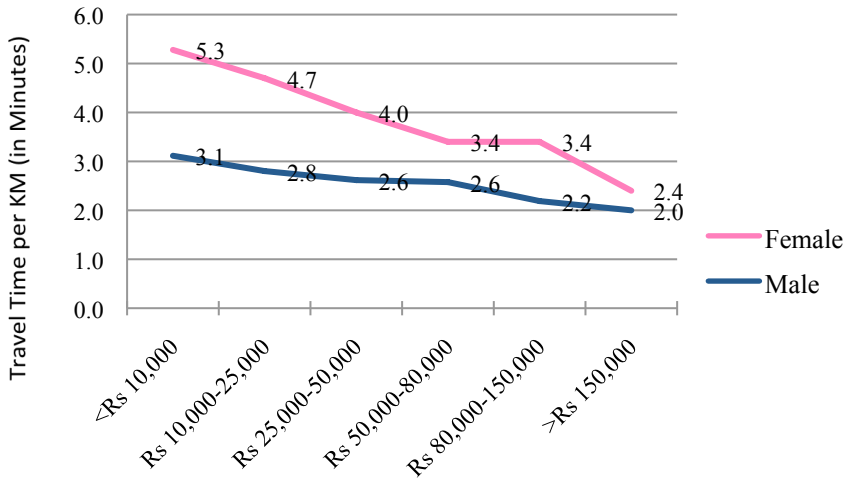

FIGURE 3 Travel Time (Minutes) per Kilometer

- In general, women seem to be making slower trips than men. The two way ANOVA revealed suggestive evidence for interaction with gender ($F=0.22$, $p=0.08<0.1$, 90% confidence)
- Figure 3 shows that the data line for females is steeper. Hence, the impact of monthly household income on travel time per kilometer is more pronounced for women than men.
- The difference between average travel distance of men and women is more pronounced in the lower and middle income categories. This coincides with the higher use of public transport and non motorized modes by women in the lower and middle income categories as shown in Figure 1.

Time-based Exclusion

When we discuss time-based exclusion, there are two sides of the story to consider. The first is about the higher travel time per unit distance for women. This can be linked to the use of slower modes by women as discussed under 'exclusion due to opportunity'. Women, especially in lower and middle income groups, use more public transport than men. These modes are definitely slower than cars and require several interchanges and walking to and from stops. Hence, women are spending more time than men in the unpaid task of commuting. Crane (*14*) also reports similar differences in an American study where the difference in travel time varied by gender and ethnicity. He links this to modal split citing that over the years, decrease in transit use among women has made their journeys faster.

The second face of time-based exclusion is about the availability of time for 'paid work'. Extensive research shows that women from dual earner households from across the world, even in the most egalitarian countries, are often loaded with lion's share of household responsibilities, which seldom get shared (*3,15,16*). The study questioned the respondents about the time they spend daily in household chores. No significant difference was found among various income groups. However, women spent 3.5 hours per day on household work while men spent only 1.5 hours on an average workday. Women respondents spent over 15 hours per day on office work, commuting and household work all combined together. For men this figure was also similar at 16 hours per day. This means that while women spent more time in unpaid tasks such as commuting and household work than men, they spent considerably less time at paid work. Due to the limitation of time these women also remain excluded from participating in better jobs that require them to work longer or travel longer. These women may not be able to maximize their earning potential as much as men. To corroborate this we found that the number fixed one was significantly higher ($\chi 2=54.8612$, $P= 0 < 0.01$). As opposed to 40% of the women respondents, only 26% of the males were engaged in flexible jobs. In addition to this, with a paucity of free time available, these women face a form of exclusion that limits them from pursuing leisure activities and affects their quality of life. Over 75% of the female respondents thought that the time and effort required by their work commute severely affects the quality of their life.

Perception About Safety and Security

Off late Indian cities, specifically Delhi has been infamous regarding unsafe travelling conditions for women. Local newspapers, replete with news about incidents ranging from 'eve-teasing' and 'chain-snatching' to severe crimes like rape with commuting women, are bound to affect the female psyche. The survey revealed that:

- Over 90% of women respondents had experienced some form of harassment while travelling.
- On an average only 15 percent of the women respondents are willing to travel alone after dark in Delhi. This is significantly less than 92% of men who are willing to travel alone after dark. 28 percent of women would consider traveling alone after dark 'only if necessary' while 57 percent of women do not travel alone after dark. Willingness to travel alone after dark was marginally higher among women from higher income categories, probably due to higher use of car as mode of transport.
- 82 percent of women feel that they need to dress differently when they take public transport. This includes dressing more conservatively and avoiding wearing expensive jewelry items. Detailed talks with respondents revealed that they do this to avoid undue

attention from stalkers, eve-teasers and potential 'chain snatchers'-all of whom are common nuisance factors on Delhi roads. On the other hand only 18% of men feel the need to dress differently when they take the public transport. The freedom to choose the way we dress without fear is a basic right, which all should be able to enjoy. Any system, which does not allow a certain section of people to do so, is exclusionary.

- The survey revealed that over 65% of the women take some form of precautionary measure to 'be safe' during their commute. These attempts include keeping a can of pepper spray handy, travelling with small knives in their handbags and very surprisingly, sporting long and sharp nails for self defence.

Fear Based Exclusion

If the fear of getting stalked, robbed, stared at, commented upon, groped or raped keeps women from travelling longer distances and wear what they like, freely during the day and evening, to all areas of the city, we can conclude that this form of exclusion is occurring. Women, especially in Delhi, are so attuned to the idea of taking measures to ensure their personal safety that the same becomes a critical factor in making decisions about their career and the commute it requires. Literature suggests that security concerns may limit women from using certain transit services (*3*). Although this study does not provide enough evidence to conclude this, but many women may be purging certain job options specifically because of safety concerns related to commuting. This may be leading to a situation of fear-based exclusion that then gets combined with all the other forms of transport-based exclusion.

Home to Work Distance

A cross tabulation of home to work distance was done for males and females across the six income categories. Figure 4 below shows the average distance from home to work computed for each gender cross tabulated against the monthly household income categories. It revealed that the average distance between workplace and home ranged from 6.0 to 14.1 kilometers for women from the poorest and the wealthiest households respectively. For male respondents, the average distance ranged from 10.1 to 14.8 kilometers.

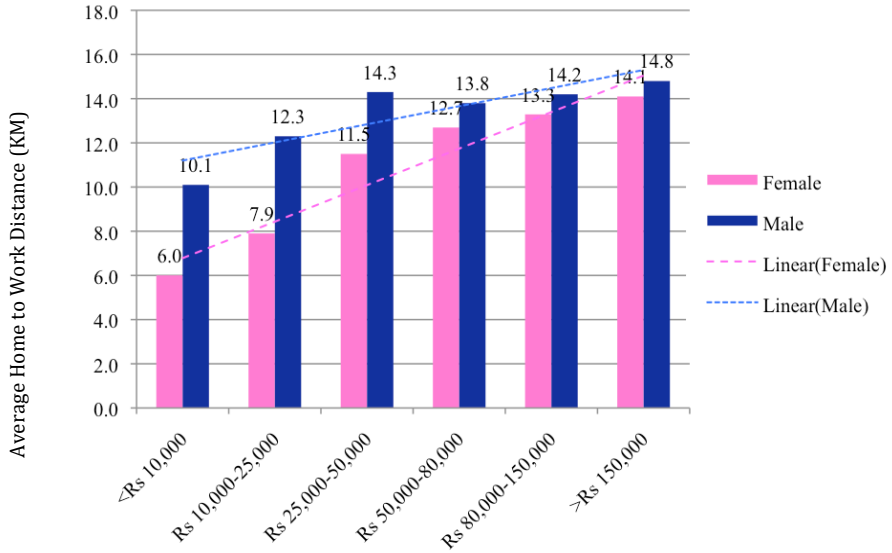

FIGURE 4 Average Distances for Home to Work Trip (In Kilometers)

A two-way ANOVA test was run to find whether (and how) the distance from home to work depended upon gender and household income. It showed that there is very strong evidence that the distance depended upon household income ($p=0.009<0.01$). However, it also showed that moderate evidence existed to suggest that home to work distance is not independent of gender ($p=0.03<0.05$). Hence, men seem to be making longer work trips than women. As the work distance statistic for women respondents show a greater variance than their male counterparts we can conclude that change in financial condition of household has a greater impact on women.

Geographic Exclusion

This trend is a symptom of geographic exclusion of women, specifically women belonging to lower income categories. Church et al (*1*) enunciate that distance travelled is a valid indicator of transport related exclusion. This form of exclusion debilitates women from participating in job locations farther way from home. In order to derive conclusive evidence regarding this form of exclusion respondents were asked if they had ever declined or given up a better job because of the commute distance. The study results show that the instances of declining a job due to commuting distance were significantly higher among women (χ^2 (df=2, N = 2400) = 249.35, $p=0 < 0.01$). While over 70% of the female respondents had at some point in their life declined or given up a better job due to commuting distance, only 40% of males had to do the same. This strongly proves that geographic exclusion may be a reality for many women. The results also show that this form of exclusion is higher for lower income women possibly because:

- less available money to choose more efficient modes to increase their radius of movement;
- lack of time, due to heavy household responsibilities, to commute farther; and
- greater security concerns as they travel by public modes making them more vulnerable.

IN CONCLUSION

The mobility patterns of men and women are a reflection of their social position. In the strictly patriarchal society like Delhi, the study found a marked difference between the two sexes in terms of modes used, length of commute and average time spent per kilometer. The impact of monthly household income on all three indicators was found to be significant. The impact of income was more pronounced in case of women than in case of men. Although, women in higher income categories have mobility patterns that are not very different from their male counterparts, these differences get magnified in case of lower and middle-income households. Women with higher incomes are able to break the cultural clichés and exert their rights. These women enjoy lives not very different than their male counterparts. They possess the freedom to travel longer distances to work their desired jobs and move around efficiently and safely.

In order to understand the impact of gender and income on transport-related exclusion, we need to qualify what we mean by exclusion here. Exclusion would mean not getting to do what you want to do because you are a woman. It would mean not being able to participate in life, society and the world as a whole person. Rather, your participation is limited due to factors governed beyond your control. It would mean that while another person may be enjoying every freedom and possibility, you have only limited options because you wear a skirt, or are primary caregivers of your kids or have to cook the dinner.

When it comes to easy mobility, there is no doubt that personal modes of transport are better than the public transport options in Delhi. Hence limited access to personal modes of transport would mean limited mobility. Women, especially those in lower and middle income households, remain excluded from exercising control on time efficient mobility resource aka the family car. Households with two wheelers also see them being used primarily by men for their commute. The additional excluding factors in this case are safety and security concerns. The masculine motorbikes suitable for Delhi's traffic and flyover-ridden terrain are difficult for women to ride. Women-friendly two wheelers, locally called 'scooties', are considered unsafe by the women of Delhi. In effect, due to these factors women remain excluded from using flexible and time efficient modes of travel. This in turn breeds other forms of exclusion.

With women in low and middle income groups using less time efficient modes, as discussed above, they end up spending more time in public transport, or waiting for their spouses to pick them up. The study also revealed how women in low and middle income groups spend significantly more time in domestic work. With the combination of these two factors, these women may be having less time available excluding them from opportunities to engage in paid work and personal recreation.

Owing to less available time and use of less efficient modes, it is not surprising that women are not able to travel as far as men do for work. It is interesting how the gap between distance travelled between men and women reduces as we move up the economic ladder. Hence women in low and middle income group are able to travel only shorter distances which in turn limits their career options. This is reinforced by the fact that a significantly higher percentage of women in the lower and middle income groups have given up or not considered better job options owing to commuting woes. This clearly shows how transport related exclusion may be leading to exclusion from desirable economic activity for women. Similarly security concerns regarding travelling alone after dark may be excluding women from jobs and activities that require extended work hours and travelling freely to areas not perceived safe.

A careful scrutiny of the indicators of the four types of exclusion discussed above reveals that these exclusions are interlinked. For example, women may be travelling shorter distances due to paucity of time and lack of availability of car. On the flip side, women may not be able to claim their right on the sole car of the household, as their work place is closer to home. Some women may be spending more time on the unpaid task of commuting as they may be taking the bus, which they perceive safer and more secure than using a scooty in Delhi. Each link between these various forms of exclusion is worth exploring and needs detailed research. A cocktail of these factors severely debilitates women and limits their working potential, especially in the lower and middle-income groups. Data corroborates this as significantly higher percentage of women (than men) have given up better careers to stay close to their homes.

Several other factors may be exacerbating transport related exclusion of women. Does a certain section of women put their domestic identities before any professional ambitions? Is gender based transport related exclusion worsened by the patriarchal family structure and unquestioned supremacy that males enjoy in certain households? In addition to this, the ideals of women regarding their 'most important role' whether professional or personal may also be affecting their decisions to travel less. Although not discussed in this paper, it would be interesting to see how these factors differ from culture to culture.

Research shows that over the years, car ownership among women has risen very quickly, sometimes even faster than men (*17*). Even in India, as the female automobile consumer is an emerging market with infinite demand. With double incomes, easier car loans and snail-paced improvements in transit services women seem eager to buy their own cars (*9,15*). Our study results revealed that over 65% of female respondents (against 56% male respondents) in the lower and middle-income categories aim to buy their own four-wheeler in the next two years. If this is true, Delhi is sitting on a congestion time bomb! With the National Urban Transport Policy of India pushing to 'move people, not vehicles' efforts are afoot in Urban India to limit the rise in private car use. This is the time of change in India when millions are being pumped into public infrastructure such as Metro and Bus Rapid Transit systems. It is important if men and women have specific transportation needs, they are met and met quickly.

NOTE

1. 1 Euro = 85.37 Indian Rupees as on 28 February, 2014

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Gender and daily mobility:
Did the gender gap changebetween 1996 and2006 in the Québec urban area?

Responses to the comments

English had to be improved, so a translator revised the paper.

Itwasunclear, for a reviewer, if the trends detected between the two survey years were statistically significant.Results from statistical tests on differences between the two survey years could not be included on schedule. We added a mention about that limitation in the conclusion part of the paper.

One weakness of the study, raised by a reviewer,was the method of survey data collection in which one member of the household responds for all members. Another mention has been added about that weakness in the conclusion part of the paper.

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Abstract

Gender differences in daily mobility have been an issue in transportation studiesin recentdecades.Researchers are looking for potentially explanatory variables that canimprove our understanding ofthe gaps between men's and women's daily travel patterns.Using data based on Origin-Destination surveys (O-D), this study analyzesthe evolution of gender differences in the daily mobility of men and womeninthe Québec urban area between 1996 and 2006, with particular reference to trip chaining.Most of theresults obtainedwere consistent withfindings reported in the literature. Women make considerablymore daily trips than men, but these trips are on averageshorter in distance and travel time. Men, significantly more than women,drive cars or use bikes and makemore work and education-related trips,whereas women tend to travel more as car passengers, use public transport or walk.Their daily mobility is more frequentlyfor household necessitiessuch as groceries, shopping anddriving other people around. Moreover, women are more likely than men to trip chain, and their trip chains tend also to be more complex – with more intermediate stops – than those of men.

Introduction

Recent decades have seen a number of major changes takingplace in our society, withgrowing numbers of women joining the work force, the tertiary sector playing an increasingly important role in the economy,and suburbs becoming not simply places to live but also to work. These changes have affected bothcitystructures and the way people travel,as can be seen inthe increasinguse of cars (*1*). Yet the changes have not impactedon men and women in the same way, as illustrated by the fact that women's wages are still often lowerthanthose of men and that women are more likely to hold part-time jobs (*2,3*).The increased presence of women in the labour force has added work-relatedresponsibilities to thefamily and householdresponsibilities they already shoulder(*4,5*).In many cases, this dualrole leadsthemto work closer to home to limit their travel time (*6*)so as to better respond towork, family and householdneeds.Access to cars – and possible better management of their trips – is more ofa challenge for women because of their lower wages, lower numbers of driver's licences held and the greateruse of family vehicles by the men of the household (*3,7, 8*). However, there is no general agreement among researchers on what is known asthe "household responsibility hypothesis" (*2,9-11*) because of the difficulties inherent in measuring household responsibilities and taking into account every potentiallyexplanatoryvariable (*3, 12-16*). Nonetheless, in spite of the differences of opinion, one fact is widely recognized: men covergreater distances and spend more timeinwork-relatedtravelthan women (*2,7, 8, 11, 14-22*).

What do recent data show?

Gender differences in personal mobility are often analyzed usingthree criteria: the number of trips made, distance travelled and travel time. Both for North America and Europe, two prominent trends emerge from the literature. On the one hand, women make more trips than men(*23-29*) and are also more likely to trip chain (*23, 26*). On the other hand, on average men travel greater distances and spend more timetravellingthan women (*24, 26-28, 30-34*).

Some travel modes and trip purposes are more characteristic of men, others of women. On the whole, men tend to drive cars or travel by bike, whereas women travel more often as car passengers, use public transport orwalk (*27, 28, 33, 35, 36*). In addition, women make more trips for passengers (mainlychildren), for shopping or for personal and family errands (*23, 25-28, 35*),while men still make more work trips than they do(*29, 35*).There are however, some circumstances when men tend to make more daily trips than women. In Germany, single men travelon average more often than single women (*27*).This is also the casefor British men between 50 and 60 years old(*35*).

If women generally make more trips than men, these trips remain shorter in distance and travel time(*24, 26-28, 30-34*). Worktrips, which constitute a significant proportion of daily trips for both genders, are markedly longer for men than for women (*24, 27, 29-35, 37-42*).This is the kind of situation where different contexts can lead to different outcomes. In the United States, in 2000, unemployed women aged between 40 and 59 travelled, on average, greater distances than their male counterparts. Travelling greater distances was also the case for women living in households comprised of two adults or more,where the youngest child was aged between 6 and 15 (*24*).Furthermore, Crane (*32*) findsthat,in the United States, increases in distancestravelled for work between 1985 and 2005 were relatively greater for women than for men. The same situation was observed in Great Britain in the 'nineties(*35*).

Trip chaining

The international literature reveals that women tend to trip chain more than men, and thattrip chains,composed of more than one intermediate stop (*23, 26*), are generally more complex for women.The data show that women stop on average 50% more often than men between their places of work and their residences. A proportionately higher number of women are likely to make at least one or two intermediate stops, for whatever reason. In fact, in every type of trip chain (home to home, home to work, work to work and work to home) women make more intermediate stops than men (*23*).

McGuckin and Nakamoto (*26*) report that the primary purposes ofstops made between homesand work places are to 1) transport passengers, 2) dofamily and personal errands and 3) buy a coffee or a meal. On the return home from work, the main purposes are to 1) make purchases, 2) transport passengers and 3) runfamily errands. In all cases, it is the women who stop more often. Even when men added more stops to transport passengerswhile trip chaining, women are still the main group to engage intrip chainingbehaviour. In fact, women in employed-couplehouseholds are twice aslikely asmen to drive children to or from school.

Since trip chaining is less often taken into consideration in travelpatterns, the significanceof the present studylies in its analysis of gender differences in the context of trip chaining.

Objectives and hypothesis

The primary objective of this study wasto determine whether trends in gender differences in daily mobility were observablein the results for the Quebecurban area on the basis of mobility surveysfor 1996 and 2006. More specifically, we analyzed daily mobility and its evolution for those yearsbased onthe number of trips, distance travelled and travel time, broken down bytravel mode, trip purpose, age, occupational status, household composition, residential location and the number of cars owned by the household. We also analyzed and compared men's and women's trip chaining behaviourfor both years with reference to distances travelled and travel timesand the number of intermediate stops – these being the defining features ofcomplex trip chains.

Our literature review led toour first hypothesis, that gender differences still remained in 2006 but that the gap was less significant compared to 1996 in terms of travel mode choices, trip purpose, distance travelled and travel time. Our second hypothesis wasthat women are more likely to trip chain than men and that these trip chainstend, in turn, to be more complex, in view of the number of intermediate stops madeanddistances travelled.

Data and methodology

For a more complete description of data and methodology used in this study, interested readers can consult the Master's thesis on which this study is based (*43*).

Data used in ourstudy come fromQuebec City O-D surveys of 1996 and 2006. Collected every five years since 1977 by the government transportation department (the*Ministèredes Transports du Québec)* in collaboration with transit agencies, these surveys collect information about all trips made by residents of a giventerritory overa typical working day (Monday to Friday)in the fall. Data are collected by telephone interviews from a representative sampling of approximately 10% of households. Stratified systemic cluster samplingis the method used for the analyses. The sample is spatially stratified among a certain number of areas of analysis broken down on the basis of different criteria and by age group. Expansion factors defined by Statistics Canada can be applied to the samples to estimate mobility behaviours for the entirepopulation.

However, these expansion factors were not applied in the context of the presentstudy as to avoid skewing the tests of assumption by increasing the number of degrees of freedom.

The surveys are in three parts. The first part collectshouseholdinformation, such as the number of vehicles and the geographic location of the residence. The second part identifies household data such as gender, age, occupation, location of the workplace. The last part collects details of trips made by members of the household: time of departure, trip purpose, travel mode choices, origin and destination data.Responses are provided by one of the adult members of the household, who describes trips made by all household members. Data on trips made by children under the age of 6 are not collected, since it is assumed that these children travel with an older person.

Some data usedin our study do not come directly from O-D surveys. Household respondents are not asked about distances travelled and travel times.Information on the shortest routes between the place of origin and destination was derived by researchers at Université Laval's *Centre de recherche en aménagement et développement*and the *Accès à la Cité* research team using GIS transportationsoftware.While these data clearly differ from real distances and travel times, they do provide a more realistic picture than Euclidean distance measurements and can be used to establish an overview of key trends, such as positive or negative changes in the behaviour patterns analyzed,when results are compared.Similarly, residential location was determined usingcluster analysis based on ten census tract variables while household composition was derived from dataon the peoplein those households.

The original 1996 O-D survey contains167,943 records representing 25,102 households, 60,940 people and 153,959 trips. After some filtering, the sub-sample used in this study refers to21,773 households, 42,966 peopleand 137,293 trips. The 2006 O-D survey originally contained224,639 records representing 33,859 households, 78,207 peopleand 209,849 trips. After some filtering in this case as well, the final sub-sample refers to28,367 households, 58,067 peopleand 192,122 trips.Over the years, the sizeof the urban area under analysishas changed. To ensure that comparisons are valid and are not weakened by changes between 1996 and 2006 in the size of the urban area in question, the areacovered by this study is the same as the oneused for the 1996 survey onresidential locations and commuting destinations.

Tests of proportion differenceswere used to compare and measure the significativity of differences in travel modes and trip purposes.For the same reason, tests of mean differences were used to comparethe number of trips,distances travelled and travel time for men's and women's trips. Multiple linear regression models were applied to explain variations in distances travelled and travel time for both sexes. In the trip chaining analyses, tests of proportion differences and mean differences were alsoconductedin reference tothe number of trip chains and intermediate stops. A binary logistic regression model was usedto measure the probability of men and women respectivelyundertakingat least one trip chain compared to none. For those who trip chained at least once, a second binary logistic regression model was applied to calculatethe probability of their using complex trip chainswith more than one intermediate stop, compared to simple trip chains with only one intermediate stop. Mean trip chain distances and travel timewere analyzed using tests of mean differences. Lastly, the impact of the number of trip chains on total distances travelled and travel time for daily trips wasmeasured using multiple linear regression models.

Results

The first sectionof the results described below presents a broad overview of the daily mobilityofmen and women: number of trips, distances travelled and travel time,whereas the second part shows the results in terms of trip chaining.

Number of trips

Firstly, in considering theproportion oftrips made by men and women, broken down by travel mode, we find that gender differences were significant for almost all travel modes in both 1996 and 2006 ($\alpha = 0.05$).Men, driving their cars or using bikesmade a significantly greater number ofdaily trips than women whereas women travelled more than men as passengers in cars, or by walking or using public transport. The gender gap increased between 1996 and 2006 for those who walk or use bikes while it narrowedfor the other travel modes, although the gap remains significant.

Men and women also travelled for different purposes, although the differences aresignificant for only a small percentage among them ($\alpha = 0.05$).Asreported in the literature, men travel markedly more than women for work or study purposes.Conversely, women make a far greater number of trips to transportpassengersand for shopping purposes. Between 1996 and 2006, the gender gapdecreased for work and recreationaltrips while it increased for studies, for shopping and for transporting passengers.

In 1996, there was no significant difference between the mean numbers of daily trips made by men and women: 3.21 and 3.18 respectively. In 2006, the difference became significant ($\alpha = 0.01$), with women making more daily trips than men:3.33 compared to3.28.

In terms ofage groups, some differences persistedbetween 1996 and 2006. Women aged between 25 and 44 made on average significantly more daily trips than men of the same age ($\alpha = 0.01$) and the gender gap increased over this period.Men aged between 55 and 74 made more daily trips than women of the same age($\alpha = 0.01$), although the gap narrowedbetween the two survey years.The gender gap was particularly evident in 2006 for women aged between 20 and 24 and for men aged 75 or more ($\alpha = 0.01$).

When they worked full time,or part time, only in2006,women made on average farmore daily trips than men. The converse stands forretired men for both 1996 and 2006 ($\alpha = 0.01$).Between the two periods surveyed, the gender gap increased for people in the labour forceand decreased for retired people. There was, however, no observable gender difference between the mean numbers of daily trips made for study purposes.

We found, in reference to household composition, that women in households with oneemployedadult,with children, or in single-parent families,made more trips than their male counterparts in 1996 ($\alpha = 0.05$) and 2006 ($\alpha = 0.01$) while this was true only in 2006 for women in households with two employed adults, with children ($\alpha = 0.01$). Conversely, men in households with twoemployedadults,without children,andthose living alone made significantly more daily trips than women inboth survey years. The gender gap increased in households with twoemployedadults,with or without children, in households with oneemployedadult,with children, and in single-parent families.

Whena household does not own a vehicle, there wasno observable difference in the mean numbers of daily trips made. When ahousehold ownsone vehicle, men made more trips than women in 1996 only ($\alpha = 0.01$). In the case of households withtwo vehicles,women made significantly more trips than men in the two periods surveyed ($\alpha = 0.01$), although in 2006 this

was the case only for households with 3 vehicles or more ($\alpha = 0.01$). The gender gap narrowed in households with one or no vehicle and increased in households with two vehicles or more.

There were also observable gender differences, although primarily in 2006, in terms of place of residence.Women made, on average, significantly more daily trips than men when they lived in new suburbs orperipheral urban areasin 2006 ($\alpha = 0.01$). Thiswas also the case when they lived inold suburbs in 1996 ($\alpha = 0.05$), but the situation had changed by 2006. When they lived downtown, men and women made similar numbers of daily trips, whereas the gender gap increased for people living in new suburbs and in peripheral urban areas.

Distances travelled and travel times

While women on average makemore daily trips than men, the latter make significantly longer trips. Table 1shows the average distances travelled and travel timeformen and women in 1996 and 2006. Average distances travelled and travel timesdecreased between 1996 and 2006 for bothsexes. The gender gap decreased for distances and increased for travel times.

TABLE 1MeanDistances Travelledand Travel Times for Men and Women in the QuebecUrban Area in 1996 and 2006

	1996			2006		
	M	**W**	**Sig.**	**M**	**W**	**Sig.**
Distance travelled (km[1])	**8.1**	7.3	**	**7.8**	7.0	**
Travel time(minutes)	**9.6**	9.3	*	**8.9**	8.6	**

* Significant at 0.05

** Significant at 0.01

[1]1 km = 0.62 mile

The multiple linear regression model in Table 2shows, after controlling for household composition,place of residence, number and age of children in the household,number of vehicles, occupational status of household members, times of departure, travel mode and trip purpose, that women travelled 8% less distance than men in 1996 ($B = -0.082$; $p < 0.000$) and 5% less in 2006 ($B = -0.053$; $p < 0.000$).It should be noted that the dependent variable (distance) was converted intothe natural logarithm (ln) in order to express the coefficients as percentages; the same procedure was used for the travel time model.Women's travel time for trips was about 6% shorter than that ofmen in 1996 ($B = -0.067$; $p < 0.000$) and 5% shorter in 2006 ($B = -0.05$; $p < 0.000$). It should also be noted that the same variables wereappliedfor the travel time model and that, in general, the results are similar to thosefor distance travelled.

TABLE 2MultipleLinear Regression Model for the Average Distance Travelled by Men and Women in the QuebecUrban Area in 1996 and 2006

	1996					2006				
	R^2	R^2aj.	DF	n	Sig.	R^2	R^2aj.	DF	n	Sig.
	0.365	0.365	27	72,494	0.000	0.39	0.39	26	105,307	0.000
Dependent variable: Distance (ln)	**B**	**E. S.**	**Beta**	**t**	**Sig.**	**B**	**E. S.**	**Beta**	**t**	**Sig.**
Constant	8.874	0.018		480.21	0.000	8.729	0.016		543.361	0.000
Number of vehicles	0.115	0.006	0.073	20.47	0.000	0.035	0.005	0.023	7.68	0.000
Time of departure	-0.043	0.003	-0.054	-14.41	0.000	-0.040	0.002	-0.049	-16.10	0.000
Gender (0: Male, 1: Female)	**-0.082**	**0.008**	**-0.033**	**-10.64**	**0.000**	**-0.053**	**0.006**	**-0.021**	**-8.34**	**0.000**
Household composition (Ref: 2 employed adultswith children)										
Single-parent family	-0.101	0.017	-0.020	-6.01	0.000	-0.029	0.015	-0.005	-1.94	0.053
Person living alone	-0.080	0.015	-0.021	-5.22	0.000	-0.029	0.013	-0.007	-2.17	0.030
1 employed adultwith children	0.044	0.014	0.011	3.10	0.002	–	–	–	–	–
Other	-0.024	0.012	-0.009	-2.12	0.034	0.054	0.010	0.020	5.48	0.000
1 employed adult without children	0.029	0.019	0.005	1.51	0.131	0.036	0.012	0.009	3.09	0.002
2 employed adultswithout children	0.008	0.015	0.002	0.51	0.612	0.053	0.013	0.013	4.23	0.000
Residential location (Ref: Downtown)										
Periphery	0.235	0.015	0.056	16.00	0.000	0.551	0.012	0.157	45.65	0.000
New suburbs	0.064	0.011	0.023	5.77	0.000	0.345	0.010	0.128	33.08	0.000
Old suburbs	0.032	0.010	0.013	3.14	0.002	0.114	0.010	0.043	11.53	0.000
Number of children										
Between 6 and 15 years old	-0.094	0.006	-0.060	-15.94	0.000	-0.074	0.005	-0.049	-16.13	0.000
Between 16 and 20 years old	0.052	0.007	0.025	7.49	0.000	0.063	0.006	0.027	9.94	0.000
Up to 6 years old	–	–	–	–	–	-0.316	0.016	-0.049	-19.59	0.000
Occupational status (Ref: Employed full-time)										
Retired	-0.279	0.015	-0.068	-18.27	0.000	-0.147	0.011	-0.043	-13.24	0.000
Other	-0.082	0.015	-0.019	-5.36	0.000	-0.087	0.015	-0.016	-5.79	0.000
Employed part-time	-0.036	0.015	-0.007	-2.37	0.018	-0.097	0.016	-0.015	-6.02	0.000
Student	-0.025	0.016	-0.008	-1.60	0.110	-0.046	0.013	-0.014	-3.61	0.000

	1996					2006				
	R^2	**R^2aj.**	**DF**	**n**	**Sig.**	**R^2**	**R^2aj.**	**DF**	**n**	**Sig.**
	0.365	0.365	27	72,494	0.000	0.39	0.39	26	105,307	0.000
Dependent variable: Distance (ln)	**B**	**E. S.**	**Beta**	**t**	**Sig.**	**B**	**E. S.**	**Beta**	**t**	**Sig.**
Travel mode (Ref: By car as driver)										
Walk	-1.892	0.013	-0.510	-140.44	0.000	-1.879	0.011	-0.495	-173.42	0.000
Bike	-0.894	0.048	-0.056	-18.61	0.000	-0.796	0.033	-0.059	-24.23	0.000
Public transport	0.172	0.015	0.039	11.13	0.000	0.296	0.013	0.061	22.32	0.000
By car as passenger	0.022	0.011	0.006	1.91	0.056	-0.061	0.010	-0.018	-6.38	0.000
Trip purpose (Ref: Work)										
Other	-0.388	0.012	-0.151	-33.49	0.000	-0.326	0.014	-0.070	-24.13	0.000
Transport of passenger(s)	-0.465	0.021	-0.076	-22.66	0.000	-0.479	0.011	-0.128	-42.31	0.000
Studies	-0.233	0.018	-0.067	-12.67	0.000	-0.295	0.015	-0.074	-19.32	0.000
Shopping	-0.135	0.017	-0.029	-7.93	0.000	-0.555	0.011	-0.174	-49.52	0.000
Recreation	-0.120	0.021	-0.020	-5.83	0.000	-0.240	0.012	-0.071	-20.38	0.000

– : No data

Trip chaining

Trip chaining is considered here as being a series of trips made between two anchors, generally theplace of residence and workplace, with at least one intermediate stop. Table 3 shows that women on average made significantly more trip chains and more intermediate stops than men in 1996 and 2006. Mean numbers increased during that period and the gender gap narrowedfor the number of trip chains and slightly increased for the number of intermediate stops.

TABLE 3Numberof Trip Chainsand Intermediate Stops made by Men and Women in the Québec Urban Area in 1996 and 2006

	1996			2006		
	M (n = 20,760)	**W** (n = 22,206)	**Sig.**	**M** (n = 27,898)	**W** (n = 30,169)	**Sig.**
Number of trip chains	0.67	**0.78**	**	0.77	**0.85**	**
Number of intermediate stops	0.84	**1.00**	**	0.98	**1.15**	**

* Significant at 0.05
** Significant at 0.01

In fact, as can be seen in Table 4,the proportion of men doing no trip chainingwassignificantly higher than that of womenin both 1996 and 2006 but a higher percentage of women made one or two trip chains.The respective proportionof men and womendoing no trip chaining decreased between 1996 and 2006 but increased for men making one or two trip chains, decreased for women making one trip chain and increased for those making two trip chains. The gender gap decreased for those who made one or no trip chain.

TABLE 4Distributionof the Number and Proportion of Trip Chainsmade byMen and Women in the QuebecUrban Area in 1996 and 2006

Number of trip chains	1996			2006		
	M	**W**	**Sig.**	**M**	**W**	**Sig.**
0	10,424	9,172	*	12,566	11,836	*
	50.2%	41.3%		**45.0%**	39.2%	
1	7,530	9,604	*	10,643	12,623	*
	36.3%	**43.2%**		38.1%	**41.8%**	
2	2,131	2,680	*	3,540	4,388	*
	10.3%	**12.1%**		12.7%	**14.5%**	
3	543	602		897	1,026	
	2.6%	2.7%		3.2%	3.4%	
4	104	118		190	224	
	0.5%	0.5%		0.7%	0.7%	
5	21	25		47	58	
	0.1%	0.1%		0.2%	0.2%	
6	5	5		12	11	
	0.0%	0.0%		0.0%	0.0%	
7	2	0		3	3	
	0.0%	0.0%		0.0%	0.0%	
Total proportion	100%	100%		100%	100%	
Expanded data	237,367	246,657		277,473	283,615	
Sample data	20,760	22,206		27,898	30,169	
Relationship between gender and number of trip chains	$\chi 2 = 351.693$ $p < 0.000$ $C = 0.09$			$\chi 2 = 205.183$ $p < 0.000$ $C = 0.059$		

* : Significant at 0.05

Table 5 shows that when trip chaining takes place(no intermediate stop meaningno trip chaining), a higher proportion of women than men in both 1996 and 2006 madeat least one intermediate stop, although this was markedly the case only in 2006 for 5 or more intermediate stops.The proportion of trip chains generally increased between 1996 and 2006, except for women making just one intermediate stop. The gender gap narrowedfor people making 2 or fewer intermediate stops and increased for people making at least 3 intermediate stops.

TABLE 5Distributionof the Number and Proportion of Intermediate Stops made by Men and Women in the Québec Urban Area in 1996 and 2006

Number of intermediate stops	1996			2006		
	M	**W**	**Sig.**	**M**	**W**	**Sig.**
0 stop	10,424	9,172	*	12,566	11,836	*
	50.2%	41.3%		**45.0%**	39.2%	
1 stop	6,266	7,730	*	8,691	9,713	*
	3.2%	**34.8%**		31.2%	**32.2%**	
2 stops	2,396	3,105	*	3,769	4,646	*
	11.5%	**14.0%**		13.5%	**15.4%**	
3 stops	972	1,285	*	1,548	2,079	*
	4.7%	**5.8%**		5.5%	**6.9%**	
4 stops	377	530	*	694	998	*
	1.8%	**2.4%**		2.5%	**3.3%**	
5 or morestops	325	384		630	897	*
	1.6%	1.7%		2.3%	**3.0%**	
Total proportion	100%	100%		100%	100%	
Expanded data	237,366	246,656		277,474	283,615	
Sample data	20,760	22,206		27,898	30,169	
Relationship between gender and number of intermediate stops	$\chi2 = 350.365$ $p < 0.000$ $C = 0.09$			$\chi2 = 260.616$ $p < 0.000$ $C = 0.067$		

* :Significant at 0.05

Binary logistic regression models for trip chains (see Appendix 1) and for intermediate stops (see Appendix 2) show, after controlling for household variables (age group, occupational status, household composition, vehicle ownership rate, motorized household or not and the presence of children of different age groups), that women weresignificantly more likely to make at least one trip chain in 1996 and 2006 ($p < 0.000$). Moreover, among those making at least one trip chain, women werealso more likely to make at least two intermediate stops – so creatingmore complex trip chains – in 1996 and 2006 ($p < 0.000$).

In the daily mobility section of the study, we found that men's average trip lengthswere considerably higher than those of women.In trip chaining, while distances travelledremained significantly greater for men in 1996 and 2006, the gender gap decreased (Table 6).

TABLE 6AverageDistances Travelledand Travel Times of Trip Chains Made by Men and Women in the Québec Urban Area in 1996 and 2006

	1996			2006		
	M	**W**	**Sig.**	**M**	**W**	**Sig.**
Distance travelled(km)[1]	**16.6**	15.2	**	**15.0**	14.3	**
Travel time(minutes)	17.7	17.3		16.3	16.5	

* Significant at 0.05

** Significant at 0.01

[1]1 km = 0.62 mile

Finally, Tables 7 and 8 show that gender, the total number of daily trips, the number of trip chains and the residential location affect total daily distances travelled and travel times.In addition to againobserving that women tend to travel shorter distances and for shorter travel times than men (about 15% less in 1996 and 10% less in 2006), readers will also remarkthat the number of trip chains tendedto increase daily travel distances in 1996 by approximately 2% but toreduce

these distancesby 4% in 2006.However,it is interesting to notethat it is the number of trip chainsthatmost influences the time spent on total daily travel.In fact, total time spent on traveltendedto dropby 19% and 18% respectively in 1996 and in 2006 when the number of trip chains increased.

TABLE 7MultipleLinear Regression Model forTotal Daily Distances Traveled by Men and Women in the QuebecUrban Area in 1996 and 2006

	1996					2006				
	R^2	R^2 adj.	DL	n	Sig.	R^2	R^2aj.	DL	n	Sig.
	0.093	0.093	6	42 959	0.000	0.209	0.209	6	58 060	0.000
Dependant variable: Total daily distance (ln)	**B**	**E. S.**	**Beta**	**t**	**Sig.**	**B**	**E. S.**	**Beta**	**t**	**Sig.**
Constant	8.969	0.017		512.72	0.000	8.262	0.015		545.11	0.000
Sex (0: Male, 1: Female)	**-0.151**	**0.011**	**-0.07**	**-14.15**	**0.000**	**-0.103**	**0.009**	**-0.04**	**-11.90**	**0.000**
Total number of trips	0.193	0.004	0.28	44.11	0.000	0.243	0.004	0.37	67.63	0.000
Number of trip chain	0.024	0.009	0.02	2.74	0.006	-0.040	0.007	-0.03	-5.45	0.000
Residential location (Ref: Downtown)										
Periphery	0.366	0.021	0.10	17.51	0.000	1.114	0.016	0.36	71.10	0.000
New suburbs	0.095	0.016	0.04	5.97	0.000	0.834	0.014	0.34	60.55	0.000
Old suburbs	0.059	0.015	0.03	3.96	0.000	0.425	0.014	0.17	31.01	0.000

TABLE 8MultipleLinear Regression Model for Total Daily Travel Times by Men and Women in the Québec Urban Area in 1996 and 2006

	1996					2006				
	R^2	R^2 adj.	DL	n	Sig.	R^2	R^2aj.	DL	n	Sig.
	0.151	0.151	6	42 959	0.000	0.178	0.177	6	58 060	0.000
Dependent variable: Total daily duration (ln)	**B**	**E. S.**	**Beta**	**t**	**Sig.**	**B**	**E. S.**	**Beta**	**t**	**Sig.**
Constant	2.285	0.013		171.56	0.000	2.293	0.012		186.73	0.000
Gender(0: Male, 1: Female)	**-0.040**	**0.008**	**-0.02**	**-4.98**	**0.000**	**-0.032**	**0.007**	**-0.02**	**-4.58**	**0.000**
Total number of trips	0.264	0.003	0.48	79.49	0.000	0.271	0.003	0.52	93.21	0.000
Number of trip chains	-0.193	0.007	-0.17	-28.73	0.000	-0.181	0.006	-0.17	-30.23	0.000
Residential location (Ref: Downtown)										
Periphery	0.157	0.016	0.05	9.88	0.000	0.131	0.013	0.05	10.32	0.000
New suburbs	0.044	0.012	0.02	3.65	0.000	-0.017	0.011	-0.01	-1.48	0.139
Old suburbs	0.034	0.011	0.02	3.02	0.003	-0.104	0.011	-0.05	-9.41	0.000

Discussion

In the first part of our study, the working hypothesis was that gender differences would continue to be found between men's and women'sdaily mobility in the Quebec urban area and that these differences would beless pronouncedin 2006 than in 1996. Tests of proportionshowed that, for travel modes and trip purposes, differences persisted in 2006 but that, in certain circumstances, the gender gap was narrowing. Men travelled significantly more than women as drivers of cars or by bike, while women travelled as passengers, usedpublic transport or walked more than men. Men alsomade significantly more work trips than women whereas the opposite wastrue for shopping and personal or family errands. Moreover, tests of mean differences showed that, whatever variable was considered (age group, household composition, occupational status, residential location or number of vehiclesowned), gender differences continued to existin 2006, notably in terms ofthe number of daily trips, distances travelled andandtravel time. Women made significantly more daily trips than menbetween the ages of 25 and 44, when they worked full time, lived in a household of one employed adult with children or in a single-parent family and when they had easier access to the household car. However, in practically all cases except when the women were students, their dailytrips weresignificantly shorterin terms of distance travelled and time spent.When the variables of household composition, residential location, the number and age of children in the household, the number of vehicles, occupational status, time of departure, travel mode and trip purpose are held constant, multiple linear regression models confirm these findings.

This seemsto suggest that women'sdualroles in the form of work-related and household responsibilitiesstill influence their daily mobility patterns. Besides their worktrips, which increased in number between 1996 and 2006, women continue, more than men, toassume responsibility for household needs such as chaufferingchildren, buying groceries and carrying out errands. Our observations on travel modes, trip purposes, the mean number of daily trips and the distances and time spent intravelare in line withwhat is sometimes described as"women's spatial entrapment",as well as the household responsabilitieshypothesis, which suggests that women work closer to home so as to better manage work and household related trips, mostoften when there are children in the household.

Aparticularlyinteresting aspect of this study comes from the analysis and comparison of male and female trip chaining behaviour. The hypothesis in this regard was that women are more likely to trip chain than men and that they are more likely to make more complextrip chains, in light of the number of intermediate stops they make and the distancesthey travel. The results show that women on average madesignificantly more trip chains and more intermediate stops than men in both 1996 and 2006. It also would appear that the situation couldbe changing. We found a dropin the proportion of men making no trip chains, relative to women,and an increase in the proportion of men making one trip chain, while the proportion of women decreased. Women still make more trip chains than men, but the gap seems to be narrowing. The same holds for the number of intermediate stops. The gender gap decreased for people making one or two intermediate stops even though it increased in the case ofwomen making at least three intermediate stops.

Binary logistic regression modelsconfirm these observations while controlling for age, occupational status, household composition, residential location, level of household motorization and the presence of childrenunder 6, between 6 and 15 and between 16 and 20. These models also show that the presence of children, regardless of age, tends to reduce the probability of trip

chaining and of making complex trip chains.Contrary to what might be expected, having children does not seem to increase the likelihoodof trip chaining. Except in the case of single-parent families,it appears instead to *reduce*this propensity.In all probability,because people in single-parenthouseholds, unlike those in two-adult households,cannotcount on a second person tocarry out different family tasks, they have no choice but to trip chain andto make more complex trip chains to boot.Readers should be reminded that while these are valid models for the years in question, they should not be interpreted asproviding the full picture.Fundamentally, the models should be understood as exploratory, since O-D surveys are not normally designed with this kind of analysis in mind.A finalobservation that can be drawn from the models of the effects of trip chaining on total distances travelled and travel time is that linking trips may indeed bean effective means ofreducing total daily travel time.

Conclusion

In summary, the findings in this study allow us to confirm that a number of gender differences in daily mobility and trip chaining remained significant between 1996 and 2006 in the Quebec urban area. As the literature shows, gender is not the only variable affecting daily mobility; othersociodemographic variables also come into play. Globally, the purpose of this study, far from being wide-ranging, was simply to derive an up-to-date picture of the gender gap in daily mobility using data rarelybroken down for further analysis as we did.In particular, the results pertaining totrip chaining behaviour shed some light on an aspect of daily mobility that is less often analyzed. Nevertheless, two caveats must be kept in mind.The first is the survey data collection method, which relies on one personanswering for all members of a household. The trip chaining resultscould be particularly sensitive to this method of data collection as interviewees may not be fully aware of all the details they are being asked to describe. Also,the trends observed between the two survey years cannotbe consideredto be statistically significant,as the models were not designed for that purpose. Further modelling and inclusion of results from statistical tests on differences between the two survey years could usefully complete the analysis.

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Appendices

APPENDIX1BinaryLogistic Regression Analysis of the Probability of Making at Least One Trip Chain

	1996					2006				
Variables	**B**	**S.E.**	**Wald**	**Sig.**	**Exp(B)**	**B**	**S.E.**	**Wald**	**Sig.**	**Exp(B)**
Constant	-0.31	0.122	6.59	0.010	0.73	-0.06	0.120	0.27	0.604	0.94
Gender (0: Male; 1: Female)	**0.13**	**0.023**	**34.00**	**0.000**	**1.14**	**0.08**	**0.020**	**17.41**	**0.000**	**1.09**
Motorized household(0: No; 1: Yes)	0.50	0.055	81.84	0.000	1.64	0.33	0.050	45.04	0.000	1.40
Vehicle ownership rate	-0.19	0.026	55.15	0.000	0.83	-0.10	0.023	18.05	0.000	0.91
Age group (Ref: Aged between 5 and14)			**8.30**	**0.081**				**85.93**	**0.000**	
65 or over	0.50	0.190	7.04	0.008	1.66	0.46	0.127	13.14	0.000	1.58
Between 25 and 44	0.15	0.101	2.36	0.124	1.17	0.42	0.090	21.87	0.000	1.52
Between45 and64	0.14	0.102	1.83	0.176	1.15	0.21	0.090	5.64	0.018	1.24
Between15 and24	0.08	0.087	0.76	0.382	1.08	0.26	0.077	11.36	0.001	1.30
Occupational status (Ref: Full-time employed adult)			**1847.20**	**0.000**				**2623.44**	**0.000**	
Retired	4.49	0.174	669.57	0.000	89.50	3.94	0.094	1765.74	0.000	51.64
Other	4.39	0.134	1068.84	0.000	80.45	3.83	0.131	854.95	0.000	46.00
Part-time employedadult	0.59	0.043	183.11	0.000	1.80	0.55	0.050	122.76	0.000	1.73
Student	-0.13	0.050	7.21	0.007	0.88	-0.17	0.044	15.20	0.000	0.84
Household composition (Ref: 2 employed adults with children - Downtown)			**412.49**	**0.000**				**646.55**	**0.000**	
Single parent family - New suburbs	0.39	0.092	17.94	0.000	1.48	0.22	0.097	5.06	0.025	1.24
Single parent family - Old suburbs	0.15	0.084	3.29	0.07	1.16	0.26	0.094	7.45	0.006	1.29
Single parent family - Periphery	0.12	0.148	0.63	0.427	1.13	-0.10	0.125	0.63	0.428	0.91
Single parent family - Downtown	0.09	0.108	0.66	0.418	1.09	0.33	0.117	8.05	0.005	1.40
Person livng alone - Old suburbs	0.07	0.077	0.88	0.348	1.08	-0.25	0.087	8.06	0.005	0.78
Person livngalone - Downtown	0.05	0.1	0.29	0.593	1.06	-0.02	0.094	0.03	0.87	0.99
Person livngalone - Periphery	0.04	0.135	0.10	0.757	1.04	-0.25	0.133	3.50	0.061	0.78
2 employed adult couple with children - Old suburbs	-0.02	0.058	0.14	0.707	0.98	-0.08	0.076	0.98	0.321	0.93
Person livngalone - New suburbs	-0.04	0.088	0.21	0.644	0.96	-0.30	0.100	8.96	0.003	0.74
2 employed adult couple with children - New suburbs	-0.07	0.061	1.24	0.266	0.93	-0.10	0.073	1.91	0.166	0.90

	1996					2006				
Variables	**B**	**S.E.**	**Wald**	**Sig.**	**Exp(B)**	**B**	**S.E.**	**Wald**	**Sig.**	**Exp(B)**
2employed adult couple with children - Periphery	-0.10	0.079	1.51	0.219	0.91	-0.18	0.077	5.19	0.023	0.84
1 employed adultcouple with children - Downtown	-0.24	0.096	6.12	0.013	0.79	-0.12	0.139	0.79	0.374	0.88
2 employed adult couple without children - Periphery	-0.28	0.111	6.57	0.010	0.75	-0.78	0.093	69.13	0.000	0.46
2 employed adultcouple without children - Downtown	-0.34	0.093	13.50	0.000	0.71	-0.39	0.094	17.00	0.000	0.68
2 employed adult couple without children - New suburbs	-0.37	0.078	21.80	0.000	0.69	-0.68	0.082	70.04	0.000	0.51
1 employed adult couple without children - Old suburbs	-0.37	0.095	14.78	0.000	0.69	-0.63	0.096	43.53	0.000	0.53
1 employed adult couple without children - Downtown	-0.40	0.133	9.13	0.003	0.67	-0.46	0.119	15.17	0.000	0.63
1 employed adult couple with children - Old suburbs	-0.41	0.074	30.96	0.000	0.66	-0.23	0.099	5.43	0.020	0.79
Other - Periphery	-0.42	0.085	23.72	0.000	0.66	-0.65	0.083	60.90	0.000	0.52
2 employed adult couple without children - Old suburbs	-0.44	0.070	38.86	0.000	0.65	-0.67	0.081	67.55	0.000	0.51
Other - Old suburbs	-0.45	0.061	54.70	0.000	0.64	-0.48	0.075	41.23	0.000	0.62
Other - New suburbs	-0.46	0.065	50.03	0.000	0.63	-0.63	0.076	68.49	0.000	0.53
1 employed adult couple with children - New suburbs	-0.48	0.082	34.94	0.000	0.62	-0.30	0.093	10.52	0.001	0.74
1 employed adult couple without children - Periphery	-0.48	0.171	7.78	0.005	0.62	-0.61	0.134	20.54	0.000	0.55
1 employed adult couple with children - Periphery	-0.53	0.121	19.54	0.000	0.59	-0.46	0.108	17.85	0.000	0.63
Other - Downtown	-0.55	0.072	58.48	0.000	0.58	-0.46	0.086	28.03	0.000	0.63
1 employed adult couple without children - New suburbs	-0.60	0.111	28.94	0.000	0.55	-0.67	0.103	42.56	0.000	0.51
Presence of children aged between 16 and 20 (0: No; 1: Yes)	-0.33	0.057	33.74	0.000	0.72	-0.44	0.052	72.55	0.000	0.64
Presence of children aged between 6 and 15 (0: No; 1: Yes)	-0.91	0.096	88.48	0.000	0.40	-0.99	0.085	135.15	0.000	0.37
Presence of children aged 6 or less (0: No; 1: Yes)	–	–	–	–	–	-1.09	0.132	67.90	0.000	0.34
– : No data	χ^2 = 13,037.797 (p < 0.000)					χ^2 = 16,909.107 (p < 0.000)				
	DL = 40; n = 42,966					DL = 41; n = 58,067				
	R^2_L = 0.22					R^2_L = 0.214				
	Hosmer and Lemeshow : 0.156					Hosmer and Lemeshow : 0.000				

APPENDIX2BinaryLogistic Regression of the Probability of Making a Complex Trip Chain (More than one intermediate stop)

	1996					2006				
Variables	**B**	**S.E.**	**Wald**	**Sig.**	**Exp(B)**	**B**	**S.E.**	**Wald**	**Sig.**	**Exp(B)**
Constant	-1.86	0.274	45.80	0.000	0.16	-1.97	0.230	73.34	0.000	0.14
Gender (0: Male; 1: Female)	**0.08**	**0.034**	**5.67**	**0.017**	**1.08**	**0.20**	**0.026**	**56.00**	**0.000**	**1.22**
Motorized household (0: No; 1: Yes)	0.93	0.078	144.34	0.000	2.54	0.47	0.061	59.03	0.000	1.60
Vehicle ownership rate	-0.25	0.042	34.38	0.000	0.78	-0.05	0.033	2.26	0.133	0.95
Age group (Ref: Between 5 and14)			**23.00**	**0.000**				**29.03**	**0.000**	
Between25 and44	0.01	0.254	0.00	0.962	1.01	0.31	0.196	2.52	0.113	1.37
Between45 and 64	-0.06	0.255	0.06	0.812	0.94	0.26	0.197	1.76	0.184	1.30
65 or over	-0.23	0.263	0.76	0.384	0.80	0.06	0.201	0.10	0.753	1.07
Between15and 24	-0.31	0.239	1.72	0.190	0.73	0.10	0.181	0.30	0.587	1.10
Occupational status (Ref: Full-time employed adult)			**81.51**	**0.000**				**198.74**	**0.000**	
Retired	0.50	0.068	54.16	0.000	1.65	0.61	0.046	173.90	0.000	1.84
Part-time Employed adult	0.37	0.061	36.40	0.000	1.44	0.24	0.065	13.71	0.000	1.27
Other	0.28	0.053	28.34	0.000	1.33	0.42	0.051	68.11	0.000	1.52
Student	0.12	0.090	1.68	0.195	1.12	-0.03	0.074	0.21	0.646	0.97
Household composition (Ref: 2 employed adultcouple with children - Downtown)			**109.19**	**0.000**				**196.03**	**0.000**	
Single parent family - Periphery	0.48	0.218	4.91	0.027	1.62	0.29	0.196	2.24	0.134	1.34
Person livngalone - Downtown	0.19	0.124	2.32	0.128	1.21	0.28	0.126	4.97	0.026	1.33
Single parent family - New suburbs	0.18	0.142	1.52	0.218	1.19	0.16	0.153	1.03	0.309	1.17
1 employed adultcouple with children - Periphery	0.11	0.169	0.43	0.511	1.12	0.27	0.152	3.08	0.079	1.31
Person livng alone - Old suburbs	0.11	0.107	0.99	0.319	1.11	0.21	0.121	2.94	0.086	1.23
Single parent family - Downtown	0.09	0.175	0.26	0.611	1.09	0.51	0.171	8.78	0.003	1.66
Person livngalone - Periphery	0.05	0.164	0.08	0.774	1.05	0.36	0.157	5.17	0.023	1.43
Person livngalone - New suburbs	0.00	0.118	0.00	0.979	1.00	0.36	0.130	7.70	0.006	1.43
1 employed adult couple without children – Downtown	-0.02	0.173	0.01	0.910	0.98	0.07	0.164	0.16	0.688	1.07

	1996					2006				
Variables	**B**	**S.E.**	**Wald**	**Sig.**	**Exp(B)**	**B**	**S.E.**	**Wald**	**Sig.**	**Exp(B)**
Single parent family - Old suburbs	-0.02	0.137	0.03	0.872	0.98	0.13	0.147	0.76	0.383	1.14
2 employed adult couple with children - Old suburbs	-0.03	0.097	0.08	0.784	0.97	0.21	0.119	3.11	0.078	1.23
2 employed adult couple with children – Periphery	-0.06	0.134	0.22	0.639	0.94	0.15	0.122	1.43	0.233	1.16
1 employed adult couple without children - Old suburbs	-0.08	0.130	0.38	0.536	0.92	-0.17	0.137	1.55	0.214	0.84
2 employed adult couple without children – Periphery	-0.09	0.185	0.25	0.618	0.91	0.01	0.154	0.01	0.944	1.01
2 employed adult couple with children - New suburbs	-0.13	0.104	1.50	0.221	0.88	0.14	0.115	1.45	0.228	1.15
1 employed adult couple with children - Old suburbs	-0.14	0.117	1.42	0.233	0.87	0.28	0.141	4.01	0.045	1.33
Other - Periphery	-0.16	0.122	1.74	0.187	0.85	-0.10	0.124	0.70	0.402	0.90
1 employed adult couple with children - New suburbs	-0.19	0.129	2.07	0.150	0.83	0.23	0.135	2.92	0.088	1.26
2 employed adult couple without children - Old suburbs	-0.20	0.121	2.70	0.101	0.82	0.01	0.131	0.01	0.930	1.01
2 employed adult couple without children - New suburbs	-0.20	0.134	2.15	0.143	0.82	-0.10	0.133	0.56	0.454	0.91
1 employed adult couple without children - New suburbs	-0.20	0.151	1.81	0.178	0.82	-0.10	0.139	0.48	0.490	0.91
1 employed adult couple without children - Periphery	-0.21	0.227	0.88	0.349	0.81	-0.33	0.172	3.72	0.054	0.72
Other - New suburbs	-0.31	0.102	9.40	0.002	0.73	-0.18	0.117	2.31	0.129	0.84
Other - Old suburbs	-0.33	0.098	11.63	0.001	0.72	-0.21	0.116	3.28	0.070	0.81
1 employed adult couple with children - Downtown	-0.36	0.151	5.64	0.018	0.70	-0.16	0.195	0.64	0.425	0.86
2 employed adult couple without children - Downtown	-0.38	0.166	5.30	0.021	0.68	-0.02	0.149	0.02	0.880	0.98
Other - Downtown	-0.43	0.111	14.76	0.000	0.65	-0.10	0.124	0.62	0.431	0.91
Presence of children aged between 16 and 20(0: No; 1: Yes)	-0.32	0.112	8.00	0.005	0.73	-0.26	0.097	7.13	0.008	0.77
Presence of children aged between 6 and 15 (0: No; 1: Yes)	-0.74	0.246	9.03	0.003	0.48	-0.45	0.187	5.70	0.017	0.64
Presence of children aged 6 or less (0: No; 1: Yes)	–	–	–	–	–	-0.25	0.287	0.73	0.393	0.78
– : No data	$\chi^2 = 497.917$ ($p < 0.000$)					$\chi^2 = 871.604$ ($p < 0.000$)				
	DL = 40; n = 23,370					DL = 41; n = 33,665				
	$R^2_L = 0.02$					$R^2_L = 0.023$				
	Hosmer and Lemeshow : 0.027					Hosmer and Lemeshow : 0.963				

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5TH INTERNATIONAL CONFERENCE ON WOMEN'S ISSUES IN TRANSPORTATION

(7875 words – two figures)

FRENCH GENDER EQUALITY POLICIES AND ITS RECEPTION IN A MEN'S FIELD: AN EXAMPLE IN ROAD TRANSPORT AND LOGISTICS

SUMMARY:

In the field of distribution[1] over the past few decades, modernisation of production tools, new standards of gender division of labour, and the development of support functions has led to the feminisation of these professions, providing the opportunity to consider research that goes beyond companies' reports which are limited to a comparison on a year-to-year basis. These reports do not allow for monitoring differences in gender division of labour or career development opportunities, and potentially hide inequalities between men and women, as well as gender diversity issues (Cousin, 2007).

This feminisation occurs in a labour changing world (economically, organizationally, technically, and socially). Today in France, new socio-cultural issues driven by new kinds of social movements, such as those addressing gender inequalities and environmental protection, seem to nourish socio-economic issues of wealth distribution and production tool ownership or control. Professional equality is now an issue of CSR (Corporate Social Responsibility), including economic, environmental, and social dimensions. If professional equality aims to contribute to the well-being of employees, it is also part of the performance measurement of an organization. In this process, French legislation tends to be a regulator.

However, gender equality policies are more difficult to understand and to apply in male-dominated environments where legal obligations face organizational constraints and/or cultural ones. Therefore it is necessary to determine to what extent employees of male-dominated companies recognize and abide by the law. Indeed, the introduction of a gender equality policy requires a re-examination of new forms of solidarity, organization processes, ways of working, and the nature of work itself.

It is our hypothesis that transport companies do address gender equity under the impulse of an opportunity effect while facing the paradox of a male working culture where theoretical gender equality implies highlighting women. In the company studied, the difficulty of workers' jobs (particularly due to heavy carrying, flexible schedules, and subzero temperatures), added to the tense economic context faced by the sector, create the conditions of a collective resistance based on a male-dominated culture. From this perspective, managers do not see an interest in applying law, which cannot be supported by human resources managers either.

This proposal is based on a case study of the European leader of goods transport and logistics under controlled temperatures[2]. In a workforce where only 18% of nearly 12,000 staff members are female, the "gendering of work" increases with efforts to work on gender in a masculine organization where theoretical gender equality resides alongside informal and invisible structural inequality. We will consider issues of equality between men and women according to their concrete and tangible manifestations, such

[1] See "vocabulary"

[2] The entire supply chain is chilled, refrigerated or insulated to organize the delivery of perishable goods. Work in platforms and warehouses is being performed in temperatures between -27 ° (for the coldest frozen warehouses), +2 ° (for "fresh" platforms) and 15 ° (for the "sensitive temperature" products).

as gender equality agreements, women advancements policies, etc., ambitions which often challenge realities and local constraints.

KEY WORDS: gender division of labour – masculinities – distribution – logistics –freight transportation – gender equality policies – gender discriminations
PHD SUBJECT: Gender relations and masculinities: an ethnography of virility among the leader of distribution under controlled temperature
PHD DIRECTOR: Régine Bercot

METHODOLOGY: This proposal is based on a PhD research in sociology in the European leader of goods transport and logistics under controlled temperature from within the roles of gender equality leader and also as a temporary employee in warehouses over the time period of a few days up to several weeks. In addition, observations during negotiations of a gender equality agreement, semi-structured interviews with employees and managers, as well as the collection of internal and external data are key to the study.

KEY FIGURES: The transport and logistics sector is the fifth largest economic activity in France, after industry, construction, trade, hotels, and catering industry. With the expansion of exchanges, the sector continues to grow. It has more than 1.5 million employees, which represents 5.5% of employees in France. Transport has around 700 000 employees, most of them are workers. Jobs in logistics are overwhelmingly occupied by men : only 18% of women among employees. This percentage is about 11% in road freight transport.[3]

VOCABULARY: "**DISTRIBUTION:** Regarding goods distribution, the process of storage, handling, loading, and delivery (mainly by road) of goods/products to retail outlets or the final consumer. In practice, many other individual functions may be involved (order processing, order picking, inventory control, etc.)" (Source : *The dictionary of transport and logistics,* David Lowe, Kogan Page Publishers, 2002)

PARCEL SERVICES = Messagerie
WAREHOUSE = Entrepôt logistique
PLATFORM = plateforme de transport
QUAY = Quai
SUPPLY CHAIN = Chaîne d'approvisionnement
GENDER RELATIONS = rapports sociaux de sexe

[3] MARIOTTE H., *L'emploi dans la fonction logistique en France*, SESP, En bref, n° 16, mars 2007
See also : Bilan social annuel du transport routier de marchandises, Observatoire social des transports, Commissariat général au développement durable.
Fiche sectorielle de l'INSEE : http://insee.fr/fr/ffc/docs_ffc/ENTFRA13o_FTLo10transports.pdf

1. INTRODUCTION

In recent decades in France, gender studies have developed as a new academic discipline. We count few studies regarding issues of gender equality policies, their establishment and their impact. (Laufer, 2009; Poilpot-Rocaboy, Kergoat, 2010). Most studies focus on the feminisation of professions and women's access to hierarchical responsibilities (Landrieux-Kartochian, 2007; Laufer, 2004). Due to socio-cultural developments and legal requirements, gender equality has recently become a concern for organizations. The Corporate Social Responsibility policy (CSR) is a new criterion which specifies that "enterprises should have in place a process to integrate social, environmental, ethnical human rights and consumers' concerns into their business operations and core strategy in close collaboration with their stakeholders".[4] Gender equality is part of CSR, and could be defined as: "equality of rights and opportunities between women and men regarding access to employment, working conditions, training, qualification, mobility, articulation of lifetime, promotion and compensation (equal pay)."[5]. Gender equality is concretely introduced into companies through diversity policy actions and has two main objectives: to fight against discrimination and to create the conditions for a male and female mixed environment where both sexes have a place. In this process, the French government can be seen as a regulator through the enactment of gender equity laws. The government now requires, under threat of financial penalty, that companies with over 50 employees institute: gender equality in hiring, wages, and career opportunities. These obligations have to be covered by a collective agreement and measured in a report on gendered working conditions.

However companies' openness to gender equity varies from one company or sector to another (Britton, 2000; Belle, 1990). In male-dominated organizations like distribution, the introduction of professional gender equity can be challenging for companies as « gender is deeply embedded in organizational structures » (Acker, 1994). Moreover, theoretical gender equity promoted by laws faces a numerical and structural gender hierarchy. In this context, can a male-dominated structure comply with the gender equity law? We will focus on this issue through a case study in distribution where theoretical and legal obligations are facing sectorial and cultural constraints. With males making up over 80% of more than 12,000 employees, the introduction of gender equality policies in this company requires (beyond a pedagogical approach) some substantial improvements.

We favour an approach in terms of gender and not in terms of sex, to underscore that gender is a social construct. We generally oppose "sex" as revealing the biological makeup of an individual reproductive anatomy of men and women and prefer "gender" as it reveals a social and cultural identity. "Human society with remarkable monotony overdetermine biological differentiation by assigning different functions to both sexes (divided, separated and generally hierarchized) in the social body as a whole." (Hirata, 2004). Gender reveals the global logic of a social organization that is not limited to mixed environment. Gender not only reveals standards of a social group, but also "uncovers the androcentrism[6] basic concepts in sociology such as work" (Clair, 2012). In this context, ethnographic studies describing gender relations are the materialistic translation to a cultural conception of gender. These studies questioned a social order and social practices. It is with this perspective that this article will explore issues of gender equality policies in transport.

It is our hypothesis that transport companies do address gender equity under the impulse of an opportunity effect while facing the paradox of a male working culture where theoretical gender equality implies highlighting women. In the company studied, the difficulty of workers' jobs (particularly due to heavy carrying, flexible schedules, and working under subzero temperatures), and difficulties running

[4] "A renewed EU strategy 2011-14 for Corporate Social Responsibility", European commission report, 2011.

[5] French Ministry of Labour, Employment, Training and Social Dialogue

[6] Androcentrism is a way of thinking, conscious or not, which consist to consider the world to the point of view of male human beings. For more details on this topic : Mosconi N., « L'androcentrisme de la théorie sociologique », *Femmes et savoir : la société, l'école et la division sexuelle des savoirs*, l'Harmattan, 1994 ; Léveillé D., *L'androcentrisme en anthropologie*, Groupe de recherche multidisciplinaire féministe, Université Laval, 1989

through the Transport sector create the conditions of a collective resistance based on a male-dominated culture. In this perspective, managers do not have an interest in applying law which cannot be supported by human resources managers either.

We will first describe the legal obligations companies need to consider and the context in which these obligations are embedded. Then, we will study how transport companies have responded to these obligations. Finally, we will focus on our field of study to demonstrate that instability in the transport market strengthens a masculine-dominated culture that inhibits implementation of these laws.

2. FRENCH GENDER EQUALITY POLICY IN ROAD TRANSPORT: THE OPPORTUNITY EFFECT

While our perspective remains the working environment, we will begin by establishing how gender equality has developed more generally in France and in the transport sector.

Following the enactment of equal employment and affirmative action policies in the United States in the 1960s, « diversity» imposed itself in France and in Europe in the late 90s. (Martin, 2010) Under pressure from international and European laws, French legislation has demonstrated a continually renewed inspiration to ensure equality between men and women. Gender equality is firstly a constitutional principle that specifies equal rights between men and women. It has developed into a legal requirement -employers cannot discriminate on the basis of gender- and corporate policy -taking into account concrete discriminations for men or women-. Most studies tends to demonstrate the benefits of diversity in business (Welbourne, 1999), including the contribution of women in the performance of companies (Landrieux-Kartochian, 2007, Bender & Pigeyre, 2003; Belghiti & Rodhain, 2001). More than a fight against discrimination (as in the US), it is a fight for equality of chances and diversity. We count no fewer than nine successive laws taken in this direction. The first, in the preamble of the French constitution, the latest on 27th January 2011, raised a wave of panic by requiring companies to impose quotas for women in their boards (at least 20% of women by 2014; this percentage increases to 40% by 2017). Since 2010, a financial penalty has accompanied these laws. In addition we include various initiatives taken by the current French government, such as the creation of a ministry of women's rights and a gender equality label to reward good business practices. The legal pressure is lower than in the U.S and does not constitute a sufficient incentive, but guarantees a logic of equality. (Landrieux-Kartochian, 2007)

In distribution, we note a lack of gender analysis in France especially in the area of warehouses and platforms. It remains difficult to compare business practices in this sector. However, some studies have focused on women in male environments (Pruvost, 2007; Quemin, 1998; Buscatto, 2005; Scotto, 2008), while very few look at the transport sector (Rodrigues, 2010; Ponchut, 2010), as the working area is shown as "genderly" neutral (Kelan, 2009). The concept of "masculin neutre", especially developed by Jacqueline Laufer in France, highlights the lack of gender perspectives and the androcentrism of research, particularly in studies focusing on organizations (Laufer, 2010). It is as if labour escaped a gendered structure type, perhaps because of its disembodied bureaucratic nature and is therefore asexual in the collective imagination (Acker, 1990). In other words, labour organizations appear falsely as alien to issues of gender relations.

Still, this concept is even more valid in male environments like distribution, where the absence of gender perspectives is embodied by a lack of references made to gender policies in collective agreements. In France, each company is related to a collective agreement which defines the status of employees in a professional branch following negotiations between employers and unions. The main collective agreement governing the sector of road transport and logistics was created in 1950 and was amended in 1994 to address conditions of equality at work between men and women. It suggests in one paragraph

the terms of this equality. When we interviewed a representative of the major employer's organization of transport[7], she confirmed the poverty of measures on the subject

> "There are still so many things to do. Our collective agreement[8] is at the grassroots, especially on the subject of maternity leave. There's 36 days of compensation, plus a maternity leave of 16 weeks[9].
> - Are you working with unions to rewrite the collective agreement, especially about the gender equality part?
> - Oh yes, it's five years' work now, to rewrite the whole collective agreement, it is very outdated. When looking at the classification of jobs, it's amazing! There're trades that do not exist in the collective agreement. A lawyer does not exist, a human resources manager does not exist, a computer specialist, does not exist either! The problem is that we negotiate with truck drivers, they want to start working on their jobs." (extract of field notebook)

Distribution is mainly represented through truck drivers which constitute most union representatives[10]. Their main objective is to negotiate about working conditions in an increasingly tense economic context in which gender equity does not appear to be a priority. From this perspective, it seems difficult for transport company to appreciate a topic that federations and representative of business do not make their own.

However, we can note some initiatives taken by companies (Keolis with a Gender Equality Label obtained in 2004[11] and LG Transport with a campaign of recruitment of women), road transport associations (program OPCA Transport – T Profession'elles, association "women and the road"), or research seminars (WIit, International Forum of Transportation – "Transport and gender"). In France, this slow and deep movement was born in 2002 through the first regional agreement for the feminization of business of transport and logistics between the Upper Normandy Region and professional federations of transport[12]. Its objective was to increase the percentage of women truck drivers from 0.8% to 2%. Communication campaigns were conducted and days of meetings were organized by the Regional Delegation for Women's Rights, training organizations and the French employment center[13]. This agreement was renewed for the 2006-2013 period. The objective of 2% of women among truck drivers was nearly reached (1.9% in 2006); the goal for 2013 was 4%. This initiative was taken at a time when the transport sector was going through a crisis of recruitment (Rodrigues, 2010). Indeed, in the past decades, the military service provided men with a truck driving license. Since 1997, this military service is no longer compulsory and obtaining a this license requires costly training. This is one of the reasons leading to a crisis of recruitment for this job. To overcome this issue, initiatives have been launched to recruit available, flexible, and cheaper employees: women. This is the first opportunity effect we identified. The second opportunity effect that promote professional gender equality between men and women is promulgated by way of an avoidance strategy. As one leader of a representative employers union explained, the topic of gender equality appears to be well-suited to elude other issues:

[7] We count several professional employers unions in transport : TLF (Fédération des entreprises de Transport et de Logistique), FNTR (Fédération nationale des Transports Routiers), UNOSTRA (Union nationale des organisations syndicales des transporteurs routiers automobiles) and OTRE (Organisation des Transports Routiers Européens). Professional employers unions defend the interests of their professional sector. These organizations among other activities negotiate with major workers unions about working conditions.

[8] The collective agreement of road transport and related activities.

[9] Statutory maternity leave is determined by the Labour Code and is at least 16 weeks. In most collective agreements, leave is extended and employees benefit of it. In other words, the collective agreement of transportation meets the minimum required and provides no other benefits to women.

[10] The feminization of trucks drivers is around 2% (Rodrigues, 2010).

[11] French Government created in 2004 " the equality label" to reward companies or institutions which recognizes exemplary practices in gender policies.

[12] TLF, Unostra, FNTR and FNTV

[13] Pôle Emploi

"For now, we're not really up to work on hardship. When Mr F. from CFDT[14] has offered to negotiate on gender equality, I have not waited the permission of my boss , I have said « I'm in ! ». Disability can be connected with hardship, so I want to be careful on the subject. When I explained this to my President that I didn't waited for his permission, that I had already said "ok" for negotiations on gender equity because while we talk about it, we do not speak of sensitive topics, he said "yes, seen like that, it suits me very well !" . (extract of field notebook)

Besides these "utility" effects or initiatives taken by some companies, in the last few years the feminization of these professions has slowly grown and remains stable in transport. Feminization doesn't exceed 10% and in logistics services, this feminization seems instable.

FIGURE 1 : EVOLUTION OF WOMEN IN TOTAL EMPLOYMENT IN TRANSPORTATION AND LOGISTICS BY SECTOR

Source : 2012 Report - Observatoire Prospectif des métiers et des qualifications dans les Transports et la Logistique

Marine Ponchut and Isabelle Barth have theorized some reasons to help explain the absence of women in a company of passenger transportation[15]. Three factors have been identified: "congruency between male characteristics and expectations of behaviours in management positions, separation of personal and professional spheres, and a culture of long working hours". In this article, we aim to utilize a case study in distribution to go further and identify new methods of explanation to take into account not only top management and hierarchy, but also dynamics across occupations and hierarchical levels.

[14] One of the main workers union

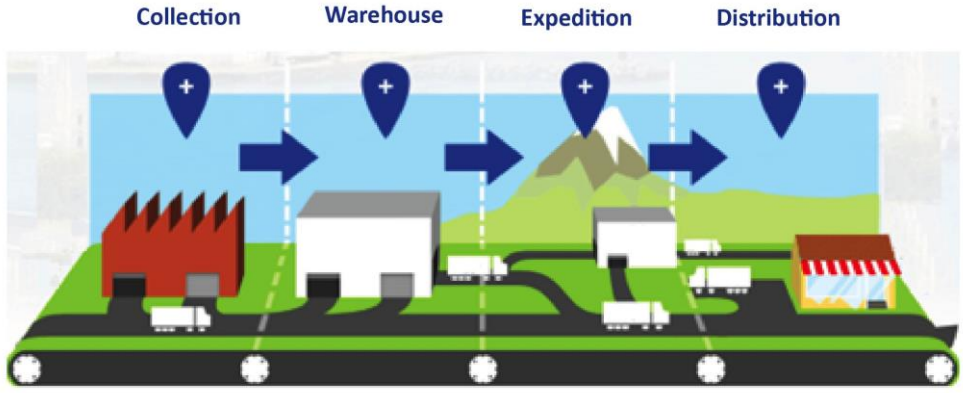
[15] PONCHUT, M. et BARTH, I. « *La place minorée des femmes dans les organisations. Exploration d'un facteur explicatif: la culture organisationnelle. Cas d'une entreprise de transport public* ». *@ GRH*, 2012, no 3, p. 11-31.

3. AN ETHNOGRAPHIC APPROACH OF GENDER EQUALITY IN ROAD TRANSPORT & LOGISTICS

This article is based on an ethnographic study of the European leader of refrigerated business of transport and logistics from headquarters (those that drive the gender equality policy) to warehouses and platforms (those affected by their decisions). We conducted this study from the perspective of the roles of gender equality leader and also as a temporary employee in warehouses over the time period of a few days up to several weeks. In addition, observations during negotiations of a gender equality agreement, semi-structured interviews with employees and managers, as well as the collection of internal and external data, are key to the study. The study will be conducted over three years, between 2012 and 2015.

The company has around 12,000 employees (85% male) in France spread over 160 platforms. 70% of the activity is related to Transport, 30% to Logistics. We anonymize the company, calling it "Transfrilog". Distribution has as a main task the delivery of the finished product to the stores. It consists of order processing, warehousing, and transportation under controlled temperature. Distribution can be seen as management of internal and external flows such as a succession of small transportations of goods (from the fabric to the warehouse, then to the distributor and in the end, to the consumer).

FIGURE 2



Source : Transfrilog

The specificity of Transfrilog's jobs are their difficulty mainly due to "just-in-time" pressure and some heavy carrying in a refrigerated environment. This reinforces the natural assignment of men and women to specific tasks and "justifies" a gender division of labour. For this article we chose to separate transport and logistics, as we see differences in the nature of work, the proportion of men and women, and the integration of gender policy actions.

An initial approach to gender equality was made in 2008 through an internal collective agreement at Transfrilog. Its two main objectives were: combatting discrimination and developing jobs for women. A primary task of the agreement was to develop feminisation in Transfrilog. Between 2002 and 2012, the proportion of women increased from 15.6% to 20.60%; Transport only saw an increase from 14% to 15.7%. This feminization of the company occurred especially under the pressure of the growth of support functions and the co-optation, characteristic of a company that boasts a paternalist capitalism. Women mainly integrated Transfrilog through trained jobs of employees or managers while men were mostly self-taught.

In 2013, Transfrilog accepted my application to conduct a study on gender mix as an opportunity to demonstrate goodwill in this process and to develop an innovative diversity policy. Their policies toward handicapped workers are dynamic and have been repeatedly rewarded. The project was formed

to implement the same policy upfront. In 2013 a second collective agreement was signed, including Logistics. Transfrilog specified in this agreement that it is an important issue for both management and unions and decided to develop a proactive policy. In accordance with legal obligations, the head of human resources developed various tools for each platform and warehouse to work on the subject. It is as of yet too early to examine the impact of the second collective agreement, but we can analyse what has transpired since the signature of the first collective agreement. Through this monograph we are going to describe the difficult enlightening of gender issues in a male-dominated sector where the professional culture has been built on manly strategies. As we said earlier, we will focus on transport as the first agreement was signed for this activity of the company.

4. ISSUES OF IMPLANTATION OF A PROFESSIONAL EQUALITY POLICY

At the end of 2008, Transfrilog counted 1,194 women and 6,998 men in the transport section (14.6%). At the end of 2012, the proportion increased to 15.6% of women as the number of male employees fell to the benefit of the staff in Logistics. Staff of the company inflated through Logistics and support functions as the transport section, the historical profession of the Group, stagnated for the first time since the birth of Transfrilog. In the meantime, the feminisation promised is close to zero and we have no trace in the company records of gender actions initiated between 2008 and 2012.

We note a discrepancy between what seems to be a priority (gender equality) for the French government, for companies, and in some ways, for Transfrilog, but concretely this is an airtight area. We are going to explore some possible explanations, based on the field we studied.

We have not overlooked the extent to which androcentrism in the company has had an influence on the slow implementation of such policies. We choose not to dwell on this argument, already well-studied in the literature (Acker, 1990; Guilbert, 1966; Laufer, 1982). Moreover, we realize that hardship jobs may have an influence on the feminization of Transport, but as jobs in Logistics are more physical and have a higher proportion of women (22%), this does not seem to be a valuable argument either. In the light of these considerations, we develop two main explanations of the issue of implementing a gender equality policy: the subaltern position of human resources managers and an instable market of Transport that lead to a reification of gender relations through masculinities issues.

A) GENDER EQUALITY POLICIES FACING THE TIED POSITION OF HUMAN RESOURCES

Transfrilog is a family-owned company, established on the basis of a paternalistic capitalism. The founder (and current president) of the Group maintains the image of a good father who soon will pass the reins of the company over to his son. The company prides itself on being 16% owned by employees who invest all or part of their year-end bonuses in the company. 2012 was the twentieth birthday of the company saving plans but also a year to celebrate a change of governance. Coupled with financial uncertainties, organizational changes, and the retirement of the elders who had founded the Group, this helped to bring a change in managerial methods.

The establishment of a gender equal opportunity policy was decided on a few months before a turning point for the company, the transfer of power between the former leader (the founder of the Transfrilog) and the new leader, who implemented a different kind of management. In the past few decades, while under a strategy of internal economic growth, the group doubled the number of employees. The new corporate governance, which tends to accelerate an external development, now favours marketing and business entities to the detriment of other departments, which are forced to save. The feminization of the company due to this mechanical growth (attributable to the enlargement of support functions), is now discontinued due to a recent decision to implement a hiring freeze in the department. Worst still, current trends suggest that this function is threatened, and human resources managers fear a scheduled “defeminisation” due to human resources’ loss of power. To clarify this shift, at the beginning of 2012, one of the first decisions taken in this the new direction was the restructuring of

headquarters offices. Trade and marketing entities conquered space, gaining additional offices while human resources piled in a corner. The “diversity pole” (in charge of disabled employees, elders, and gender equality) was the only service to be moved from the building. Cut off from corporate headquarters, even from human resources and its information, this evidenced the way in which human resources and its diversity policies were relegated. In platforms of transport, this tension seems to have been reproduced.

We observed in the agencies we studied a clear dichotomy between offices and quays. The company is structured in a pyramidal configuration: corporate headquarters at the top, regional branches in the middle, and at the bottom, platforms (offices + quays). Orders are given from the top to the base where they are applied. This contrasts with a relative autonomy once enjoyed by platforms. Now, decisions are centralized at the head office and are made by top management. Autonomy in decisions replaces execution of them.

> "One day I was told: you make "management" of human resources. If you want to implement a project, you have to show them how to save money. They run a 14 000 employees business in a difficult economic context, it is normal but sometimes I feel I’m dealing with « inhuman » resources" (human resources manager, extract of filedbook)

Thus, we observe two forms of response: "silent authoritarianism" or "solidarity against corporate headquarters" (Benquet, 2011). HR managers already marginalized in platforms due to perform what some consider to be "unproductive" work are in a position of tension between the corporate headquarters and the field, between managers and employees. Managers themselves are in a similar position of tension between headquarters and employees. Managers have to juggle the "just in time" characteristic of the sector of perishable goods. This position requires responsiveness and the constant adjustment of work. The productivity pressure and the flexibility are building a business identity. In this context, middle managers favour obligations, like payroll or psychosocial risks. This short-term strategy contrasts with diversity actions as long-term projects, including gender equality policies. In addition, a succession of new laws and the burden of their application have increased demand on middle manager’s attention. Companies now need to negotiate on disability, pensions, hardship work, etc., all reasons to forget what does not seem a priority. In this process, the increase of bureaucratization hides the process of implementation and multiplies the number of actors. Information came slowly and sometimes partially Crozier, 1963). Also, piecemeal commitment of human resources managers on gender equality stresses the implementation of concrete actions. The lack of training on the subject and disinterest in adopting a gender perspective mask any discrimination. Therefore, at each hierarchical level, you can hear the same chorus: "what's the point of this?"

> “- Is it a topic that interests you ?
> - It stresses me out. It takes at least 2 days and we really do not have time ...
> - Yes, it's terrible, but we must prioritize and push from all sides. We don’t have time for gender equality" (human resources managers, extract of filedbook)”

Human resources are faced with daily management of uncertainties of the work that requires a risk control. These difficulties of positioning for executives in companies do not allow them to develop the flexibility of implementing long-term projects (Cousin, 2008; Flottes, 2004). In this perspective, HR managers cannot be a relay on this subject. Not supported by executives, caught between managers and employees, focused on short-term projects, the flexibility of HR managers is relative. (Gilbert, 2006)

This flexibility seems to reduce as the labour market tightens but the re-individualization of human resources managers contrasts with the resistance of a collective transport identity. When the work is becoming precarious, is collective resistance possible? It is our assumption that the casualization of transport jobs reinforce a collective dynamic based on a culture of masculinity which rules out the introduction of a policy of equal opportunities.

B) MUTATIONS IN THE TRANSPORT SECTOR AND ITS IMPACT ON GENDER EQUALITY POLICIES

The transport profession, as it has traditionally functioned, is experiencing a crisis. (Rodrigues, 2010). The fragmentation of labour, over computerization, ongoing discourse about the crisis and pressure from social movements create an uncertain future. In 2012 in France, transport activity contracted. Quantities transported (by vehicles over 3.5 tons) decreased by 6.7% and fell to a lower level than in 2009. In this context, employees in road transport fell by 1% between 2011 and 2012. The largest decrease was observed in parcel services where employment continues an uninterrupted decline for 10 years. The number of jobs collectively in the supply chain fell from 16.3% compared to 2011. Recent trends in 2013 show that while the French economy slightly rebounded (+0.5%), the volume of goods transported and employment continues to decline[16]. These market developments influence the mapping employment in Transfrilog. Between 2002 and 2012, the Group doubled the number of employees under the pressure of Logistics and Support Functions. Meanwhile, between 2007 and 2012, the number of employees in the transport section decreased. While some transport platforms closed, new logistics warehouses are created. Yet Transport is the historical activity of Transfrilog and many of its employees have built their carrier on the know-how of these trades. The degradation of working conditions and the uncertainty of work reinforces what was once valued in a trade: a professional business identity and the consistency of working conditions depending on registration of its employees in collectives (Castel, 2009; Beau, 2004). The family structure of the company is no longer valid. The emergence of new forms of employment is a clear break in the constitution of a socially protected wage (Castel, 2009; Paugam, 2007). If the most valued components of a business do not exist, can it remain attractive? Precariousness and solidarity are not incompatible concepts (Béroud & Bouffatigue, 2009). We even think that the uncertainties in the workplace tend to recreate solidarity in a profession. In the case of Transfrilog, the sense of belonging to this company added to the feeling of belonging to "the family of transport," strengthening a professional identity. This identity has been built by men and is still carried by them through truck drivers and transport operators (95% of whom are men) as the basis of a masculine organizational culture.

« An organizational culture comprises discourses, practices, norms, languages, and values which reflect the socially-constructed images of maleness and femaleness and define specific power relations among the members of an organization according to their sexual membership » (Gherardi, 2001). Studying a culture means examining the « symbols, beliefs, and patterns of behavior learned, produced and created by the people who devote their energy and labor to the life of an organization » (Strati, 1992: 1-2). In distribution, maleness occupies a hegemonic position through a series of well-established rules, both explicit and implicit, which define gender contents relative to the male and the female behaviors appropriate in the organizational context in which maleness is dominant (Gherardi, 2001). The environment of working in Transfrilog is based on a non-gender mix culture[17] which legitimates some cultural behaviours and gender divisions of labour (Kergoat, 1982). The few women who have achieved a position in top management of the company are brandished as evidence of equal access and opportunity. This leads us to a recurrent argument we heard in Transfrilog : « Look at the head office, there's only women, look at human resources department, there's only that ! » Some women legitimate this discourses by integrating these inequalities, which renders invisible further potential discrimination and produces "gender blindness" (Messing, 2009).

> "On the platform everyone respects each other. Regardless of whether you're a man or a woman. I do not feel particularly discriminated against. I have no problem working part

[16] Bilan social annuel du transport routier de marchandises (2012) – Observatoire social des transports, Commissariat général au développement durable, décembre 2013.

[17] Generally define by a proportion of men or women not more than 30%.

time. The director is really understanding. In this sector, you need to be firm for sure, but it is never mean and once you make them forget that you're a woman, there is no problem." (extract of fieldbook)

Marginalized women gather at well-defined areas of the platform, creating zones of lawlessness where -informally- they do not have access. In some areas, gender equality polices are no longer relevant due to a simple lack of women. This is precisely the case on quays where strenuous jobs hardly allows for hiring women. Indeed, work collectives gather around masculine values which can be seen as a method of circumventing arduous work. (Dejours, 1993; Foli, 2010). While physical force is no longer necessary to operate the equipment, thanks to technological progress,it remains central in the constitution of the masculine identity and the identity of business. (Rodrigues, 2010) In this perspective, introducing a gender mix to warehouses is seen as a way to disturb this manhood balance.

"I can tell you, I'm not ashamed, I don't want a woman on my quays. It's really disturbing for my guys. They can't work with a women, they're all disturbed. Besides, a woman can't do our job, it's too difficult and you have to be quick. My guys will have to help her all the time, it's a waste of time" (extract of fieldbook)

For Transfrilog, preventing on-the-job accidents seems easier than restructuring an organization of work so that gender may be registered. The resistance to gender equality policies is constitutive of a -productive- job identity that top management has no interest in disturbing. That reinforces an absence of relay at each level of the company, even from top management which is not interested in hiring women who will challenge manly strategies, destabilize the labor collectives, and require a rethinking of the organization of work. It is our hypothesis that the fear of hiring women feeds into this masculine culture that has built its reputation and expertise on virility.

Moreover, gender equality policies are even less understood than intersectional issues make them obsolete. Ethnic issues are now intertwined with the question of equality in the workplace, leading to new forms of issues as matter of race and class as well as gender. Class and race dynamics need to be understood and combined with gender to apprehend that a gender equality policy cannot be appreciated or applied without a global diversity policy. In some platforms, particularly in the south of France (where racism is more of an issue) or in the suburbs of Paris, gender must be understood in the light of the cultural diversity of relationships between men and women. As we were told by a female director of a warehouse in Paris suburb:

« You put two ethnicities in the same warehouse, they can kill each other. Once, we had big problems on a platform. The leader of the tribe was the only one to read and write. So he was making all the admin stuff for everyone. He just had to snap his fingers for everyone to align. It was such quite difficult for management. At first, he didn't say hello to me because I was a women. Now, I deal with it. » (human resources manager, extract of filed book)

In this perspective, "they may be less in the gender conflict than in an affirmation of masculinity". (Neveu, 2012, p.133). Conflicts between men do not leave room for such conflicts with women, and relegates them to menial jobs, schedules, and circumscribed spaces. In this perspective, gender equality policies tend to even more to stigmatize women. The working conditions is no stranger to gender but "justifies" a gendered labour division that becomes constitutive of a social environment in a male-dominated organization. From this analysis, we can observe a reification of gender relationships through a conflict of masculinities more than an evolution for women in transport. This valuation of masculinity is valid from top management to the base. Gender equality policies face domination and prejudice even more so because potential complaints about gender are received and conveyed by men whose job identity is based on the image of a "hegemonic masculinity" (Connel, Messerschmidt, 2005).

5. CONCLUSION: IS THIS PROBLEMATIC SPECIFIC TO THE ROAD TRANSPORT FIELD?

Some studies already develop the question of men's resistance to gender equality in organizations (Cockburn, 1991; Burton, 1991). In distribution, the subject is recent and requires further study. As we do not have any studies, we cannot make a real comparison. However, the importance of Transfrilog in the French transport field gives us good reason to suspect that similar patterns are operating in other companies. Although we cannot yet be certain, the long hours culture, the professional solidarity, the difficulty of jobs, and the popular ideology that permeates the transport sector may create such an environment. However, some studies in male-dominated sectors which show similar manhood strategies as hegemonic masculinity leads us to believe that this is not something specific to France and/or to transport but more generally to male-dominated sectors.

The problematic of the implementation of a gender equality policy in companies of distribution is of too recent vintage to determine their effects, but is no stranger to the actual crisis of the market. The long-term effectiveness of such policies is conditional on an overall improvement in working conditions. Moreover, professional equality policies are likely to be ineffective without prior and appropriate pedagogy but can also be a way to address a topic that would probably never have been discussed otherwise. Because we don't have concrete results on the benefits of such policy, it is above all an opportunity to question an organizational model, provided that women themselves feel concerned. Structural changes will be measured in the long-term. In the meantime, an avenue of research to worth consideration remains the study of "arrangements" adopted by women in male-dominated environments, as well as surveys to determine to what extend transport and logistics define themselves as professions.

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Gender employment inequality in the transport and logistics industry: the specifics in the Republic of Serbia and the Republic of Macedonia

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ABSTRACT

In 2011, the average women's share of theworkforce for thetransport and logistics industry (TLI) was approximately 22% in the European Union. In the Republic of Serbia, the share was similar (22%), while in the Republic of Macedonia this share was only 13%. These data inspired us to explore the nature of gender employment inequality (GEI) in the TLI and the possibilities to decrease it,while respecting their specific and complex environments. The Republic of Serbia and the Republic of Macedonia have many similarities, so it could be expected that the GEI rates in transport and logistics sectors are similar.

Both quantitative and qualitative research methods areused in the presented research. We compared the countries'maincharacteristics, by usinga statistical database on gender employment in the TLIin both countries,"Gender Organization System" (GOS) perspectiveand gave an example toexplorethegap between the women's share in the TLI labor force in the two countries, andpossible reasons for it.

Wewent beyond the GOS perspective and explored bothhorizontal and vertical impacts on sex segregation in the TLI, as well as the impact of a macroeconomic context. The paper underpins the necessity forunderstanding gender-related industry specifics withinan overall economy environment, and a need fora suitable database development. They are necessary preconditions for the continuous monitoring of gender mainstreaming and a starting point to set up the priority measures to improve gender equality and equity in the TLI in the future.

A list of Acronyms:
GEI - gender employment inequality
TLI - transport and logistics industry
GOS - Gender Organization System" perspective
CEE/CIS - Central and Eastern Europe/ Commonwealth of Independent States
WWII - World War II
PTT - Postal transport and telecommunications, an acronym used in the name of the company "PošteSrbije"
SSO – State statistical office

1. INTRODUCTION

The Transport and LogisticsIndustry (TLI) is traditionally considered a "man's world". According to some reports, the average women's share in the workforce was approximately 21.83% in the European Union (EU27+Croatia) in 2011 (Davydenko, 2009, Eurostat). In the Republic of Serbia, this number wasapproximately the same (over 22%, according to theStatistical Office of the Republic of Serbia, 2011b, p. 19), while in the Republic of Macedonia the share wasonly 13% (Eurostat).These data inspired us to explore the nature of Gender Employment Inequality (GEI) in the logistics industry and the possibilities to decrease it, respecting the specific and complex environments in both countries. They are neighbors and former Yugoslav, Balkan landlocked countries, which hopeto join the EU.Also, both of them have vulnerable economies thathave been targeted with transition, a hard political situation and with an overall economic crisis. Therefore, it could be expected that the GEI rates in transport and logistics sectors are quitesimilar.

By exploring similarities and differences between economies, TLI,labor force characteristics, as well as the ones from genderperspective, the research aims to identify and explain the possible reasons for such a gap in GEI, and prepare the directions (obtain the ground) for the set of related measures.

We used both quantitative and qualitative research to explore the nature and level of the GEI in transport and logistics. By comparing the statistical database on gender employment characteristicsin both countries, we beginfrom the theoretical lens of "Gender Organization System" perspective (GOS) to explain significant differences in gender employment and management position inequality. Besidesthe three main groups of factors covered by GOS - individual, social and organizational, the impact of logistics industry specific characteristics on sex segregation within a macroeconomic context was also included into the analysis.A lack of data about vertical gender distribution was partly bridged with an example.

2. GEI IN TRANSPORT AND LOGISTICS SECTOR IN EUROPEAN ECONOMY

The transport sector is characterized by a great diversity and different transport modes that come with different technologies, regulations, challenges, know how, and skills requirements (Davydenko*et al*., 2009). TLI is one of the most important sectors for the European economy and it takes up a substantial proportion of employment (Mallard and Glaister, 2008). Beside its size, its importance also stems from the fact that it plays a crucial role in interconnecting different economic actors. It traditionally belongs to the sectors with clearly expressed GEI, with dominant male workforces. This male dominated industry employs limited numbers of women with even fewer numbers of women in management, particularly in senior positionsaround the globe (French and Strachan, 2009).Such interference of profession-specific horizontal sex segregation, and traditional vertical sex segregation, related with women under-representation in management structures,result instrong gender inequality and inequity[1] in TLI, and its range was from 6.28% in Turkey, to 32.93% in Icelandin 2011(Eurostat).

The road freight transport sector is particularly dominated by men. Possible reasons for the low presence of female employees in this sector could be that the work has a higher physical workload. But social reasons like safety issues on European roads, especially concerning long distance freight transport and safe parking areas (rest areas), or that it is more unfavorable for family life, as well as the difficulties for women to enter male-dominated occupations, should also be considered (Davydenko*et al*., 2009).

3. THEORETICAL FRAMEWORK

[1]For further reading see also (French and Sheridan 2009).

While the majority of logistics and transport research is focused to the social, economic and spatial needs of communities, a neglected area of research is relating to the strategies and employment policies of firms in the industry itself (French and Strachan, 2009).

The GOS perspective is used for the prescriptive part of our research, to explore the complex interaction between three groups of factors, which constrains women to progress toward higher management positions: individual, social and organizational ones (Fagenson, 1990).The GOSapproach practically assumes that gender, organizational context and overall social framework, legal environment and culture may influence vertical sex segregation, i.e. the women's share in management positions.All three groups of factors will be briefly explained. Additionally, we included the macroeconomic and industry-specific factors into the analysis to comprise both vertical and industry specific, horizontal segregation into the research.

Individual factors
Individual factors may be natural, e.g. physical and psychical strength, or related toearly socialization and accumulated learning, whereby women traditionally take an inferior position. They include character, temperament, attitudes, language, gestures and interpersonal orientation (French and Sheridan, 2009).

The individual factors may be crucial for accepting or breaking traditional frames both, in the occupation, or education choice, personal ambitions, or overall management skills. While the former two arerather related with horizontal sex (de)segregation, the latter two refer moretovertical sex (de)segregation, although it is hard to make a simple classification. For example, ambition and self-motivation skills impact both the level of education and the carrier's attitude.

Social and legislative factors
The social factors refer to social norms, expectations and gender stereotypes (French and Sheridan, 2009). Males are expected to be strong, independent and prepared to take risks, which, consequently, has an impact on the viewpoint that they have naturally better predispositions for managers, or for harder and more risky occupations.

Legislation, regulations and gender policies may set the framework thatcould gradually change some traditional occupational and/or hierarchical divisions. However, the success and the needed time for the changes is affectedalso by other environmental factors, i.e. macroeconomic and industry more specific characteristics. They will be discussed separately.

Organizational factors
The traditional viewpoint related with gender equality is that organization should be gender neutral. However, it has been exposed to criticism, because deeper analysis reveals that it is developed on male values, just allowing the women to compete with men following men's rules (Smithson and Stokoe, 2005).Women have traditionally more responsibility for the family and the home, which rather directs them to a reduced work time than toward overtime hours. Therefore, women have often not been perceived to ‘fit in’ with the social characteristics of managers, particularly on senior positions (French and Sheridan, 2009).Negative attitudes towards maternity leave were also noted (*ibid*.).

Transport and logistics industry-specific characteristicswhich impact on individual and organizational factors
The study done for the European Parliament on women and transport highlights "the male-domination of employment within all areas of the transport labor force and the few examples of good practice that are trying to overcome women's under-representation in this industry" (IP/B/TRAN/ST/2005_008, p.i). The study points out that the EU missed to address gender differences in employment between men and women in the transport labor market.

The male domination can be explained with the numerous risks thatthe staff faces throughout the industry. The most significant risks facing employees in the transport sector are noise, vibrations, lighting, temperature fluctuations/heat, emissions, dust, strenuous postures/lifting, challenging working hoursfor long-distance drivers, repetitive work, safety etc. (Davydenko*et al.*, 2009).That explains why the majority of transport drivers, pilots, seafarers and handling operatives are male, as well as those employed in vehicle trades (e.g. as car mechanics).

Today, transport and logistics techniques and technology development, including supporting information technology development, give more opportunities toemploy women. It has improved working conditions, e.g. in regard to ergonomics, assistance by handling heavy objects, reduction of noise and pollution, as well as safety and protection (Davydenko*et al.*, 2009). New technologies have made it possible for physical workers to be replaced bycontrollers, planners, analysts and managers.These trendsincrease the number of jobs that requireless physical strength and more skills and education level (Bragdon and Berkowitz, 1997). It seems that these opportunities have not been utilized enough to improve the GEI sector picture until now.

Women are also under-represented in professional and managerial positions within the sector; hence their influence over the decision-making processes (IP/B/TRAN/ST/2005_008). Male superiority and centrism, combined with hard, risked and stressedjobs,support sexual harassment as a manifestation of society's gender-bias.

Macroeconomic factors
It is well known that economic growth is closely and positively correlated with human capital (e.g. see Piatkowski, 2002) and transport activities (Mersman, and Van der Voorde, 2008). The current economic crisis has intensified gender inequalities throughout the world. The crisis seems likely to affect women in such areas as employment and social safety nets, unpaid care work, education, migration and gender based violence (Baroni*et al*., 2009).Women in the developing world are even more exposed to the financial crisis, due to their vulnerable employment, lower earnings and lower levels of social and gender protection, while maintaining primary household care responsibilities(*ibid*.).

Additionally, the workforce faces many and hard challenges in economies which have past economic transition (e.g. see Fekete, 2009, Baroni*et al.*, 2009). The economiessuffer the consequences of transitions even after decades of transformation from a command economy to a market economy(Piatkowski, 2002). In cases of economies with an unsuitable business environment, where a significant amount of the workforce is part of the grey sector and/or rich labor market, struggling enterprises and entrepreneurs cannot be reasonably expected to take into account labor rights and gender employment equality, even within the context of a fair legal framework.

All explored factors have separatedandcompounded, joined and synergizedthe impact on GEI.

4.THEMAIN CHARACTERISTICS OF THE ECONOMIC AND SOCIAL ENVIRONMENTS IN THE REPUBLIC OF SERBIA AND THE REPUBLIC OF MACEDONIA

4.1 Common economic, individual and TLI characteristics in both countries

The general characteristics of economies and TLI are similar in the Republic of Serbia and the Republic of Macedonia. Both countries suffer the coupled effects of the global economic crisis and the effects of a pasteconomic transition, which make their economies very vulnerable. The post-socialist transformation processes, which involve changes towards market economy, ownership transformation,and sector restructuring, have led to substantial changes in the characteristics of the labor market. They create an increase in unemployment and an informal economy (Gender Equality Council, 2008a). Women's income has had a more significant role in the family budget, but as a vulnerable workforce group, they often face more challenges to protect their rights in finding jobs, keeping them and making progress in their professions.

Within the processes of European integration, in both countries, the sets of strategic documents and regulations regarding the labor gender employment equality policy have recently been adopted.

TLI has additionallyfaced numerous challenges in the Western Balkan region that refer to aged transport and logistics technology, bad infrastructure and typically insufficient investments. The favorable geographical position inthe Western Balkans brings out opportunities for the TLI in both countries. Asa whole, the Republic of Serbia has more developed inland waterway transportation, several international ports and airports, which also contribute to industry development and employment. However,Serbia also has three times more inhabitants than the Republic of Macedonia,and as a result of that, the labor force is also that much larger.

Regarding the individual perspective, both countries are still pretty conservative regarding the woman's role in the family, which putsbig pressure on them to have a job, butkeep a traditional key role in the family. Of course, there are also urban/rural, and education-related differences like in most developed countries.

In the rest of the section, the particular characteristics thatdescribe TLI and the related main gender employment characteristics will be briefly shown.

4.2 The Republic Of Serbia

4.2.1 Economic characteristics

The economy and the people in the Republic of Serbia still suffer the consequences of the economic transition and political events in the recent period. Once a mid-developed republic in former Yugoslavia, in the early 90's Serbia became an economy with a capita of below US$ 1000 suffering further stagnation and structural destruction caused by: loss of the former market, UN ban on foreign trade and direct investment, hyperinflation and, finally, the NATO bombing campaign, together with inconsistent and wrong policies (Cerović, 2006).

4.2.2 Labor market characteristics in Serbia

In Serbia, workers' rights are openly violated under the excuse of maintaining economic stability, while big companies and tycoons are free to refrain from paying taxes, salaries and other benefits (*Baroni et al*., 2009).In order to dealwith the economic crisis within particular business environments, small, medium and micro enterprises may find the solution in informal and short-term employment and a grey economy.

The process of privatization has led to a significant transfer of the workforce to the private sector. However, it is interesting to note that the enterprises with state ownership employ a more female workforce (49.6%), than the male one (40.7%), while in private sector (registered) work 54.9% of male and 47.9% of female population (Statistical Office of the Republic of Serbia 2012a, p. 28). In the public sphere, the job positions may have a lower status and be paid less, but in praxis the labor rights are more protected than in the private sector. This phenomenon is similar with the experiences from other East European countries (Gender Equality Council, 2008b.), andis one of the underlying reasons for the fact that the total number of employed women had a significantly lower decrease (0.6%)than men (4.6%)in 2011, compared with 2010 (Statistical Office of the Republic of Serbia, 2012b, p. 47). The overall number of employees who have formal - legal employment contracts decreased in 2011 by 2.8% (*ibid*., p. 53).

In 2012, 76% of the population aged 15 years and overrepresented the share of the active population. The total employed population was 2,228,343 in the Republic of Serbia, of which 42% are women, while in the unemployed population (701,138 persons) the female rate is 44.2% (Statistical Office of the Republic of Serbia 2012a, p. 43). Women slightly prevailed among the inactive population group "willingand able to work" - 54.5% in 2012 (*ibid*., p. 44). Further, in the inactive population,

significantly more women than men report that they are not able to work due to diseases, inabilities, personal or family reasons.

Although the legal system related to the labor market and gender equality has been continuously improving in the last decade, and some strategic documents have beenadopted, it is still fragmented and inefficient, and there is a gap between the normative framework and practice (see also Gender Equality Council, 2008b).

Serbian annual TLIstatistical reports do not offer the female'sshare and age distribution of the employed in the TLI. However, the overall female age distribution revealsthat only 11.8% of employed females are aged up to 25 years, or 17.1% are younger than 30 in 2012. On the other side, 55.85% of employed females were older than 50 years of age in 2012 (Statistical Office of the Republic of Serbia 2012a, p.47). This is an alarming situation, which can be a consequence of the overall long-term circumstances, including insufficient maternity support during the job, emigration of young, educated and skilled people, etc.

4.2.3 Transport and logistics labor market characteristics in Serbia

Although the process of privatization has started in the early 90's, and emerged after the political change in 2000, some vital and big enterprises in the TLI, which do not belong to the road sector, have not been privatized until 2013 (e.g. the national post, the railways, the airport Nikola Tesla and state air company, the port of Novi Sad, main part of the public urban mass transport etc.). The recent economic crisis combined with the abortive economic transition has had a serious impact on the transport industry. A high level of grey economy is recorded, particularly in the road transport industry (Srbijatransport, 2013).

Regarding the salaries, in the TLI sector, men's salariesare 101% of the average industry salary, while women earn 97% of the average industry salary (Statistical Office of the Republic of Serbia 2011c, p. 65). It might be predominantly, but not exclusively, related totheir occupations and lower management positions.

The first problem in exploring the women's share inthe TLI labor forcewe faced is a lack, or non-consistency of official data in different sources. For example, the Statistical Office of the Republic of Serbiaoffers two official sources with different number of employees in the TLI. According to one source, which uses survey methodology (2011b), the total number of employees in Transport and storagewas 122,788, with the women's share being 23.82%in 2011. Another source, where theannual statistical data are obtained regularly from all sector enterprises, the data showsonly 60,937 employees in the transport sector in the same year, without showing thewomen'sshare (2012b, p. 308).Furthermore, it is impossible to separate the labor data for passenger and freight transport. Therefore, in the rest of the section, we'll analyze the overall sector characteristics, with the limitation that it can be supposed that the gender distribution characteristics are similar across the sector.

The women's share of the total sector of the workforce has continuously recorded a growth until it was doubled atthe beginning of the new century, when it was stabilized around 20% (Statistical Office of the Republic of Serbia, 2008 and 2012a). Compared with 2011 (23.82%), the share of women in the labor force shows a slight decline in 2012 (20.36%), but it still cannot be considered as a trend.

Transport and storage belong to the sections and activities with the largest dropof employment rates. However, it is hard to estimate how much this number is related to the shifting of business toward the grey economy. According to data from the Statistical Office of the Republic of Serbia, from 2007-2011, the number of employees in the TLI (including the postal section) has decreased 12% (Statistical Office of the Republic of Serbia 2012b, p. 318**)**. The sector covers only 2.9% of total employed females in 2012 (Statistical Office of the Republic of Serbia 2012a, p. 21).

Although there are only 34 big enterprises among 4,586 in TLI, they employ the majority of the workforce - 64%, while approximately equal rates of employees share micro, small and middle enterprises (app. 12%) (Statistical Office of the Republic of Serbia, 2011a, p. 22).Most employees in the transport and storage sector have full time jobs (92%) (Statistical Office of the Republic of Serbia 2012a, p. 60).

Due to a lack of data related to vertical sex distribution within the enterprises, for that purpose, we used an example. As the postal section keeps agood level of industry employment, it was explored more in-depth.

4.2.4 The example of "PošteSrbije"

The postal operational network of Serbiastands as the largest infrastructure and logistics network in the country, although its activities are specific within the industry. The total number of employees in thepublic enterprise "PošteSrbije" in 2011 amounted to 14,939. The gender structuresofthe occupations and the management positions aregiven in Table 1.

TABLE 1TheGender Structure In Occupations And Management Positions In "PošteSrbije"in 2012

Position groups	Males (%)	Females (%)	Total (%)	Total (no.)
1. Top management (Board of Directors, CEO, Deputy of CEO)	100.00%	0.00%	100.00%	10
2. Middle management	43.75%	56.25%	100.00%	16
3. Low management	64.94%	35.06%	100.00%	77
4. Experts, professionals (engineers, economists, lawyers)	59.07%	40.93%	100.00%	2018
5. Technicians, associate professionals, controllers (also mostly with high education - engineers, economists, lawyers, etc.)	37.49%	62.51%	100.00%	2059
6. Administrative staff	34.44%	65.56%	100.00%	360
7. Drivers and delivery workers	98.61%	1.39%	100.00%	1511
8. Technical and technological staff (handling workers, warehouse staff, walking deliverers	57.38%	42.62%	100.00%	8923
9. Half-qualified and non-qualified workforce	61.76%	38.24%	100.00%	102
Total	**58.56%**	**41.44%**	**100.00%**	**15076**

The company employs 41% women, which is almost double than the industry average. The females slightly dominate among middle managers, technicians and controllers and administrative staff (groups 2, 5 and 6 in Table 1, respectively).

Although the women are surprisingly fairly presented in management, the gender inequality might be recognized in a couple of details - for example, the "zero presence" in top management and just 35% of the management positions in total. Also, comparing the position groups 4 and 5, both include high education (former entirely, latter mostly), butthe less average salaries are in group 5. This means thatwomen dominate in the position group where employees have less than average salariesfor the same education level.

It can be concluded that the company “PošteSrbije” mostly recognizes and uses equal employment opportunities, although there is room for improvement. However, according to the overall sector statistical data, it seems that the companycan be rather used as a good example for cross-TLI sector benchmark study, than a sector representative one.

4.3 The Republic of Macedonia

4.3.1 Economy characteristics

The Macedonian economy has faced many challenges since claiming its independence from Yugoslavia. With the implementation of the “management/employee buyouts (MEBOs)" the formation of privatization has had negative consequences onfuture growth and labor market developments (Zalduendo, 2003). Also, the absence of good infrastructure, and many political events like; UN sanctions on Yugoslavia as Macedonian largest market, Greek economic embargo in 1995, NATO attacks on Serbia and 2001 armed conflict in Macedonia,all created bad conditions for the development of the national economy.

In the lastfew years,the Macedonian government managed to develop a constant macroeconomic policy. Structural reforms and fiscal policy as well as a high level of public investments in the recent past, lead to a stabile macroeconomic condition and improved the business situationin the country.

The world economic crises had reduced economic growth of the country from 2009 to 2012, but on the other hand, numbers show that the crises did not have a negative impact on the unemployment rate. According to the data of the State statistical office (SSO), one of the key sectors that mitigate the effects of the world economic crises on the Macedonian economy in 2010 was the logistics sector (transport and communication) with a 5.1% growth. The government projections for the following yearsare expected to show further macroeconomic stability of the country that will reduce the unemployment rate and increase salaries.

4.3.2 Labor market characteristics in Macedonia

According to SSO, 56.5% (943,055 persons) of the population over the age of 15 was active and participating in the labor market, while 43.5% (726,910 persons) in 2012 were inactive. The unemployment ratefor 2012 was 31% (292,502 persons),which placesthe country atthe bottom of the European list of countries (SSO, 2013a).

The main characteristic of the labor market is that men participate much more than women (61% active men, 39% active women). Bearing this in mind, and considering the share of employed and unemployed men and women in the active population, a conclusion can be made that men and women in Macedonia have equal opportunities to find a job. Calculations show that the unemployment rate for women in Macedonia in 2012 was 30.3% and it is even lower than the unemployment rate formen – 31.5%.

What significantly contributes to the gender gap employment in the country is the high share of women in the inactive population. If we analyze the structure of the inactive population, data reveal that the share of women in the inactive population is 64% showing significantly higher female participation, whereby over 46% of inactive women are considered to be housewives. This is specific tomore traditional societies and strongly urgesus to consider individual and social factors when analyzing gender employment inequality in the transport and logistics industry.

According to the education statistics, the data shows that 53.6% of the employed individualshave a secondary education, of which 33.9% are men and 19.7% are women. The smallest percentages of employed individualsare individuals who havecompleted a higher vocational education (3.1%), and individuals without an education (3.2%). Rendering to the statistical reports, 21.1% of the employed persons had completed university level education, of which 10.8% men and 10.2% women (SSO, 2013a). It indicates that educated women have as equal opportunities for employment as men do. It also shows that women participate in jobs that are close to the decision making processes in the work place.

4.3.3 Transport and logistics labor market characteristics in Macedonia

There were 6,445 active companies in 2012 in the transport and logistics sector in Macedonia, which is 8.7% of the total active companies in the country (SSO, 2013d). Most of them (90%) are small

private companies with less than 10 people employed. Only 7 companies in this sector have more than 250 individuals employed and some of them, like railway companies (transport and infrastructure) and Macedonian post are state owned companies. Our calculations, based on the data of the Statistical review 2.4.13.07/748 shows that over 43% of the total individualsemployed in the sector work in the category of companies with 10 or less peopleemployed. This indicates that these small companies create most of the employment potential on the transport and logistics labor market. Data shows that 72% of the employed persons in the sector work in private companies. More than 15% of the employed in privately owned companies are women, compared to the companies with state ownership, where more than 23% are women. Therefore it can be concluded that state companies employ more women than private companies do.

Table 2 shows that over 76% of the total employees in the transport and storage sector are working in land transportation. We can also notice that some logistics subsectors like air transportation or postal and courier services which are using higher levels of technology, as well as more sophisticated equipment and working methods, have low level of GEI. Still these subsectors are only 9% of the total labor force in the transport and storage sector and do not have much influence onreducing the gender employment gap in the logistics sector in Republic of Macedonia.

TABLE 2 Employees In Transport And Storage Sector By Types Of Ownership, 2012 (Data Are Weighted)

Sector / subsectors	**Total**		**Ownership**			
			Private		Other	
	Total	Women	Total	Women	Total	Women
Transport and storage	28441	4993 (18%)	20436	3146 (15%)	8005	1847 (23%)
Land transportation and transportation via pipelines	21750	3177 (15%)	17805	2402 (13%)	3945	774 (20%)
Air transportation	73	32 (44%)	73	32 (44%)	-	-
Warehousing and support activities for transportation	4167	869 (21%)	2347	603 (26%)	1820	265 (15%)
Postal and courier activities	2451	915 (37%)	212	108 (51%)	2239	807 (36%)

Source: SSO, Statistical review 2.4.13.07/748, p.16

Land transportation has the highest disproportion ofgender employment, as less than 15% of the total employees in this subsector are women. That is why we must point to gender employment improvements in land transportation. Reducing the gap in land transportation will cause a reduction in the overall gender employment inequality in the transport and logistics industry in the country.

One of the good signs ofgender employment equality in the sector is that the number of persons employed in 2012 increased compared to 2011, as a result of employing more women in the land transportation subsector (SSO, 2013b, p.11).

Most of the employed (95%) in this sector are full time workers. By economic status, the structure of the employed shows that 75% are employee, 8% employer and 15% are self-employed. According to the analysis of the structure of the employed by occupation in the business entireties, most of the workers in this sector are plant and machine operators and assemblers (56% in 2012) which is expected bearing in mind the characteristics of the sector (Table 2). The number of employed inthese positions has increased nearly 6.5% from 2012 to 2011. On the other hand, the share of managers and professionals in this sector, which includesindividuals with higher levels of education, is low (7.4% in 2012) and has decreased in 2012 compared to 2011 (SSO, 2012a, 2013a). So, as we have noticed initially one of the specifics of the Macedonian labor market is a lowerparticipation of women without higher education. Thus we can conclude that at this point, the specifics of the transport and logistics labor market favors men over women.

We can support these findings by analyzing the employed individuals in the transport and logistics sector by gender. Barely 17.5% of the total workers in the sector are women and they only contributed with less than 2% of total women workers in Macedonia in 2012 (SSO, 2013b). Most of them are

aged 25-64. An encouraging situation is that the number of young women employed in this sector has doubled in 2012 compared to 2011 (Table 3). It leads to anincrease ofthe share of employed young women in the total young people employed in the sector from 10% in 2011 to 25% in 2012. Even though their share in total employment in this sector is insignificant, it still shows that young women are getting more chances than before for employment in the logistics sector. It might be an indicator ofcertain improvements in the sector on the gender employment issue.However,this picture is pretty different from the Eurostat statistics data about the Republic of Macedonia (13.3% of women share), although there is still much room for further improvement.

TABLE 3 Employed by Activity of Business Entities, Age and Gender

	Men			**Women**		
Transport and storage	15-24	25-64	65 and over	15-24	25-64	65 and over
2011*	1068	25260	40	129	3837	53
2012**	753	25608	-	264	3750	36

Source: * statistical review 2.4.12.11/727, p.45, ** Statistical review 2.4.13.06/745, p.56

Still, at this level of development of the country and thelabor market, we cannot say that there is high potential for opening new job positions at the moment in the transport and logistics sector.

Now we can conclude that the employment in Macedonia is characterized by a very unfavorable gender structure. This situation also appliestothe employment rate in the logistics sector. We have identified some reasons why this condition has not changed over a longer period of time as: unstable economic and social conditions in the country; imbalance between the available and required profiles on the labor market; the traditional role of the femalein a family, especially in rural areas; small number of women employed in land transportation as a result of low level of technical and technological development of this logistic subsector compared to other subsectors, etc.

5. DISCUSSION

Our research tackled an important question of GEI in the TLI in two Balkan countries. We started from the GOS perspective, and analyzed all threehierarchical levels. Our research confirms that there are much more similarities than differences between the two countries in many ways. The overall impression is that the women's personal capabilities and characteristics, social norms and gender stereotypesare not the source for the significant differences between Serbian and Macedonian female sharesof theTLI labor workforce.

The impact of organizational factors on GEI is strongly related with industry-specific characteristics and circumstances. The number of middle-sized and big enterprises has strongly decreased in the recent period, and it is difficultto speak about career and vertical progress ofmanagement positions in micro and small firms. The available data from Serbia shows that in big enterprises organizational factors have similar characteristics as in other, more developed countries. However, in both countries, the dominance of small firms in the TLI sector limits the variability of impacts of organizational factors.

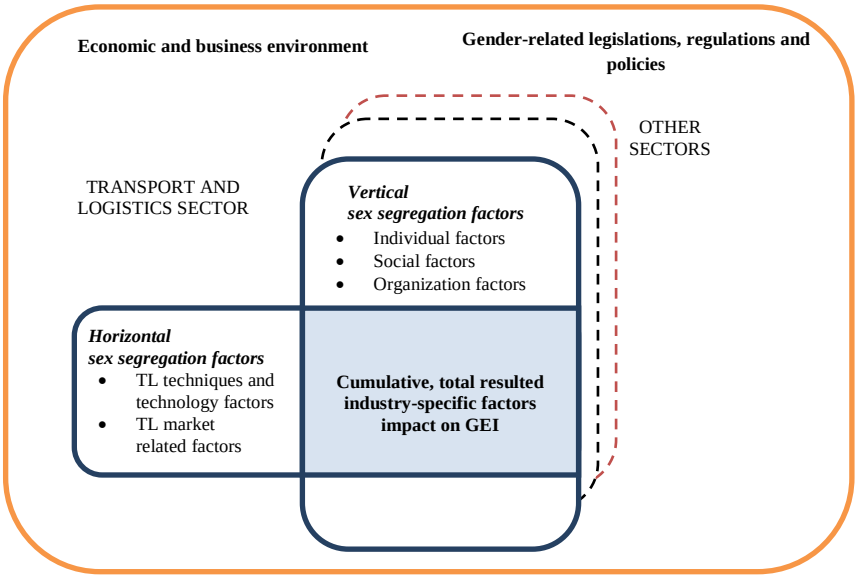
It was obvious that GOS was not enough to explain by itself the gap in women's share of theTLI workforce. Therefore, we expand the analysis on industry specific factors and, particularly, the impact of the macroeconomic environment on it. This extended research framework on GEI, which comprise horizontal, vertical and environmental impact factors,is given in Fig. 1. The sector gender employment inequality is a result of complex (direct or indirect) impacts of all these factors. While GOS may find the same reasons for GEI in different sectors, the sector and environmental factors explain percentage variations between the sectors and economies and they are principal for sector improvement measures.

Old infrastructure, transport, storage and transhipment capacities strongly impact on competitiveness and the overall employment in the TLI in both countries. Theyalso contribute negatively onthe share

of employed women in the TLI. Changing educational levels and improving technology are necessary preconditions, to reconstruct the patterns of gender segregation. While the women's educational level has improved in recent decades, there are often transport capacities and equipment older than 10 years, where still traditional physical work is necessary. Therefore, improving technology should be considered in order for many limitations regarding GEI to decrease in the industry.

The gender-related legislative framework progressing toward women's protection issimilar in both countries. In the socialist period, women had legally protected rights, and it made ground for their better share in the workforce in state-owned enterprises. According to the EU standards, both countries have started to introduce a set of laws and regulations that highlights a need for gender equality and equity, and constituted the governmental bodies and offices which continuously support their implementation and monitoring, but the developments of the institutions are yet to be finished.

FIGURE 1 Thesources of impact factors on sex segregation in transport and logistics sector



They also improved the statistical database on gender employment and unemployment, but there is still a lack of some data and an inconsistence between the sources within and between the countries.

According to the obtained data, it seems that GEI is rather expressed in the structure of the inactive population, particularly in the "willing and able to work" group, than in the share of the unemployed workforce. Women desire full time jobs because they arekeyfor increasing the family income.

The most recent trend is that the Republic of Macedonia records a slight increase of the women's share in the workforce in the TLI, while the Republic of Serbia records a slight stagnation in 2012. However, it is too early to makeany conclusions and further research on these trends in the forthcoming period is necessary.

The most important difference between the two countries is in the total number of employed in the TLI, and the employment rate in big and middle sized companies in Serbia, which are still mostly state-owned. Although these enterprises often record an excess of employees, they still treat them more carefully and with more sense for social factors than the private sector and, particularly, small firms in the industry. According to the results, we can express the concernsthat decreasing the number of state ownership in Serbia could have a serious impact on further decreasing the women's share in the TLI workforce. This hypothesis has to be more thoroughly explored in further research.

According to the findings in this research, we can identify the main factors related to the improvement in gender employment equality in the TLI in both countries:

- Maintenance of macroeconomic stability of the countries, and improvementof the overall business climate and country competitiveness. It will contribute to the sector both through the increased transport activities and create a better business environment, particularly when it comes to the grey market.
- Increasing the level of technological development of the TLI and attracting the investments.
- Generating opportunities for part time employment and flexible arrangements with the intention of legal support to balancing women's private and public lives.
- Adjusting the educational system according to the labor market needs and introducing training programs to increase theskills and competencies of women.
- Availability and consistency of statistical data, necessary for making governmental policies on gender equality and equity in the TLI in both countries.
- Supporting sector programs for self-employment with improved access and facilities for women to start and run their own businesses.
- Further compliance of national gender-related regulations with European standards and their implementation in practice.
- As the big enterprises are still mostly under state control, it could be taken as an opportunity to implement and control selected gender equality policies, where possible.
- Caring not only about quantity, but also about quality in gender mainstreaming (Wittbom, 2011).

We are completely aware of the challenges involved in implementing therelated measures, but we think that future research and praxis has to be directed atsupportingthem. Also, the aim shouldn't be only directedatclosing the gap, but to mutually use the experiences, particularly of goodexamplesin both countries to make the improvements.

6. CONCLUSION

Women in the TLI suffer both horizontal and vertical sex segregation more so than in most of the other sectors. Therefore, the attention directed toward gender mainstreaming and efforts to reach it should be more appropriate. Surprisingly, the literature research reveals that there are indeed small concrete directions related tohigher women employment rates in the TLI.

In the post-socialist period, the economy transition, and recently, the economic crisis, both reflect on an overall unemployment rate and endangered labor rights in both countries. The TLI in such economies facesvarious challenges. They are related primarily, but not exclusively with privatization, an increased level of unemployment, grey economy, old technology and insufficient funds for investment into further development. In such conditions, the enterprises try to survive in a more challenged market than in developed countries, and the workforce suffers the consequences in different ways. Although such consequences target the workforce as a whole, women, as a more vulnerable group, may often feel a synergy of negative impacts and, therefore, require additional efforts to be protected.

We identified a list of the most important factors thatcontribute to GEI. It is difficult to weigh their priority without more in-depth research, but intuitively, we think that an overall economic development is theprimary goal. For example, investing in education and training without an overall economic development and welfarecould have very serious and complex consequences. It maypartly improve the level of women employed in the TLI, but it can also contribute to a higher level of unemployed highly-educated young women, or their migration from the countries.

The paper underpins the necessity to go beyond traditional GOS analysis and to understand industry specifics within the overall economy environment. There is a need fordevelopinga more comprehensive database for continuous monitoring of gender mainstreaming in the TLI. It is one of the preconditions for applying all related current and future gender related policies, regulations and recommendations.

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A list of Acronyms:

GEI - gender employment inequality
TLI - transport and logistics industry
GOS - Gender Organization System" perspective
CEE/CIS - Central and Eastern Europe/ Commonwealth of Independent States
WWII - World War II
PTT - Postal transport and telecommunications, an acronym used in the name of the company "PošteSrbije"
SSO – State statistical office

The Challenges of Enhancing Women's Mobility: Examples from Road Rehabilitation Projects in Timor Leste and Kiribati

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Knowledge about men and women's transportation needs and patterns cannot be taken for granted. In many transportation projects in developing countries, the relevant social and cultural context of gender differences is not analyzed.Without such knowledge, transport interventions meant to cater to both men and women's transport burdens cannot be tailored. To capture evidence of the challenges and needs of project road beneficiaries, and women in particular,social benefit surveys that included focus group consultations were piloted in the context of two road rehabilitation projects in the Pacific Island region. The surveys which took place in 2011-2012 covered ninevillages with 209 households from Kiribati and tenvillages with 360 households from Timor Leste. The results providedexamples of constraints affecting the transport access, mobility and safety needs of men and women as well as missed opportunities for improvement. The findings highlightedthe challenges and concerns of the intended project beneficiariesregarding road use. No significant differences between men and women were found in relation to the appreciation of road conditions. No gender link was shown in relation to perceived road condition and increased employment opportunities or agricultural productivity. However, there were gender differences in relation to use of modes of transport, personal safety issues and accessing services such as health and education. Thisreview demonstratesthe critical importance of collecting gender-disaggregated data for planning and implementing road transport projects, and ensuring that these data are used to adapt project investments to maximize opportunities for both men and women.

1. INTRODUCTION

The development of road infrastructure is critical for economic growth and social development in many developing countries. A particular challenge is how to address the transport needs of people living in rural areas where low population density and low income levels make the supply of accessible transport more difficult. In addition, conventional rural road transport planning has tended to focus on road networks and long-distance transport of goods with less consideration for the transport needs and requirements of the rural poor. There is often a lack of information on the travel patterns at the village or household level and by gender.

Surveys implemented in the context of two road rehabilitation projects in the Republics of Timor Leste, and Kiribati in the Pacific Region, demonstrate the importance of understanding local constraints. In addition to both being located in the East Asian and Pacific Island region, the countries of Kiribati and Timor Leste both have small populations, with the majority of the population concentrated around the capital cities. While the projects' focuses were different, the fundamental road design elements of each project sought to address the overall condition and usability of the roads.

Social benefit surveys and focus group consultations in Kiribati andTimor Leste were undertaken to determine the possible impact of the road projects on the communities living in the project areas and to inform the detailed designs. The surveys helpedcapture some of the views of men and women beneficiaries concerning household transport, general road use and access to transport options, road safety, and access to school and healthcare facilities. Results of focus group consultations and social benefit surveys provide examples of some of the constraints affecting the transport access and safety of women and their communities; their mobility needs and missed opportunities for adequate transport planning.

To understand the constraints of women in the Pacific Island Countries (PICs), where there was no previous gender assessment of differences in transport access and mobility patterns, the present review contrasts the results of the surveys of these two road rehabilitation projects. It contrasts the findings with existing literature on gender and transport and concludes with recommendations for encouraging the participation of local beneficiaries in assessing the needs

and in setting priorities to improve transport efficiency and access. While the surveys were successful in capturing important gender concerns, the results also highlight the limitations of small scale surveys and the necessity to tailor research to collecting gender-disaggregated data. In the end,only the survey data done in Timor-Leste adequatelycaptured gender-disaggregated data. In both countries however, data collected remains insufficient to meaningfully evaluate the factors that may influence mobility and access to transportation of both men and women.

2. GENDER BENEFITS OF ROAD TRANSPORT INVESTMENTS

The literature on transport access in rural areas and the impact of investments on rural transport by gender is limited. There are nonetheless several benchmark studies that identified a number of factors that are gender specific for planning transport interventions and show that women tend to have access to a wider range of social and economic opportunities where transportation is available, safe and affordable.

Trip patterns of women in rural areas. The mobility patterns of women in rural areas tend to relate to their domestic, economic and social tasks. Women make trips to take care of their children, handle household responsibilities and to maintain community and social networks (Moser 1993). In rural areas, women's domestic travel can also include fetching water, firewood and food (Malmberg-Calvo 1994). In terms of trip purposes, women tend to travel to access services at education and health facilities, visit relatives and go to church and shopping. Women are more likely than men to travel for health and education and to conduct shopping activities (Srinivasan 2002; Hettige 2006). Women are also more likely to work closer to home because they tend to have fewer work opportunities and transportation choices to get to their work opportunities (Srinivasan 2002). A recurring theme from these trip patterns is that women are often at the greatest risk from road safety issues.

The mobility constraints of women. Women in rural areas have much less access to private motorized modes of transport such as cars and their most prominent mode of travel remains

walking and headloading[1] (Venter et al. 2007; Srinivasan 2002; Fernando and Porter 2002). For many women in rural areas of developing countries, intermediate modes of transport (IMTs) are the most accessible and affordable modes of transport available other than walking. While IMTs can increase access to markets, schools and health care facilities, their introduction needs to be adapted to local contexts, taking into account local cultural norms and traditions (World Bank 2010). A study in Uganda on access to bicycles found that women were denied access to bicycles for both economic and social reasons (Malmberg-Calvo 1994). Likewise in Tamil Nadu, India, women may gain access to bicycles but they rarely control its use as men's or boys' needs can take precedence (Rao 2002) or as a status symbol (Bryceson and Howe 1993).

Access to maternal and child care services. Empirical evidence from developing countries that quantifies the availability and access to transport for health reasons is scarce (Babinard and Roberts 2006).Evidence suggests thatin rural areas, considerable time is spent by women and their families waiting for transportation and traveling to a health facility. In addition, poor roads, too few vehicle and high transportation costs are major causes of delay in deciding to seek and reach emergency obstetric and postnatal care. Improving access to emergency transport could help reduce maternal and child mortality rates. It is estimated that in some cases, 75 percent of the women who die in the course of childbirth do so as a result of inadequate emergency transport. There are examples of transport interventions that have successfully provided better access to maternal and child care. However, evidence of sustainable good practice at a country or regional level remains limited. In addition, studies are primarily of community interventions in Africa, making comparisons between interventions and across various levels of referral difficult (Babinard and Roberts 2006).

Rural transport projects with gender dimensions. Projects that have best addressed women's needs in transportation have taken gender into account. In the context of the World Bank's Peru Rural Roads Project, women were given the opportunity to express their transport needs in participatory workshops. The results of the focus group consultations and survey work led to changes in the program designs to support the improvement of roads connecting to the

[1] Across many Sub-Saharan countries, and in some parts of other developing countries, women carry loads, including water and firewood for domestic purposes, on their heads. This is has been linked to the lack of alternative modes of transport and also has consequences for the health and well-being of women.

communities and of non-motorized tracks, which are most often used by women and are commonly ignored by traditional road upgrading programs (World Bank 2007). The forthcoming World Bank financed Papua New Guinea Road Maintenance and Rehabilitation Project Phase 2, contains specific activities to address gender, including empowerment through employment creation. The forthcoming World Bank financed social benefit survey for the Samoa Enhanced Road Access and Enhancing the Climate Resilience of the West Coast Road Projects, will analyze the current concerns, problems and experiences of the beneficiaries, with a particular focus on women in relation to the existing transport infrastructure. The survey will be undertaken by a local consultant and the team will include male and female enumerators and female representatives from the Department Women, Community and Social Development and the data will be gender disaggregated.

3. THE ROAD PROJECTS

The surveys took place in the context of road projects aimed to repair and rehabilitate critical transportation connections on the main road networks of Kiribati and Timor Leste. These projects were the first World Bank financed road investment projects in both countries due to the very difficult and deteriorating road conditions in both countries.

The Kiribati Road Rehabilitation Project.With an estimated population of 101,000, Kiribati is a small remote country comprised of 33 atolls and reef islands of which 21 are permanently inhabited and 44 percent of its population living in its capital, the South Tarawa atoll (maximum elevation 3 meters above sea level). There is one main road along the length of South Tarawa, connecting several small islands with causeways. All road traffic on South Tarawa travels along the road, and all other roads connect to this one main road.There is very high population density along the road due to the scarcity of land in South Tarawa. The project would therefore directly or indirectly affect all inhabitants on the atoll.

The Kiribati Road Rehabilitation Project[2] is designed to improve the condition of South Tarawa's main road (approximately 26 km inlength) and to help strengthen road financing and

[2] The Kiribati Road Rehabilitation Project is jointly financed by the World Bank, the Asian Development Bank, the Government of Australiathrough Pacific Region Infrastructure Facility, and the Government of Kiribati(GoK).

maintenance capacity. Currently, the road system consists of about 36 km of bituminous sealed main roads (including causeways), about 20 km of secondary roads (half of which are sealed and half unsealed); and about 40 km of unsealed feeder roads. Virtually the entire population lives close to, and is affected by, the road's condition. While about 7 km of main road in Betio in the west of South Tarawa was rehabilitated in 2008 using finance from Japan, about 29 km of paved roads have received no major maintenance for over twenty years.

Road use on South Tarawa is growing rapidly: in central Bairiki, traffic volume on the main road has reached 6,000 vehicles per day and is growing at an average rate of 4 percent per year. High traffic levels on the road combined with persistent heavy rainfall in 2009/10 have caused extensive damage, to the extent that substantial sections have completely lost their surface and reverted to unpaved status. The state and condition of the roads in Kiribati are having both economic and social repercussions; particularly with regards to the health and safety of the population. The traffic speed has been reduced in places to 20 km/h or less as a result of the damage, and driving conditions are hazardous, particularly after the rain. In 2010 taxi drivers went on strike because they were unable to make the usual five return trips per day along South Tarawa, sometimes only managing at most three. Further, during the dry season the dust from unpaved sections of the road is contributing to upper respiratory problems among local residents.

The Timor-Leste Road Climate Resilience Project.In contrast, with an estimated population 1.1 million, Timor Leste comprises the eastern half of the island of Timor, the nearby islands of Atauro and Jaco, and Oecussi, an enclave on the north-western side of the island of Timor within the Indonesian West Timor Leste. Dili, the capital of Timor Leste supports approximately 20 percent of the total population (220,000 people).Timor Leste is a very mountainous country, with a spine dominated by Mount Ramulau, bisecting the island from east to west and located in proximity to the Dili-Ainaro road corridor. Approximately 44 percent of Timor Leste's total land area lies between 100 and 500 meters in elevation, and 35 percent lies above 1,000 meters. The coastal zones in many parts of Timor Leste consist of narrow steep hillsides.

Financed by theWorld Bank and the Government of Timor Leste, the Timor Leste Climate Resilience Project is designed to increase the climate resilience of the Dili to Ainaro road

corridor(approximately 113 km in length) and to help strengthen climate responsive maintenance and emergencyplanning and response systems. Very little improvement has been made over the years to the road network, other than some work on the main road between Dili and the Indonesian border with West Timor and emergency repairs–largely a result of frequent landslides. Japan International Cooperation Agency (JICA) has done some work on selected links, largely rehabilitation and resurfacing.

According to a road condition survey in 2009, the national road network has almost entirely deteriorated and is no longer maintainable. Many roads are often impassable during the rainy season due to landslides and road failure. This has arisen in a large measure due to underinvestment in maintenance and resulted in increased isolation of communities, higher vehicle operating and freight costs, and longer journey times. In many cases, however, the roads were also not properly designed, lack sufficient drainage capacity and/or are structurally unsound. Due to the steep terrain, ground conditions and local climate, slope instability is a major problem and frequent slips result in significant damage to the road network and potential risk to road users. Combined with the general shortage of maintenance funds, these factors result in the need to focus on emergency repairs rather than systematic maintenance.

4. DATA AND METHODOLOGY

Conducted between December 2011 and July 2012, the surveys were adopted during the preparation of both projects to inform each road design. The methodology used for each survey included the use of a household questionnaire and focus group discussions (Table 1). Each survey collected household data from villages near areas of the project.

Sampling and data collection.Local consultants were used to undertake the surveys. The sample populations were selected on the basis of their proximity to the project areas. In Kiribati, the road network is primarily located in South Tarawa and sample villages were selected along the main corridor spanning from the airport at Bonkiri in the East of Betio to the main port town in the West between January and February 2011. In Timor Leste, the sample included a number of *Sucos*at approximate distances long the road from the start of the Dili-Ainaro corridor.

Table 1:Characteristics of Social Benefit Surveys

Study area	Sample size	Questionnaire & methodology	Focus groups	Location of data collection
South Tarawa road, Kiribati (Kiribati Road Rehabilitation Project (KRRP))	209 hh selected from 9 villages	65 questions in structured questionnaire with focus group discussions led by semi-structured interview guide.	6 focus groups targeting different stakeholders (village; women; catholic youth group; bus driver; mini store owners; and big store owners).	6 villages (Bikenibeu, Temaiku, Eita, Banraeabra, Teaoraereke and Bairiki) and 3 control villages (Bonriki, Teaoraereke (off-road) and Bikenibeu (off-road).
Dili to AirnaroRoad Corridor, Timor Leste (Timor Leste Climate Resilience Project)	360 hh selected from 18 *Aldeias* from 10 *Sucos*[3].	70 questions in structured questionnaire with focus group discussions led by semi-structure interview guide.	4 focus groups targeting both men and women from(1 focus group of 7 men; 1 focus group of 6 women; 2 focus groups of 19 men and women in total). Participants included *Suco*chiefs,youth chiefs and youth members, business merchants, local agriculturists, housewives and public officials.Attendees were selected from listed provided by the S*uco* chiefs	10 *Sucos*selected from six sub-districts located in the three districts (Dili; Aileu; Ainaro) traversed by the road. 8*Aldeias*surveyed in the Aileu district, 8 in the Ainaro district and 2 in the Dili district.

Focus groups. Each household survey included the interviews of focus groups covering various groups of stakeholders ranging from store owners, villagers and church goers to women. Focus groups aimed to provide valuable qualitative information that would not have been captured by the quantitative analysis of the formal survey work. It also allows groups that are underrepresented or who may not often be provided with the opportunity to share their views to participate and share their views. The discussions of the focus groups sought to capture the main

[3]sub-village administration units that together form a Suco or village.

concerns and problems experienced by project beneficiaries in relation to travelling on the road. The focus group consultations also provided data to assess whether there was broad community support for the road programs and proposed activities in the respective project areas.

5. MAIN FINDINGS

The findings highlight the challenges and concerns of the intended project beneficiaries regarding road use. No significant differences between men and women were found in relation to the appreciation of road conditions or in relation to perceived road. However, there are gender differences in relation to use of modes of transport, personal safety issues and accessing services such as health and education.

Household characteristics.Household sizes in both Kiribati and Timor Lesteare relatively large, with a high number of people under the age of 18 sleeping in the homestead on a regular basis. These resultsare characteristic of the typical demographic composition of households in countries of the region. The majority ofrespondents were either the Head, or the Husband or Wife of the Head, of the household (78 percent in Kiribati and89 percent in Timor Leste). In Kiribati and Timor Leste some 60 percent of households had six to nine people sleeping in the homestead ona regular basis and some 10 percent had over ten people sleeping in their homestead on a regular basis.

There are differences in terms of length that respondents have lived in their current location. Respondents from Timor Leste reported a longer term of residence at their current homestead, while majority ofrespondents from Kiribati reported having recently moved to Tarawa atoll from other islands in Kiribati. In Timor Leste some 80 percent of respondentshad lived in their homestead for more than 20 years and in Kiribati some 67 percent of respondents have lived intheir homestead for more than five years.

Modes of transport. Both Kiribati and Timor-Leste are low income countries, and this is reflected by low levels of car ownership. The most reported forms of transport in Kiribati and Timor Leste were “publictransport” and “walking”, followed by “motorbike” or “driving a car”. In Kiribati the response “minibus” receivedthe highest proportion of answers (77 percent)

followed by “walking” (46 percent) and then “driving (their) own car” (16percent). In Timor Leste the response “walking” received the highest proportion of answers (67 percent), followed by“public transport” (14 percent) and “motorbike” (14 percent).

In both countries, alternative modes of transport to the car are predominant for different reasons. In Timor Leste, it is primarily becauseowning a car is not common and the Dili to Ainaro roadcorridor is not well serviced by public transport. In Kiribati car ownership is similarly low, however public transportis more readily available and is frequently utilized by respondents as reflected in the survey results.In Kiribati only 26 percent of respondents andin Timor Leste 21 percent of respondents reported owning or having someone in their homestead own a car ormotorbike.

When the main forms of transport were examined by gender (Figure 1), the results demonstrated moderate gender differences. Slightly more women than men reported ‘walking’ (69 percent) and using ‘public transport’ (16 percent) as their main forms of transport, while moderately more men than women reported ‘motorbike’ (16 percent) and driving their ‘own car’ (3 percent) as their main forms of transport.

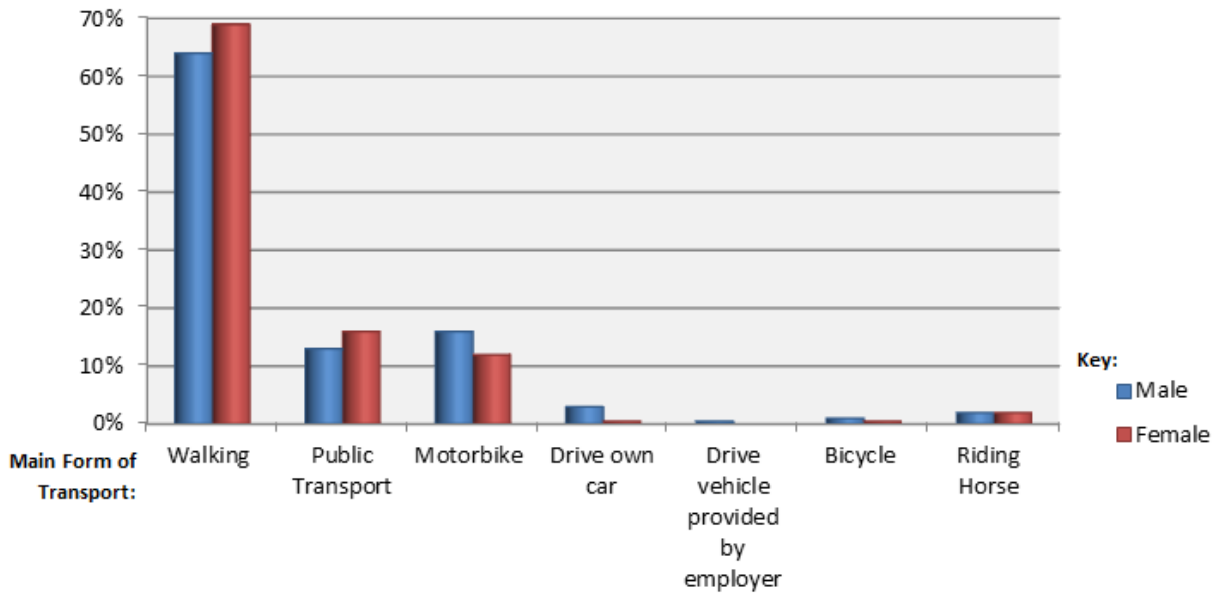

Figure 1:Mode of transport by gender in Timor Leste

Road conditions and quality. The surveys showed that the road network is in poor and deteriorating condition in both Kiribati and Timor Leste, with secondary and feeder roads in even poorer conditions. However, there were no gender differences reported regarding the overall poor condition of roads affecting residents' level of comfort except in the case where expecting women need to travel to reach maternal health services.

When asked about the general condition of the road and the condition of the road between seasons, 88 percent of respondents in Kiribati statedthat they considered the general condition of the main road to be "very poor" or "poor". In Timor Leste 91 percent ofrespondents considered that the general condition of the Dili to Ainaro road is "very poor" or "poor".The questionnaires in Kiribati and Timor Leste asked questions related to the condition of the road during the 'wet' and 'dry'seasons. Respondents from both Kiribati and Timor Leste indicated that the condition of the roads deteriorates during thewet season. Some 95 percent of respondents from Kiribati reported that the condition of the road during periods ofheavy rain was "very poor" and "poor".

Another important criterion associated with road conditions is the quality of the road infrastructure and its linkages to perceptions of comfort. In Kiribati 80 percent of respondents cited that it was "veryuncomfortable" or "not very comfortable" and 17 percent responding that it was "comfortable" or "verycomfortable".The impact of the condition of the road on the level of comfort was highlighted by participants from focusgroup consultations in Kiribati and Timor Leste. In Kiribati the Bus Driver Focus Group stated that they would "*only drive on tar-sealed roads because it is comfortable to drive on and the bus won't easily breakdown*" and in Timor Leste one focus group member commented "*I think the problem is my whole body is painful when traveling to Dili to Ainaro because the condition of the road is bad'.*

Trip patterns and frequency. In Kiribati, some 60 percent of respondents reported that they spend five or more timestravelling along the main road during the weekdays or school term by motorized vehicle, while only 18 percentreported traveling one to two times per day on the main road.InTimor Leste 74 percent ofrespondents travel one to two times per day by motorized vehicle (car, motorbike and public transport) during theweek, 91 percent of respondents travel

one to two times per day over the weekend, and some 56 percent of the respondents walk one to two times per day along the Dili to Ainaro road.

The results alsoshowed slightly longer time is spent traveling on the road in Timor Lestethan in Kiribati, where more than 42 percent of the respondents spend between five to 29 minutes a day travelling along the mainroad, 28 percent spend 29 minutes to 1 hour, and almost 20 percent spend one to three hours. In contrast in Timor Leste, 34 percent of the respondents spendfive to29 minutes a day travelling along the Dili to Ainaro road, 22 percent spend 29 minutes to one hour, 34 percentspend one to three hours and 15 percent spend more than three hours travelling.

The results showed respondents in Kiribati perceive traffic isheavier than respondents in Timor Leste. In Kiribati, almost 90 percentof respondents agreed that traffic on the main road is “very heavy” or “heavy”, while only 58 percent of respondents in Timor Leste think that traffic on the Dili to Ainaro roadis “heavy” to “medium” and 24 percent reported that the travel level is “light”. The likely reason for a reported heavierlevel of traffic reported in Kiribati is because there is only one road forall traffic in South Tarawa, leading the same cars, mini-buses and trucks to travel on the road multiple times per day. While in Timor Leste, the mountainous terrain andpoor road condition may result in respondents opting to travel on the Dili to Ainaro road only when necessaryor when an alternative route is not available.

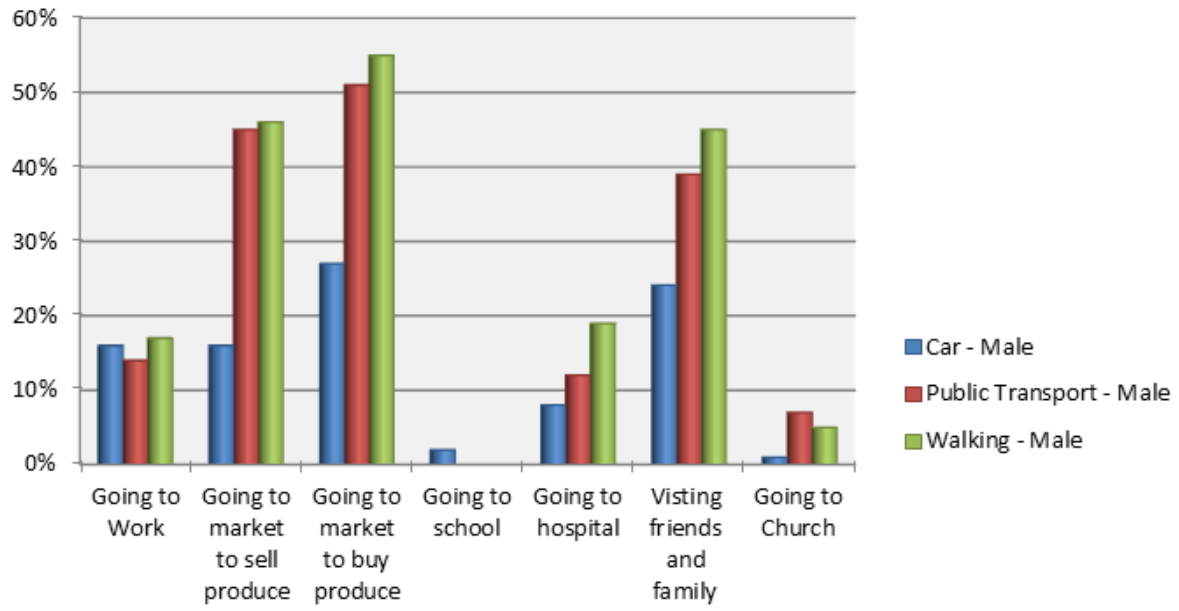

Figure 2:Male Trip patterns by mode of transport in Timor Leste

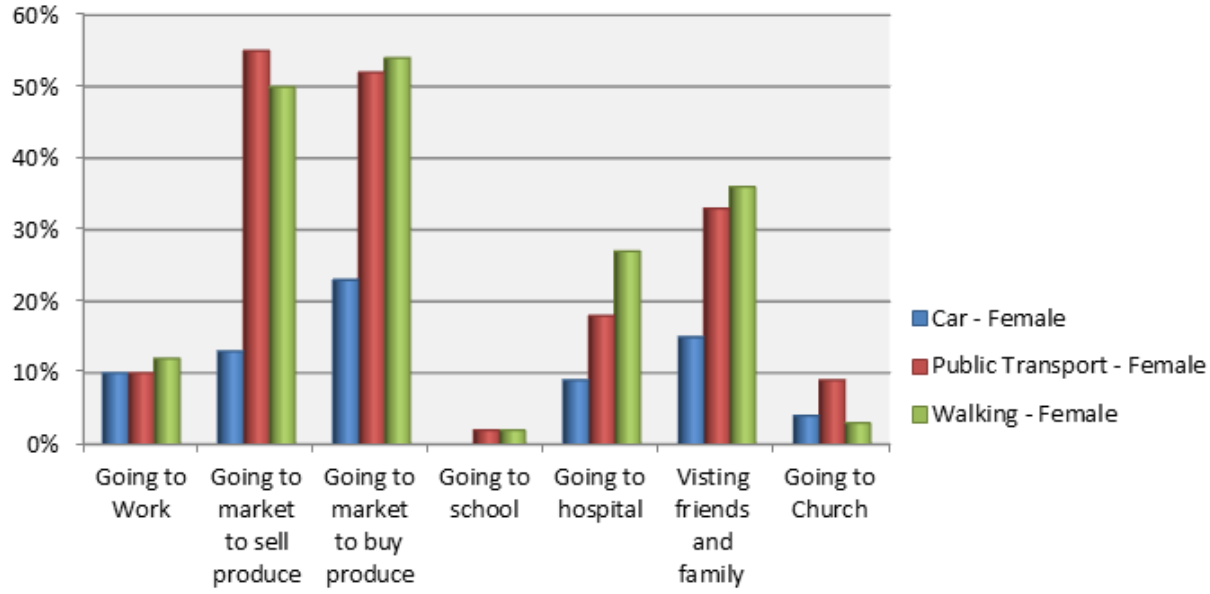

Figure 3:Female trip patterns by mode of transport in Timor Leste

Gender differences exist in both Kiribati and Timor Leste in the way transportation is used. Women are also more likely to walk and use public transport to get from one point to another.Men and women reported using all modes of transport to undertake their daily tasks,

except for going to school where only men reported using a car and only women reported using public transport or walking. In general, more men reported using a “car or motorbike” to undertake their weekly activities, while women are generally more reliant on “public transport” and “walking”.

The results also demonstrate differences between men and women’s general purpose of weekly travel and highlight that there are differences between men’s and women’s preferred mode of transport used to execute their weekly activities. While a comparative percentage of men and women reported going “to market to buy produce”, more women reported using the Dili to Ainaro road to “go to market to sell produce” and to undertake this task the women typically utilized “public transport” or “walking”, with 10 percent more women than men reporting using public transport for this purpose and at least five percent more women than men reported ‘walking’ (Figure 3). The results also demonstrated that more women reported using the Dili to Ainaro road during the week to attend a “hospital or health center”, while more men reported using the road to “visit friends and family”.

Access to maternal health services.The concern of maternal health and safety was raised in Kiribati and Timor Leste with focus group consultations reportingthat women’s maternal health is at risk due to poor road conditions and the subsequent poor level of comfort experienced while traveling on them.

The results from Timor Leste focus group consultations related to this issue of potholes, unprotected steep ravines andlandslides and the impact that these can have on maternal health as women struggle to access to health careservices and to access them in time to give birth.

When focus group participants in Timor Leste were asked how the improvedroad could benefit their household and access to essential services, several participants reported that road improvements would have a “*positive impact to the pregnant women because they can access the hospital in the time of giving birth to their children*”, while others reported that the rehabilitation of the road would facilitate easier access tothese essential services in general. They also indicated that the condition of the road “*made it worse for the pregnant women to travel*” and “*such condition of the road effects pregnant women all the time because it is not safe*”, and

"*sometimes mothers give birth to their children on their way to hospital for they move too slow and because ambulance cannot come to our place*".

Women and personal security. Another significant concern raised by community groups in relation to roads was the lack of personal safety and in particular ways to improve the personal safety of women by adding street lighting along the main road.A related concern was the need for improving road safety and the need for improving road safety and mobility features such as through the provision of footpaths (Figure 4).

In Kiribati, the Anraei/TeKawaaeBoou Village Focus Group inBonriki village, a main point raised was that "*their women are not safe because the buses don't drive through their village so the people have to get off from the airport and walk about 300-500 meters back to their village*". The same focus group listed traffic lights, street lights, bus stop/shelter and drainage as the most important safety improvements that they would like to see on the main road.Itwas also stated that an advantage of an improved road would be that "*women won't have any problems because they won't be walking a long distance to get home and won't have any cases of rape*."

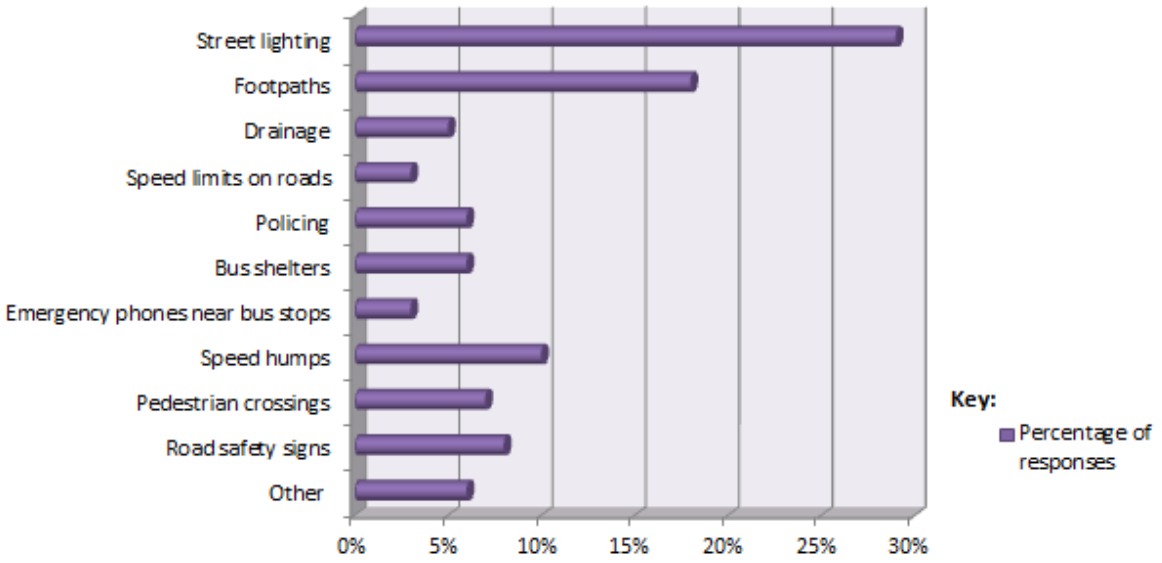

Figure 4:Road safety features requested across gender in Kiribati

Access to education. The poor quality of roads was also cited as a factor impacting the travel times and the duration of trips. While it only takes between five and thirty minutes to travel to school in the dry season for some 70 percent of children in Kiribati, it takes take half an hour to an hour for another 20 percent of the children, which is substantial considering the small size of South Tarawa atoll.In the wet season this number increases to over 30 percent.

Of particular concern for women is that poor road conditions also affect transport services, thereby limiting children's access to schools. In Kiribati, the women focus group reported the problem of buses not picking up school children, and it wassuggested that designated school buses should operate to ensure school children get to school. Further,when children are waiting for the bus, there is no bus shelter to reduce the effect of the sun's heat or the rain.The women's focus group also identified the problem of children not being safe as there is no specific spacefor them to walk on or ride their bicycles to school. One focus group in Timor Leste commented that issues of students sometimes being in accidents because the Dili to Ainaro road is narrow and there is a lack of footpaths.

6. CONCLUSIONS AND RECOMMENDATIONS

Why socio economic surveys matter. The review demonstrates the importance of surveying local communities targeted by rural road projects. The survey and focus group discussions helped understand expectations of local communities in relation to the proposed road improvements.

The comparison of the findings from the surveys and consultationshighlight several similarities anddifferences between the two beneficiary populations. There are similarities in the demographic compositionof the survey populations, for example, and respondents from KI and TL emphasize the poor condition of theroads, and there is a correlation between the main problems and concerns with the road and the main safetyproblems reported by respondents.

The results from Kiribati and Timor Lestealso emphasize the impact of periods of heavy rain and duringthe rainy season on the condition of the road. As a result, significant improvementsto the

road designs were made to ensureadequate drainage on the road inSouth Tarawa, Kiribati and along the Dili to Ainaro corridor in Timor-Leste.

In addition, the results demonstrate the impact that current road problems pose on thesocial and economic well-being of the surveyed populations. For example, respondents from Kiribati and Timor Leste bothreported the impact of poor road conditions on their ability to access places of employment oressential services.

Gender findings. By focusing specifically on the concerns and needs of both men and women, allowing for specific consultations to take place with focus groups, the surveys provided critical knowledge for identifying and understanding issues that would have likely goneundiagnosed.Broad support for the road projects was expressed in both Kiribati and Timor Leste with the anticipation that improved road access will improve livelihood,access to employment opportunities and increase level of personal safety for men, women and children.

The comparative analysis of the results reported generally poor conditions of the roads with respondents raising concerns regarding pedestrian safety and the safety of women, inparticular.There were also specific concerns in relation to access to schools for children, personal security and access to health care facilities for improved likelihood that women will get in time to the hospital to give birth.

A first but limited step toward gender integration.The survey results will help shape the policies and investments associated with the road rehabilitation programs to go beyond the traditional investments in road surfacing and maintenance programs. The results from Kiribati highlighted that providing bus shelterswill benefit school children through reduced expose to the elements and as a place where they can safelywait off the road for the bus. Likewise, in both Timor Leste and Kiribati, the provision of street lights will greatly improve the likelihood that women will feel safer to travel. In Kiribati, specific recommendations linked to the findings of the surveys have already been addressed: (1) Solar street lighting investments were increased; (2) 67 km of footpaths were included in the project; (3) 56 speed humps were added at key locations; (4) the provision of road safety signs was extended as well as the provision of

equipment and support to police to improve speed enforcement; and (5) more frequent bus stops and shelters provided along the road.

As there was no previous gender assessment of differences in transport access and mobility patterns, the surveys provided a good opportunity to elicit data and knowledge on factors that may influence gender access to transportation.Nonetheless, findings were limited. Despite the tailored questionnaires, the knowledge captured by the surveys remained insufficient to formulate deeper conclusions and recommendations on gender transport measures. Except for the focus group questions, data collected was not enough gender disaggregated for the majority of the survey questions raised in Kiribati. As a result, comparable data on men's and women's needs and experience about the same parameters was not available.

For both surveys, important development challenges that can particularly impact gender differently were not assessed. Differences in variable such as income levels and poverty status, availability of economic opportunities and linkages with the transport sector were not captured. As a result there is not enough data to capture the importance of transportation for women in relation to the development challenge of providing access to employment and economic resources.

Further investigations on how other specific improvement linked to the transportation aspects of the project could further help women achieve better economic and social well-being. In both countries, women are more likely to be poor and unemployed, relying on agriculture and the informal economy for their livelihoods. Further investigation, either in the context of a gender country or social assessment, could helpinvestigating both the direct and indirect effects that roads and transportation in general may bring to women.

The implementation challenges encountered in the context of the project surveys are not unique. Very few transport projects in medium to low income countries provide evidence of good practice for capturing gender differences and the impact of projects on specific gender needs. In fact, the majority of rural transport projects do not tend to collect gender disaggregated data or if they do, the results from the surveys may also not be well integrated in the formulation of

interventions. The example from the two projects demonstrate that conducting surveys for improving interventions in the transport sector is not an easy exercise and that results may also be difficult to interpret to meaningfully inform road design and transport policy more generally.

Moving the project forward sustainably.Overall, the surveys and focus group consultations have been successful in capturing baseline datafor the survey population. The findings highlighted common concerns, problems and experiences of beneficiariesfrom two divergent Pacific Island nations. Following the completion of the civil works, follow-up surveys and focus groupconsultations are being planned to focus on measuring and assessing the level of user satisfaction and impact of the projects,.

The studies reflect a renewed commitment by the World Bank and the development community more generally to focus on gender mobility issues and differences between men and women in accessing transportation. As further rounds of surveys are being planned in the context of the projects, it will become imperative to collect both male and female transport data. The identification of specific gender data can support the design of transport investments and related policy decisions. Relevant data can then be used to improve the mobility of all users in rural areas and to ensure a most effective use of services such as health which are often most needed by women.

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.**Annex 1**:Project area maps

Figure : The area of Kiribati Road Rehabilitation Project on South Tarawa

Figure : The area of Timor Leste Road Climate Resilience Project

.**Annex 3**:Focus group discussions

Main concerns about the road condition across focus group consultations in Timor-Leste

Focus Group	Main Concerns Raised
SucoAinaro	- Gaping holes (potholes) - Gutters are in bad condition - Water collects and stagnates on the road in the wet season and the street is duty in the summer that affects passengers health - Failed/broken bridges - Dusty, especially in the summer - Water stagnates in the middle of the street during the rainy season - There are no gutters for water to flow through
SucoFatu-Besi	- Landslides, especially during the rainy season - Water is stagnated on the road - A lot of dust in the summer and muddy and slippery road in the rainy season - Full of gaping holes - Street is too narrow - Steep road edges not protected by barriers or safety bars - The street fills with water so that it destroys the road, big drains are required to wash away the water
*aldeia*Hularema	- There is a lot of water stagnated on the road - A lot of dust along the way or very dusty along the road, companies which are responsible for fixing this problem just put soil in the gaping holes so it results in dust - Road is full of gaping holes - Road is too narrow - There are steep road edges that are not protected by barriers - There are landslides - There is a lot of water stagnated everywhere during the rainy season because the road is full of gaping holes
SucoMadu-Benu	- There are no proper gutters, sometimes there is landslide covering the road in the rainy season and the road is broken - Gaping holes along the road, so that the public transportations operating are not many - There are landslides, rocks slide in the middle of the road around the sharp turns - Drains are not good so that water cause landslide and cover the street during the rainy season - Street is very duty, especially in the summer season - Water gathers on the road and becomes stagnated - Road is too narrow, many sharp turns - No barriers around ravines - The road is muddy and slippery in the wet season and water stagnated in the middle of the road so that it is hard to get to my destination faster

Main concerns about the road condition across focus group consultations in Kiribati

Focus Group	Main Concerns Raised
Anraei/Te KawaiAeBoou Village Focus group	- Potholes in the road - Road is narrow should be widened like the one in Betio - Dust is a huge problem where it causes a lot of flu/cold/diarrhea - Red eyes/sore eyes
Mini Store Owners Focus group	- Dust is a huge problem causing health problems - Expensive to transport cargoes from port to their office - There are quite a lot of curvy roads that have caused accidents like the Mackenzie road, DrAiram (Eita), KPC (Eita) and Ionatia (Bikenibeu) - Trees overlaying onto the road should be cut down.
Big Store Owners Focus group	- The road is narrow - Should have a parking space for delivery cars to park - The road where lots of people live or shop should have a traffic sign - No parking space for delivery trucks - Lots of potholes will slow truck to deliver goods from place to place and will consume lots of fuel meaning more expenses
Women Focus group	- Children are not safe because there is no specific space for them to walk or ride their bicycles to school - There is no school bus and no bus stop with shelters to reduce the effect of the sun's heat and if there is rain they risk being wet - Drunk driving and sleep driving causing a lot of accidents - Fast drivers and lots of potholes caused women to miscarry babies and abdominal pain to people - No motorcycle or bicycle lane - Narrow road - No sign on speed bumps or near it to signal for on-coming vehicles - Cars/buses are easily damaged from riding over the potholes - There are no street lights and some mischievous kids can throw stones at the bus causing damages and injuring people on the bus
Catholic Youth Focus group	- Too many accidents from curvy roads like Mackenzie and Otintaai Hotel roads - Tanaea and Ananau causeways are too narrow - The road to the KPA is dangerous because there is no wall and is very narrow as well - Where there are a lot of people, pedestrian crossings should be build like one opposite MOEL in Betio and other crowded places like the Bairiki square and many others - Travelling in the night is not safe because the road has lots of potholes and you will have a bumpy ride all the way to your destination - Students mostly travel to school by bus or on foot
Bus Driver Focus group	- There are quite a lot of curvy roads that have caused accidents like the Mackenzie road, Ngaalu Bar (Bikenibeu) - Ananau causeway is very narrow - The damaged road causes a lot of problems to the bus especially the bearing and shock absorbers - More potholes equals more expenses - Proper design of speed bumps because the ones like in Abarao and Eita opposite Moroni High school are bad. The most appropriate speed bump design is like the ones in Betio - Trees along the road are dangerous because they can deter visibility or fall onto any vehicles causing accidents

Annex 4:Aggregated household survey questionnaires

Questions Common to Both Surveys	Questions only asked in one Survey
Household Information	
What is your relationship to the head of the household? Total number of people who sleep ere on a regular basis? How many Junior Secondary School and below who sleep here on a regular basis? – In Timor-Leste this question read 'how many people aged 18 years or below sleep here on a regular basis?' Main source of income of the household? Approximately how long have you lived here? What islands are you originally from? – In Timor-Leste this question read 'where are you originally from?'	**Questions asked in Kiribati but not in Timor-Leste** Approximate combined monthly income of the household? Three biggest weekly household dollar expenses? Approximate how much on each. Approximately how much does the household spend on transport every week? **Questions asked in Timor-Leste but not in Kiribati** Do you live on the Dili-Ainaro road? Approximately how far do you have to travel by foot to go to the Dili-Ainaro road?
Road Transport Overview	
Description of the general condition of the main road in Tarawa? –In Timor-Leste this question read 'how would you describe the general condition of the Dili-Ainaro road?' Three most serious problems concerning the main road? Description of the main road when it rains? - In Timor-Leste this question read 'description of the Dili-Ainaro road in the wet season' Description of the condition of the main road in the dry season? - In Timor-Leste this question read 'description of the Dili-Ainaro road in the dry season' Description of the general level of traffic on the main road - In Timor-Leste this question read 'description of the level of traffic on the Dili-Ainaro road during the weekdays' and 'description of the level of traffic on the Dili-Ainaro road during the weekend' During the school term, and during the weekdays, how many times per day do you usually travel on the main road in a motorized vehicle or on a motorbike? - In Timor-Leste this question was asked according to mode of transport: a) car and motorbike and b) public transport Over the weekends, how many times per day do you usually travel on the main road in a motorized vehicle or on a motorbike?	**Questions asked in Kiribati but not in Timor-Leste** Rate the condition of the access (small) roads in your village Do you live on the main road? Approximately how far do you have to travel on the access road to get to the main road? What is the access condition of the road during the year? **Questions asked in Timor-Leste but not in Kiribati** How would you rate the experience of traveling the Dili-Ainaro road by motorized vehicle during the dry season? How would you rate the experience of traveling the Dili-Ainaro road by motorized vehicle during the wet season? What is the access condition of the Dili-Ainaro road during the year? If the road is impassable, could you please tell us where the road is usually impassable? During the weekdays what is the main purpose for traveling along the Dili-Ainaro road in a motorized vehicle or car? During the weekend what is the main purpose for traveling along the Dili-Ainaro road in a motorized vehicle or car? During the weekdays what is the main purpose for traveling along the Dili-Ainaro road by public transport? During the weekends what is the main purpose for traveling along the Dili-Ainaro road by public transport?

Questions Common to Both Surveys	Questions only asked in one Survey
- In Timor-Leste this question was asked according to mode of transport: a) car and motorbike and b) public transport On average how many times per day do you spend traveling on the main road – walking, in a motorized vehicle, on a motorbike or bicycle? - In Timor-Leste this question was asked for the weekdays and weekends and according to mode of transport: a) car and motorbike and b) public transport	On average how many times per day do you travel along the Dili-Ainaro road by foot or other means of non-motorized transport? On average, how long each day do you spend traveling on the Dili-Ainaro road by foot or other means of non-motorized transport? What is the main purpose for traveling along the Dili-Ainaro road by foot or other manes of non-motorized transport?
Traveling on the main road/Household Transport	
What is your household's main form of transport? Do you, or anyone else in your homestead, own a car or motorbike? How much do you spend on average per week on petrol? How much do you spend on average per year on car repairs? If you don't own your own car or motorbike, how much does a one way trip to your work cost? - In Timor-Leste the question was asked 'if you don't own a car or motorbike, how much do you spend on average per week on public transport'	**Questions asked in Kiribati but not in Timor-Leste** Do you or anyone in your household own a bicycle? Does the condition of the main road affect your decision to have a car/bicycle/motorbike? What method of transport do you use to get to work? How long does it take you to get to work in the dry season? How long does it take you to get to work in the wet season? How do you rate the experience of traveling the main road by motorized vehicle? How often do you travel to town i.e. either Betio, Bairiki or Bikenibeu? Do you think the main road would benefit from street lightening?
Safety/Safety on the Road	
Do you consider safety on the road an issue? - In Timor-Leste the question was asked 'Do you consider safety on the Dili-Ainaro road an issue'? What, in your opinion, causes the most safety concerns on the road? Which of the following road features are important to you? Do you ever receive information about road safety? Have you ever been involved in an accident or been injured on the main road? Has anyone in your household ever been involved in an accident or injured on the main road? - In Timor-Leste these two questions were combined to ask 'have you, or anyone in your household, ever been involved in an accident on the Dili-Ainaro road	**Questions asked in Kiribati but not in Timor-Leste** How would an improved main road affect you and your household the most? **Questions asked in Kiribati but not in Timor-Leste** How safe would you rate the experience of traveling the Dili-Ainaro road by car or motorbike? How safe would you rate the experience of traveling the Dili-Ainaro road by public transport How safe would you rate the experience of traveling the Dili-Ainaro road by foot? When were you, or anyone in your household, involved in the accident? Do you know anyone, not including your or anyone in your household, who has ever been in an accident on the Dili-Ainaro road? Approximately when was this person in the accident?

Questions Common to Both Surveys	Questions only asked in one Survey
Environment	
Describe the level of dust on and around the main road? Has the level of dust on the main road ever caused you health problems? How would you rate the general rubbish levels around your village -In Timor-Leste the question read 'how would you rate the general rubbish level *around* the Dili-Ainaro road'? How often is garbage collected in your village? -In Timor-Leste the question read 'how often is garbage collected *along* the Dili-Ainaro road'? What happens when the rubbish is not collected regularly?	**Questions asked in Kiribati but not in Timor-Leste** Do you have a well for water at your homestead? Is your well affected by the runoff or dust from the road?
Health	
How easy did you find it to travel to the hospital/health centre? How frequently do you visit a hospital/health centre over the course of a year? For what purpose do you visually visit the hospital/health centre? How long does it take you to travel to the nearest hospital/health centre? What mode of transport do you use to travel to the nearest hospital/health centre? How much would a one way trip to the nearest hospital/health entre cost in a minibus/taxi?	**Questions asked in Kiribati but not in Timor-Leste** Have you had to visit a hospital/health clinic in the last 2 months? How frequently did you visit a hospital/health centre last year? **Questions asked in Kiribati but not in Timor-Leste** In which town or village is the nearest hospital/health centre located? Is the nearest hospital/health centre only accessible from along the Dili-Ainaro road?
Schooling	
Do you have children in the household who attend school? How do they travel to school? How much does the trip cost? Approximately how long does it take them to get to their school in the dry season? Approximately how long does it take them to get to school in the wet season If there are school aged children in the house who are not attending school, please ask why not.	**Questions asked in Kiribati but not in Timor-Leste** Is the nearest school only accessible from along the Dili-Ainaro road? How safe is it for the children to get to school?

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Paper Title:

Methods and tools for gender mainstreaming in Swedish transport planning

Abstract

Gender mainstreaming has been the Swedish government's strategy for gender equality policies since the Government Bill *Shared Responsibility* came into effect in 1993–1994. A transport policy objective of gender equality was introduced in 2001 and modified in 2009. How gender equality in transport should be interpreted and clarified has been discussed and studied by various operators since its introduction. A characteristic feature in many discussions has been a focus on differences in men's and women's travel patterns. Differences in travel patterns have been interpreted to mean that women and men have different values and needs. However, these over-simplifications both of men's and women's travel patterns and of their mobility needs often result in stereotypes.

The aim of this paper is to bring in a critical approach to generalisation of men's and women's travel patterns. The purpose is to present a method of how to work with gender mainstreaming in transport planning, and to provide tools to make systematic gender impact assessments adapted to the Swedish context of gender mainstreaming.[1]

The method we propose is based on methods and quality requirements similar to those existing in the fields of environmental impact assessment (EIA) and social impact assessment (SIA)[2]. That is: the method should be *appropriate*, *effective*, *knowledge-based* and *open to participation and criticism*.
• *Appropriate* means it should be useful as a knowledge base for planning and decision. Consequences should be discernible, and key issues (project-based and business-based) should be clearly defined.
• *Effective* means it can be implemented systematically, and can be structured with the intention of affecting the planning and project solution. It also means that resources should be available in terms of time and money.
• *Knowledge-based* means that it should be based on rationality and professionalism. It should be designed according to good scientific practice and implemented using methods and techniques that are applicable.
• *Open* means that discussions should take place both within the project organization and in open consultation. These discussions should be included in the reports produced and in the decision making process.

[1] Faith-Ell, C., & Levin, L. (2013). *Kön i trafiken. Jämställdhet i kommunal transportplanering [Gender Mainstreaming. Guidance for Regional and Local Transport Planners]*. Stockholm: SKL, Sveriges Kommuner och Landsting.
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Introduction

Gender mainstreaming has been the Swedish government's strategy for gender equality policies since the Government Bill *Shared Responsibility* came into effect in 1993–1994. In addition, a transport policy objective of gender equality was introduced in 2001 and modified in 2009 (Näringsdepartementet, 2009). Since then, how gender equality in transport should be interpreted and clarified has been discussed and studied by various players. A characteristic feature in many discussions has been a focus on differences in men's and women's travel patterns (transport statistics, national travel surveys). This often means that differences in men's and women's travel patterns are overemphasised while similarities are underemphasised, leading to problems when men's and women's transport needs are being formulated. One problem is that differences in travel patterns are often interpreted as entailing that women and men have different values and travel needs (cf. Law, 1999). However, men and women are not homogeneous groups, but differ in terms of age, occupation, income, life stage and household composition – and this is reflected in their conditions of travel and activity patterns. Researchers in Denmark, Finland, Norway and Sweden have problematized the stereotypes of gender and travel trajectories in these countries (see for example contributions in: Christensen et al., 2007; Cresswell & Uteng, 2008). For many reasons, the standard solution of equating travel behaviour (e.g. choice of transport mode) and travel needs (e.g. preferences) has come under criticism in their work. Depending on individuals' intentions and their views of the accessibility and safety of their transport options, this solution is quite problematic. Preferences are clearly connected with how various individuals experience their environment and evaluate their real options, so an intersectional perspective with a focus on experience and for example ageing (cf. Anu Sirén, 2005; Siren, Anund, Sörensen, & Hakamies-Blomqvist, 2004; Siren & Hakamies-Blomqvist, 2006; A Sirén & Hakamies-Blomqvist, 2005; A Sirén, Heikkinen, & Hakamies-Blomqvist, 2001), and family relationships and living in combination with working career is also fruitful (cf. Gil Sola, 2013; Gil Sola & Vilhelmson, 2012; Scholten, Friberg, & Sandén, 2012). Another consequence of the overemphasis on travel patterns is that groups of women and men who are vulnerable in terms of access to transport are at risk of becoming invisible (Listerborn, 2013; Lucas, 2004; Rosenbloom & Winsten-Bartlett, 2002).

The aim of this paper is to bring in a critical approach to generalisation of men's and women's travel patterns, and to highlight the heterogeneity that exists within groups as well as similarities between traditional traveller categories. The purpose is to present a method of how to work with gender mainstreaming in transport planning, and to provide tools (using both statistics and other data collection methods) for making systematic gender impact assessments by an objectives-led process (see e.g. Thérivel, 2010). In this case it should be possible to adapt the assessment to existing routines and practical circumstances.

A further aim with this approach is to inspire those who work with the planning process, and to increase the knowledge base in transport planning. This will be done by constructing an action-based (*verksamhetsanpassad*) model of the national gender equality policies that is adapted to the transport sector. The focus is on transport planning in municipalities and regions. The method takes its departure from previous research and case studies and practice in Sweden. It has been compiled and discussed in a recently published inspiration "handbook" published in Swedish (Faith-Ell & Levin, 2013). The foundation of the method is Sweden's comprehensive national policy on gender equality with its total of four objectives: equal power; equal work opportunities and livelihood; equal

responsibility for domestic and caring work; and a safety objective conceptualised in terms that violence against women must stop (Swedish Code of Statutes 1993/94:147).

Perspectives on women's issues in transport

When our research team started investigating gender and equality issues in transport planning eight years ago, we found the focus was on treatment of gender equality at a quite general level. Much knowledge was based on travel surveys outlining the main differences between women and men in *travel patterns* and how they behave in the transport system, e.g. how they act and move in the environment around the transport system (car parks, travel centres, bus stops, station areas, etc.). The main focus of planners, on the other hand, was on *safety* in transit environments and on *power* in transport organisations and transport planning processes.

Safety

Previous and current international research show high responsiveness to what are called women's issues in transport, often defined in terms of personal security and measures to improve the notion of safety of the transport system and the probability that women will be treated decently.

As Loukaitou-Sideris and Fink (2009), Lahiri-Dutt and Ahmad (2012) and Markovich and Lucas (2011) explain, there are important gender differences to the perception of personal safety in public transport stations, car parks and other public places. Women are more likely to change their travel behaviour based on fears of harassment and violence from other passengers, which may result in the loss of independence associated with limited mobility and social exclusion from basic service and work opportunities. Yavuz and Welch (2010) have outlined a couple of issues which may improve the sense of safety: adequate lighting and visibility at transport stops, stations, car parks, etc.; the appearance of vehicles and stations (e.g. cleanliness, space); reliability of services; the presence of CCTV cameras or police officers; and previous experience of crime. Yavuz and Welch also identify other socioeconomic factors as being important, with older men and women, people with disabilities, people on a low income, and visible minority groups more likely to be fearful of crime in transport environments. A focus on safety is also the dominating gender perspective in transport planning and in much previous research on transport and gender in Sweden. It has resulted in comprehensive safety programmes (e.g. how to organise public transport and create safer transit environments), and also in an increasing awareness of safety issues in, for example, municipalities run by local administrations, and in initiatives and support provided by The Swedish Association of Local Authorities and Regions (SALAR). SALAR is both an employers' organisation and an organisation that represents and advocates for local government in Sweden (see: SKL http://www.skl.se/).

Travel patterns

Travel patterns documented in national travel surveys serve as a good basis for knowledge of how different groups use the existing transport system. From national travel surveys we know that men travel more often as car drivers than do women. On the other hand, women more often travel by public transport (Eliasson & Mattsson, 2006). Women also commute shorter distances, and when living in partnership with a man they chain trips together to a greater extent, e.g. taking children to school on the way to work, or stopping off to shop after work (Friberg, 1999, 2002, 2006; Friberg, Listerborn, Andersson, & Scholten, 2005).

However, this is a broad and general description of travel patterns. In fact women's travel behaviour has changed in the last three decades: women are making more trips, and more frequently travel by car

as drivers, also covering longer distances. This is the case in many Western countries (Rosenbloom, 2004). There are also considerable differences in the travel patterns of subgroups of women, which are due to factors such as economic circumstances and age. At the same time, however, older women still do not drive as often as older men, and they stop driving earlier; we would expect this picture to alter when today's younger and middle-aged cohorts grow old (Hjorthol, Levin, & Sirén, 2010).

Recent studies have also emphasised the importance of not generalising too much between the groups (men/women), and instead taking context into consideration: what kind of life opportunities do they have? what are the environmental and individual opportunities for subgroups (cf. Listerborn, 2007, 2013; Lucas, 2004)? Moreover, the travel surveys offer very little documentation about non-travellers, and trips-not-taken.

Power dimensions

Another perspective in women's issues in transportation is that power dimensions of users of transport systems have received more attention in recent years (Friberg & Larsson, 2002; Gil Sola, 2013; Polk, 2002, 2004, 2005; Wittbom, 2009).

Our first research project addressed the issue of gender equality in public participation in road planning in the Swedish National Road Administration. In this project we evaluated and developed methods for consultation with the public (Faith-Ell et al., 2010; Levin & Faith-Ell, 2011b). The research project was based on a multiple methods approach: interviews with transport planners, text and image analysis of advertisements, and documentation and analysis of public meetings using questionnaires, observations and conversation analysis.

From previous national and international research we know that men and women do not take part equally in public consultations. Researchers have pointed out historical asymmetries (Greed, 1994; Scott, 1988) and lack of power of the female portion of society in political and other public situations (Burns, Lehman Schlozman, & Verba, 2001). Earlier research about the participation of women and men in public meetings, e.g. 'talk in interaction' among men and women have stated that there are differences between conversational styles, and for example Maltz and Borker (1982) suggested that cultural aspects could be an explanation. Research has also shown that both women and men can experience barriers to participation because of power asymmetries (Kendall & Tannen, 2001; Tannen, 1993).

In our reports and articles from the study of public participation in road building projects we have stated that it seems quite clear that some of the participants had a more extensive experience of taking part in public meetings and talking in front of other people (see e.g. Faith-Ell et al., 2010; Levin & Faith-Ell, 2011b). However, it is not that obvious that men are more experienced and women are the less experienced. Both women and men in the study elaborated their arguments. Two main communication trajectories (strategies) were found: one was talking and arguing alone in front of the public, and the second was to put in a question or a statement and try to involve other participants and then taking kind of a moderating role in the following discussion about the topic. Men more frequently than women talked and argued alone in the public meetings; however, some of them simply followed another strategy in making their topics known. Women more frequently asked questions or put in short comments starting a discussion involving both women and men in the evaluation and knowledge-seeking process (cf. Ford, 2008; Kendall & Tannen, 2001; Tannen, 1993). Moreover, most women and men said they were satisfied with the information they got at the meetings in these studies. However, according to the questionnaire answers, women tended to be more satisfied than men with the content of the meetings. The documentation of the meetings, observations and recorded 'talk in interaction'

that was conducted by the researchers also showed that women and men got equal attention from the experts for their questions (Levin & Faith-Ell, 2011a,b).

The next step for our research team was a research project for the municipality of Malmö, focusing on a planning project about the future of public transport in the city of Malmö. The project was designed in interaction with the municipal planning team that developed the future public transport plan. The researchers started by addressing the planners' attitudes and ideas about public transport and gender. These ideas and attitudes were explored through focus group discussions. The results showed interesting views on how planners regarded the users of public transport and those who do not use the public transport. For example, they expressed the view that women like travelling by public transport more than men do, and they referred to current travel patterns. Among the focus groups, imagined non-users of public transport were identified. Two categories of men were identified as potential non-users: older traditional men and businessmen. Both of these groups were expected by the participants in the focus groups to choose private car and never to travel by bus. However, the planners in the focus group study ascribed different reasons to these two groups for their choices: while the older traditional men were expected to never use public transport due to their strong attachment to their cars, it was expected that the businessmen would perhaps use public transport if it were more convenient and faster (Dahl, Henriksson, & Levin, 2012). The research team also intervened in the organisation of public meetings about the transport plan. Instead of traditional open meetings, dialogue meetings were organised and adapted to seven main target groups: young women and young men (high school students); trade representatives from the city; representatives from culture and sports associations; employees at the regional hospital; and employees at the police station. This approach resulted in new knowledge about specific experiences among the strategic chosen groups. For example, young men and women described different travel experiences in relation to taking part in leisure activities in the municipality, which was also discussed by the representatives from sports associations (Levin & Faith-Ell, 2011a).

An intersectional approach in addressing gendered issues in transportation

The gender concept implies a need for more problematisation of 'the issue', moving away from the stereotypes of female and male. We therefore prefer to take an intersectional approach in addressing gendered issues in transportation. Accessibility and social inclusion are key concepts here, and (taken a little bit further) the concepts involve participation objectives, finding the variations among users and players in transportation. Access to transport mobility widens the opportunities for all to reach services, education, financial independence, giving and receiving care among family members, and so on. There is an important dimension of power, to have influence over their own transport mobility, e.g. choice of transport mode, number and destination of trips, space and environment. Recent international research on social impact, gender and transport, where differences between and within groups are problematized, appears to regard this power, place and space dimension as crucial to future planning and research (cf. Lucas, 2006; Mackett, 2008; O'Faircheallaigh, 2012; O'Riordan, 2012; Power, 2012; Sairinen, 2004).

Based on our experience from the two studies described above, we continued by addressing the Swedish national objectives for gender mainstreaming on a railway-building project in a third study carried out together with the Swedish Transport Administration (Faith-Ell & Levin, 2012).

Departing from the Swedish National Gender Equality objectives, we suggested a method called JKB (an acronym for the Swedish concept *jämställdhetskonsekvensbedömning*), which translates word for word as 'gender equality impact assessment'. The method follows the structure of impact assessment (IA) developed by researchers and practitioners in an ongoing process. International processes have

tried to adapt social aspects in planning (for example, NEPA in 1969 in the United States), and the work have followed with progression in impact assessments worldwide. In the past few decades there have been efforts to implement international principles of social impact assessment (Burge & Vanclay, 1996; The Interorganizational Committe on Principles and Guidelines for Social Impact Assessment, 2003; Vanclay, 2003, 2006; Vanclay & Esteves, 2012a). Gender is one part, but not the only one, of a concept of social impact assessment and social inclusion.

First, international principles of human equal rights are of course a part of gender impact assessment processes. Second, our studies have connections with the international principles of impact assessment (www.iaia.org), and finally – third – these principles have been adapted to national gender equality objectives and the national transport policy and ideas of gender mainstreaming. Our point is that these national policies should form the basis for further assessment and measures to improve the situation in each planning context. These ideas will be further described and discussed in the next section.

Transport and gender objectives

In relation to the Swedish National Gender Equality Objectives and to international research on gender and social impact assessment, we have suggested a number of areas to work with in the Swedish transport planning context.

The point of departure for the development of a systematic method for gender mainstreaming is the policy work: in Sweden, this means the four national objectives for gender equality formulated by the Swedish government and parliament. In two research projects we took the four national objectives together with the transport policy as the background and aim of the work with gender mainstreaming. The following adaptions are suggested:

1. *Equal distribution of power and influence*. There should be equal distribution of power and influence between women and men in decision making and implementation processes in the transport planning.

2. *Economic equality*. Transport should contribute to equal opportunities for women and men to access education and paid work which gives economic independence.

3. *Equal distribution of unpaid care and household work*. Transport would contribute to the establishment of equal distribution between men and women of responsibility for unpaid household chores and the ability to give and receive care.

4. *Security*. Security should be increased by minimising the risk and eliminating the fear of being subjected to gender-related violence and crime in connection with travel and transport environments.

Our studies during the past few years show that two of the objectives (1 and 4) are clearly being dealt with in practice and are reflected in recent and current research (cf. 'Perspectives on women's issues in transport', above), whereas the other two (objectives 2 and 3) are not as visible in the transport planning process. This will be illustrated below with two examples from our research. The example projects results connect with the four national gender equality objectives.

Example I

In the study on gender mainstreaming process in the planning of a future public transport system in the city of Malmö (Levin & Faith-Ell, 2011a), it was revealed that the most substantial focus on gender equality was found in the planners' work with public consultations, which related to objective 1 (equal

distribution of power and influence). A systematic and strategic focus on the development of dialogue meetings had resulted in groups usually under-represented in public consultation (i.e. women and young people) attending the process. Further, there was on-going systematic work with the objective of security in connection with public transportation. This work related to objective 4 in the national equality policy, with a clear focus on measures for minimising the risk and eliminating the fear of being subjected to gender-related violence and crime in travel and transport environments. Meanwhile, objective 2 (economic equality) and objective 3 (equal distribution of unpaid care and household work) seem to be understood as less important in transport planning. One conclusion was that a functioning public transport system should be able to contribute to more equal distribution of resources and more equal distribution of work in the home, and that the perspective on objectives 2 and 3 should therefore be more developed in transport planning.

Example II

In the study on gender mainstreaming in Swedish railway planning, safety was found to be the most investigated of the national gender equality objectives in the planning process (Faith-Ell & Levin, 2012). The respondents in the study also stated that verbal reflections (i.e. analytical discussions) within the planning team were important for understanding variations among citizens and groups of citizens. However, these highly valued verbal reflections were rarely performed within the planning process, due to established procedure, time and other resources. Three main themes were identified in the research as key areas for the Swedish Transport Administration's and municipalities' work with gender mainstreaming in infrastructure planning:

- Working with gender equality objectives
- Tools and methods intended to guide the organisation's work on the basis of specific goals
- Tools and models for impact assessment of gender equality.

One conclusion is that, although the Transport Administration has initiated work with gender equality in transport planning, the Administration needs to work more on developing both policy and planning. The research project proposed a method for integration of gender equality impact assessment in different stages of the planning process, from procurement to implementation and evaluation (different parts corresponding to transport authorities' internal and external gender equality). Moreover, the project argues that policy and planning should be better linked together so it is clear that what is said in policy is also implemented in practice. An important policy instrument in this work will be the new performance criteria currently being developed by the Swedish Transport Administration at the request of the government.

A systematic approach to gender mainstreaming in transport planning

The method we propose is based on methods and quality requirements similar to those existing in the fields of environmental impact assessment (EIA) and social impact assessment (SIA) (cf. Vanclay & Esteves, 2012b). That is: the method should be *appropriate*, *effective*, *knowledge-based* and *open to participation and criticism*.

• *Appropriate* means it should be useful as a knowledge base for planning and decision. Consequences should be discernible and key issues (project-based and business-based) should be clearly defined.

• *Effective* means it can be implemented systematically and can be structured with the intention of affecting the planning and project solution. It also means that resources should be available in terms of time and money.

• *Knowledge-based* means that it should be based on rationality and professionalism. It would be designed according to good scientific practice and implemented with methods and techniques that are applicable.
• *Open* means that discussions should take place both within the project organization and in open consultation. It would be included in the reports produced and in the decision making process.

In essence, the method is a systematic process that examines in advance the consequences of development actions on gender equality (Faith-Ell & Levin, 2013). The method is one of several tools generating a basis for decisions in the transport planning process. Based on the results of the assessment, more informed decisions will be made. Just as with other impact assessment tools, a number of criteria need to be met in order for knowledge from experts and lay persons to be included and inform decision makers during the process of development projects:

- The impact assessment is a process that results in a document that describes how the project through the systematic process has come to a certain conclusion (Vanclay, 2003).
- The process needs to be integrated with the planning process and cannot be carried out without interaction with other disciplines in the planning project (cf. Aretun, Levin, & Faith-Ell, 2010; Faith-Ell & Levin, 2012).
- The impact assessment shall be carried out before the plan or project has been finalised in order to be able to integrate the results into the plan or project (Thérivel, 2010).

The four national objectives for gender equality formulated by the Swedish government and parliament can serve as a basis for the impact assessment method presented above. A research project called ‘Implementation of a Method for Gender Equality Impact Assessment in Swedish Transport Infrastructure Planning’ was started at the end of 2013. The project aims to further develop the method and test it on two county transport plans in Sweden.

Conclusions

This paper has suggested a method for working with gender mainstreaming in transport planning and to make systematic gender impact assessments adapted to the Swedish transport planning process. The point of departure for the method is the specific objectives for accessibility and gender equality within the national transport policy and the four national objectives for gender equality formulated by the Swedish government and parliament. It has been stated that all public administrations should adapt their work to the national policy, and the transport sector has also included a specific gender equality objective in the overall transport policy. However, research shows that, so far, it is mainly the two objectives of ‘Equal distribution of power and influence’ and ‘Security’ that are being dealt with in transport planning. The objectives of ‘Economic equality’ and ‘Equal distribution of unpaid care and household work’ are not as visible in the practice of infrastructure planning.

Today, a great deal is known about differences in *travel patterns* between women and men, and behaviour in environments connected with the transport system. *Safety issues* and *power dimensions* have been evaluated in some cases. However, gender impact assessment is not a well-developed methodology, and gender equality work is not routinely integrated in transport planning. Further research will be needed focusing on a more developed method for gender equality impact assessment that is adapted to the transport system. Comprehensive mobility options within regions can increase career opportunities for both men and women, help to break the gendered labour market, and contribute to a more equal division of responsibility for the everyday care of children and household chores.

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THE RISK ESTIMATE OF BEING ASSAULTED IN PUBLIC TRANSPORT IN LILLE URBAN AREA

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Since January 1st, 2014, The French Ministry of substainable development merged the 8 CETE, Certu, Cetmef and Setra into a new structure dedicated to risk, environment, mobility and planing called CEREMA.

ABSTRACT

In France, several opinion surveys have pointed out the fact that the feeling of insecurity is an obstacle to the use of public transport (PT). In Lille, the PT network is structured around two metro lines which support more than 60% of trips but also, as fully automatic lines, lack of human presence. From 1995 to 1997, insecurity was increasing while traffic was decreasing. Local authorities then reacted by implementing a local security contract.

The French Ministry of Transport has just completed a study about violences against women in public transport. This study shows that globally, men are more often assaulted in public transport than women. While men are mostly victims of assault and battery, women are especially victims of sexual assault. However, the insecurity statistics used in this study doesn't take into account duration of exposure and differences in mobility behaviour between men and women.

The key idea of this is to link HTS data with crime data in public transport from operator. The main objective is to estimate the risk of being assaulted in public transport, linking the number of attacks to passengers to indicators estimated from mobility data: duration of exposure, number of trips and travel time.

The paper will focus particularly on gender issues, by analysing the risk depending on gender, time of the day, status, transport mode, type of criminal act... Then, these indicators will be compared to those from road safety, where a similar approach is under-way in Lille in order to determine wether the feeling of insecurity in PT is overestimated or not.

BACKGROUND

In France, the feeling of insecurity is a continuous electing issue. In transport, several various opinion surveys have pointed the fact that the feeling of insecurity is an obstacle to the use of public transport.

Within a global context of general feeling of insecurity, the question of insecurity in public transport is particularly sensitive. Serious aggressions, such as assaults with a weapon, are largely covered by the media and public opinion is deeply and durably afflicted by them. This issue is even more important when dealing with women. For example,sexual harassment in India, also called « Eve teasing », is a big issue. About 66% of women commuters surveyed in Chennai (India) had been sexually harassed while commuting(*1*). In several countries in Asia and South America, specific bus or train services were allocated to women. In many other cities around the world, women-only taxis were developed. Most of them consider the fear of being assaulted as an obstacle to mobility, particularly in the evening and at night. Loukaitou-Sideris has shown (*2*) that even if most US agencies believe that women have distinct safety and security needs, they don't have any program that targets women security needs. For example, men prefer CCTV and radio contact from the driver, while women prefer that the driver prevents the boarding of people influenced with alcohol or drugs.

In the conurbation of Lille, the murder of a young father in a metro station in 2000 is remembered long after, and a large number of the city inhabitants assumed they did not take public transport for insecurity reasons. Concurrently, about twenty people are killed in the metropolis in car accidents each year with complete indifference.

In this context, this article proposes a method to develop objective indicators to evaluate the risk of being a victim of a crime in public transport, which could help policy makers to produce more efficient public transport security policies.

THE TRANSPOLE NETWORK

Lille Metropole is a french local authority of 1,100,000 inhabitants closed to the Belgium frontier. The 85 various municipalities within its territory range from large towns like Lille (200,000 inhabitants), Roubaix (100,000) and Tourcoing (100,000), to rural villages. Lille Metropole is responsible of public transport organisation and has delegated the operating to Transpole, a subsidiary of the international Keolis group.

The public transport network (see figure 1) is structured around two fully automatic metro lines (VAL) supporting more than 60% of trips, 2 tramway lines, about 50 urban bus lines and some regional bus lines.

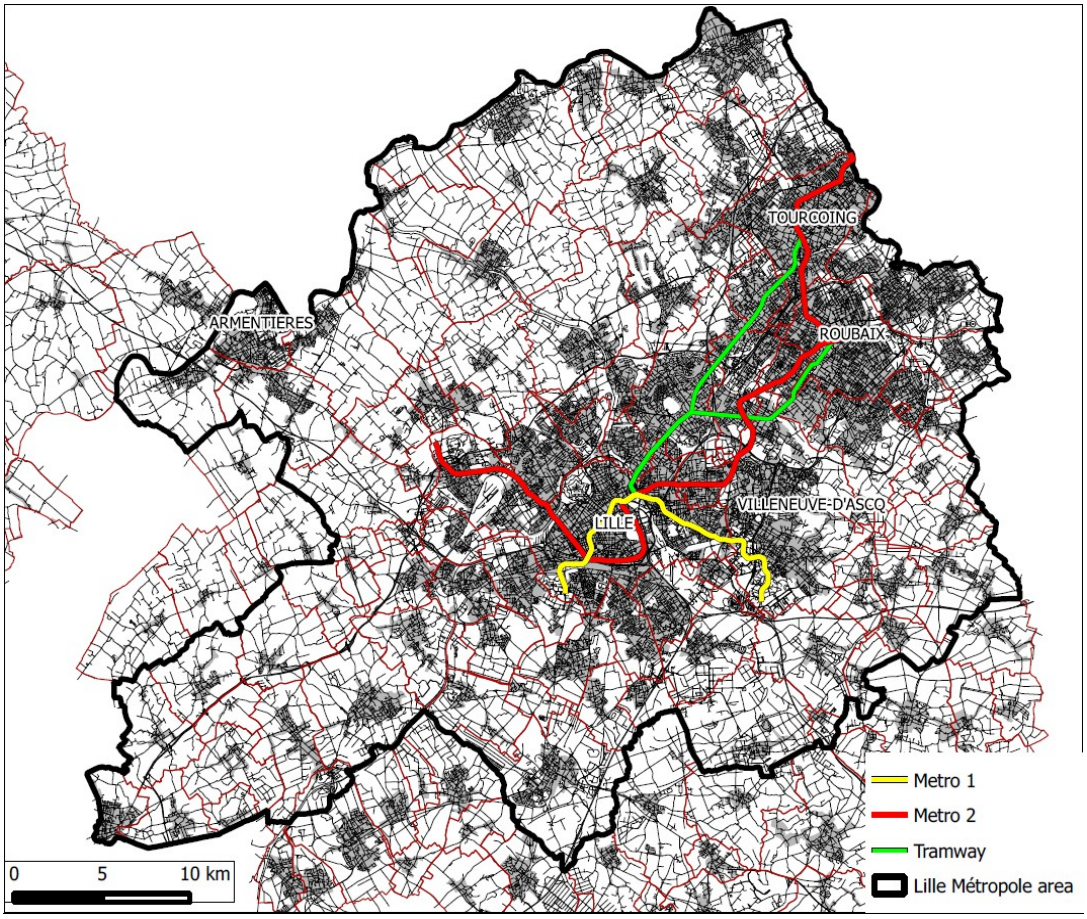

FIGURE 1 Lille Metropolis and its 85 municipalities.

After an continuous increase since its creation in 1983, the metro use decreased from 1995 to 1997, while insecurity increased (see figure 2).

In 1996, a survey involving 1,400 public transport users highlighted three key items:

- The lack of human presence
- The fear of an assault
- The lack of monitoring and alarm equipment.

The feeling of insecurity was strengthened in the metro, as it is operated without driver and without operator staff in stations. Local authorities reacted by implementing a local security contract in 1998, which was one of the first approved in France.

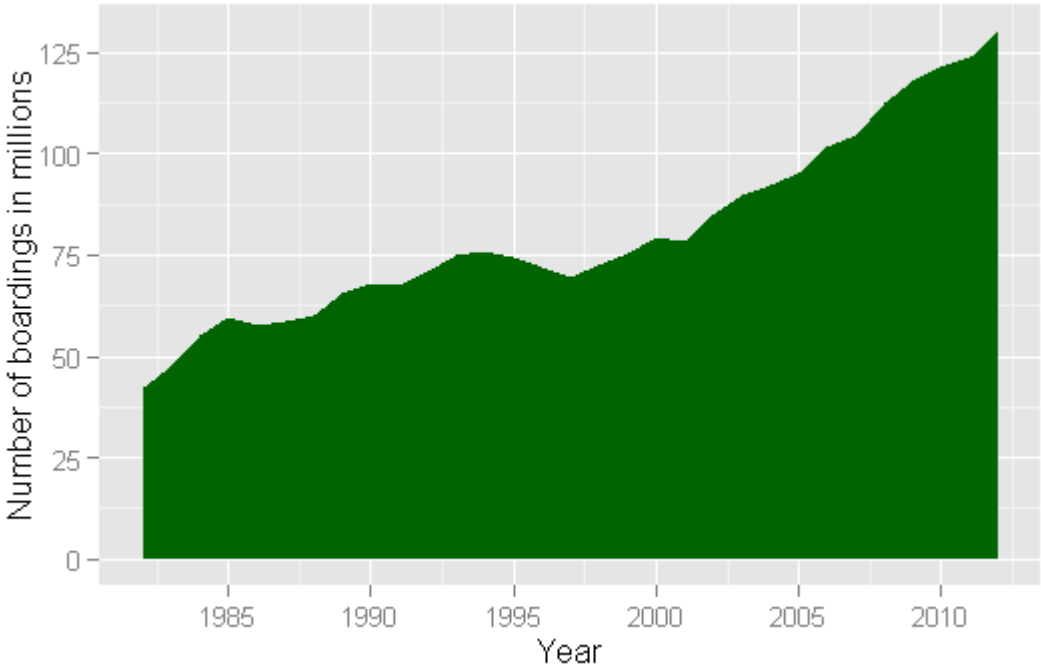

FIGURE 2 Yearly evolution of Transpole's traffic. source Lille Métropole

THE LOCAL SECURITY CONTRACT (CLS)

Transpole already implemented security policy since the early 1980s. It consolidated it in 1992 to improve security conditions. However, all these measures have had little impact quantitatively speaking.

The decrease in the Transpole network use by passengers in the mid 1990s, especially in the metro, partly because of the rising feeling of insecurity, highlighted a few requirements :

- the necessity to reinforce present means
- to coordinate the different agents interventions
- to improve surveillance and means of communication
- to enhance the database of the offences reported
- to define more formal procedures
- to congregate the different control centers, similar to the Safer Transport Command in London's transport.

In 1998 this diagnosis resulted in the Local Security Contract (*3*) whose priority interventions program and means have been implemented.

TRANSPOLE CRIME DATABASE

One of the main measures set down in the Local Security Contract was to make a list of offences committed on the network as exhaustive as possible. Transpole created a database

dedicated to offences committed on its network. The database is supplied by different sources: the Safer Transport Command, drivers, mediation officers, inspectors, etc. This list was filled out by Transpole's existing staff, and by new specialized agents hired to check and consolidate information about each offence.

Information collected gives details about the type of offence, the type of public transport concerned (metro, tram, bus...), the metro/tram/bus line, the stop or station, the place where the offence has been committed (inside a station or train...), date and time, the municipality, the modus operandi, with or without a weapon.

However, the only information given about the victims are their sex, exclusively in cases where there is one single victim, and if they live in Lille Metropole. Therefore, establishing a link between the risk of being assaulted and the victim personal characteristics is extremely limited here. For example, the age or the social class of the victim could be useful criterion.

The list of offences made by Transpole is composed of four levels of precision. The first level distinguishes three cases :

- offences committed on passengers
- offences made on staff
- offences on equipment

As this report aims at assessing the risk of becoming a victim of an assault, it will focuss mainly on the first case: assaults on passengers.

Actual bodily injuries	Violence	Petty violence
	Sexual violence	Sexual assault
		Attempted rape
		Rape
	Robbery	Snatching
		Other cases of robbery
Emotional distress and damages on property	Outrage/Threat	Outrage/Insults
		Threat
		Sexual exhibitionism
	Thefts	Pickpocketing
		Petty theft
		Theft by threatening

TABLE 3 Transpole List of Offences Committed on Passengers

In 2012, more than 4641 malicious acts were reported on the Transpole network for those three general categories (offences made on passengers, staff and equipment).

The number of malicious acts has decreased between 2006 and 2012 by 19%, while

traffic has increased by 29%. Offences on equipment represents 50% of the malicious acts, against passengers 30% and against staff 20%.

The number of offences against Transpole staff decreased from 2006 to 2012, while offences against passengers significantly increased. As traffic increased during this period, the risk of physical abuse (as a ratio) decreased slightly. However the risk of non physical abuse rose sharply. We can suppose that the growth of non physical abuse is mainly caused by smartphone thefts. The equipment rate of smartphones has considerably risen in recent years, and Iphones are particularly targeted by thieves.

In 2006, a household travel survey was undertaken and collected many valuable informations on inhabitants mobility in the Lille Metropole. Accordingly, the data analysis takes into account the figures of 2006

About 1000 offences were reported in 2006. Bodily injuries and non physical offences are divided roughly into two halves.

The report of victims gender is necessary in order to validate an analysis based on gender. Unfortunately, such information is missing part of the time: the gender of victims sex in not mentioned in 13% of offences on passengers.

In fact, it can sometimes be impossible to identify clearly the victim, especially in cases where multiple victims of different genders are involved in one offence.

Accomplishing quantitative analysis implies rectifying data in which the gender of victim is unknown. We will distribute incomplete information in due ratio of categorized offences where the gender of victim is given.

Concerning offenders, it was not possible to estimate the proportion of crimes committed by women in Lille, due to a bug in the database update process. However, Levine and Lee (*4*) found that in Manchester, only one crime in six are committed by women.

RAIL CRIME DATABASE

While Transpole is the only public transport operator in the conurbation of Lille, the regional railway transport is operated by the SNCF under the supervision of the Nord-Pas de Calais Region. In order to establish an exhaustive diagnosis related to the feeling of insecurity on public transport, Transpole crime database had to be complemented with the SNCF CEZAR database (Connaître l'Evolution des Zones A Risque). This nationwide database was created in 1998 after an accident caused by scrap metal items put on rail racks.

It is extremely valuable because it reports detailed offences. A lot of information is also collected about interventions, arrested offenders, impacts on the company activity and characteristics of victims, as it was described in a study about weak signals in rail transport system in France (*5*).

Precisely, data given on victims are the gender, the age bracket, the seriousness of offences, the potential number of temporary work disability days after an assault, place of birth.

Regrettably, the access to the database related to Lille Metropole is restricted for confidentiality reasons, and could not have been accessed.

INVENTORY OF VIOLENCES AGAINST WOMEN IN PUBLIC TRANSPORT IN

FRANCE

Beyond the urban area of Lille, a lot of public transport operators collect data concerning malicious acts committed on their network and create their personal database.

Unfortunately, each operator or local authority in charge of public transport determines his own database content by itself. As a result, none of them has the same degree of precision and completeness. In a restrictive way, some of them provide little information on victims and the gender is not reported on each network. Similarly, the list of offences sometimes changes from one network to another.

The National Transport Crime Observatory (ONDT) (*6*) has implemented a process to cope with this heterogeneous situation. The ONDT is part of the Ministry of Ecology, Sustainable Development and Energy's services. Created in 2008, it works in collaboration with public transport authorities, operators and prefectures by providing support in engineering and exchanging best practices. At the European level, the observatory participates in the development of a legal framework. At the international level, it is a member of the International Centre for the Prevention of Crime (CIPC) and of the international network of Crime Observatories.

Its intervention consists in collecting data and statistics, undertaking analysis and research by conducting and supervising studies. The observatory's aim is to encourage public policy and to provide legal expertise.

Specifically, the national observatory has elaborated a unique list of offences granted to any national analysis or comparison between the different networks. Each operator must then respect the frame put by the observatory in their own database.

In 2012, the ONDT precisely undertook a study on violence toward women on French public transport (*7*).

This study comprised a quantitative approach based on delinquency statistics delivered by public transport operators in Ile de France and also a qualitative approach made by a sociologist. In a very detailed manner, she questioned people about their mobility in public transport, the way they plan their trips, and even about strategies put in place in pursuance of reducing risks of being assaulted. For example, it can be performed by not applying make-up for women, avoiding wearing attractive or revealing clothes, avoiding travelling alone...

This study shows that a slightly higher rate of men are victims of assaults, though the offence nature is completely different. Definitely, more men are victims of violence, whereas women are preferential targets of sexual offences.

The qualitative survey proves that a bigger proportion of women fear being assaulted, especially at night. Consequently, their mobility is limited or they adapt strategies in order to reduce the risk of being a victim. To a greater extent, women who assured not being afraid of this risk unconsciously adapted their behaviour, either changing their clothes or their hairdo for example.

In spite of these evidence, the study didn't succeed in confirming the potential high-risk in the evening for example, by lack of traffic data. As the use of public transport is by far lower in the late evening than during the day or rush hours, most offences are assuredly committed during peak hours.

In addition to a database of committed offences or counted victims, we need a risk

indicator which would measure the exposure risk in an equation made of delinquency statistics and public transport usage.

DEFINING A RISK INDICATOR

In risk evaluation, the risk is generally described as :

$$R_i = p_i . e_i . s_i$$

with :

- R : the risk related to an “i” event
- p : the probability that the “i” event happens (potential risk)
- e : the level of exposure to risk
- s : the importance or seriousness of the damages suffered

The Probability of an Event

Generally, *p* does not only depend on *i* which refers to the potential type of events that can happen, but on the geographic location and on the surrounding environment too. It is also influenced by temporal components such as time or type of day, and by personal traits of the victim exposed to the risk.

Thus, Transpole's statistics providing the nature of the malicious acts show that the risk of being a victim of a sexual offence is much more important for women than for men. A young and good-looking woman who puts on make-up and wears attractive clothes can probably be more at risk. Anyway, a lot of women put into action the strategy of avoiding eye-catching when using public transport at night and alone.

One of this report's main goal is to evaluate the potential risk variable and how it can vary depending on people characteristics, (gender, status), on a temporal basis (time of the day) and on a spatial basis (mobility from the departure to the arrival places, and at larger geographic areas scale).

The potential risk may be difficult or even impossible to estimate. If the event occurs regularly, it can be measured through an indicator such as:

$p_i = \frac{n_i}{N_i}$ in which p refers to the probability that an event i might occur, n is the number of events reported, and N deals with the number of subjects exposed to the risk. For example, the probability of being the victim of an assault in the metro is calculated by the number of people assaulted in the metro divided by the number of passengers who took the metro at that time.

The number of subjects at risk has a manifold definition. Indeed, the risk of being assaulted can be estimated on the basis of:

- the number of passengers, how many passengers entered / left the train
- the number of passengers per km (if assumed that the risk is proportionate to the distance covered in public transport)
- the number of passengers per hour (here we consider that the risk is proportionate to the time spent in public transport).

Given enough delinquency data and the exact place where the offences were committed,

it is possible to elaborate more complex indicators by sophisticating elements measured here. In fact, the risk can be defined as the sum of risks of being assaulted in the station or in the vehicle. The probability of an assault depends on either the number of offences committed in a station, or on the number of passengers that entered or left the train, or maybe the time spent in a station so as to get in, to and the waiting time.

In order to assess the risk over the entire mobility chain, we must also take into account the risk of being assaulted on the public highway when going to and leaving a metro station. Such information is not given in the operator data.

On the contrary, for very dramatic events that can have significant consequences, such as the 9/11 terrorist attack or dirty bomb, it is impossible to estimate the random variable as the event has never occurred. Nothing but a qualitative assessment can be done. In these cases, risk studies aim for the most part to minimize probable impacts. This approach has been implemented in the European project Counteract (*8*). In this project, a matrix of the terrorist risk in transport network has been established. To do so, the probability that the event might occur was defined for each mode of transport and for each threat and put in parallel with impact levels. Both indicators supported a qualitative analysis during a workshop attended by different authorities in charge of the security in the public transport network.

Risk Exposure Levels

Risk exposure levels show how people's various mobility behaviours influence their risk of becoming a victim. In fact, we can assume that a person who travels twice more than another person with similar characteristics will have a risk twice higher.

The exposure indicator is a crucial point for evaluating a risk level. Martha Smith presents different ways used to estimate the risk of victimisation (*9*), based on traffic counts, time spent on the PT network, and more complex indicators taking into account intermodality and the whole journey including access and exit walk trips. To deal with the risk of victimization Ouimet et Tremblay (*10*) introduced the concept of contact opportunities which depend on the density of people located in a particular place at a given moment of the day. It can be estimated through household travel surveys, or otherwise with traffic counts, which are applied a people turnover rate.

Effects or Seriousness of the Damages

Assessing the effectiveness of a safety policy implemented on transport networks also requires to take into account the effects or the seriousness of the damages suffered after an assault. Indeed, the consequences vary largely depending on the nature of the act and the victim. Three types of effects can be developed :

- Effects on the operator

They can be of different kinds, as they concern either the staff, aggressions on drivers or controllers, deteriorated trains or fix furniture.

There are two types of effects possible on the staff : physical effects such as temporary work disability days or medical care, but also moral effects which can have indirect effects on the

service like strike calling or request for a consolidated network.

Effects possible on the furniture and apparatus are twofold : financial effects because the damaged equipment must be replaced or repaired, and disruptions in the service such as delayed and suspended trains for an unknown duration on the whole network or only on a part of it.

- Effects on passengers

Like for the staff, damages suffered have physical effects on passengers (work disability days or medical care) and moral effects. Another effect is the influence of an abundant number of aggressions on the network image. This can decrease the use of the metro as what happened in the metro in Lille in the 1990s.

- Effects on the environment

Effects on the environment can be directly linked to the malicious act itself like a deteriorated proximate environment, equipment, a fire, pollution, graffiti, decrease in the urban quality, squatness. Indirect effects can also be observed, mainly caused by disruptions in the service, implementation of a security perimeter, evacuation of areas at risk, congestion resulting in hyper-production of pollutants and in a modal report on cars, increase in noise nuisances.

Assessment of Insecurity Costs and a Security Policy

After identifying and assessing the different effects of an aggression in public transport, these effects must be monetised. By establishing the probability that each event can occur, we can estimate the monetisation of the impacts in terms of safety on the transport network.

Thus, insecurity costs can be calculated and secondly, a classical cost-benefit analysis can be adopted so as to test potential answers to insecurity in the metro.

In order to calculate the random variable of risk regarding people characteristics, temporal and spatial factors, we must know the multiple mobility habits, and also Transpole passengers characteristics. A first method would be counting the number of people arriving and leaving the trains regularly on the network. Although this approach provides us with data related to the network usage, they lack of details on trips operated. A better method, which will be used here, consists in analysing jointly delinquency data and mobility information reported by household mobility surveys.

HOUSEHOLD TRAVEL SURVEYS IN FRANCE

Over the past forty years in France, 150 household travel surveys (*11*) have been done in more than 80 territories gathering approximately 60% of the French population. These surveys are based on a very rigorous and constant general methodology called the CERTU standard (*12*). The CERTU standard eases comparisons of the plentiful mobility results collected in surveys carried out in the same city, but can as well adjust itself to the changes that occur in mobility routines and the society evolution. Detailed in a guidebook, this method is based on an x-axis concerning the sample of households classified according to their geographical location, and a y-axis about daily trips. Anyone that applies methodically this standard can benefit from a State subsidy and an assistance in project management which involves control and supervision over the survey.

Any person above 5 years old part of the household is surveyed about his or her trips

made the day before. Further information is reported about the household, the housing, the car availability, car parking, and people characteristics such as age, gender, job, level of qualifications, social class, workplace or study place. Finally, an exhaustive and precise description of every trip made the day before is reported including intermodality, arrival and departure times, modes of transport used, parking location at the end of the trip, walking time necessary to reach the final destination, activity patterns.

In the urban area of Lille Metropole, four household surveys based on the CERTU standard have been carried out in 1976, 1987, 1998 and 2006. Excepting the first one, all of them cover the territory of Lille Metropole.

Daily mobility evolution shows that the car market share increased until 1998 has started to decrease in 2006 (*13*). Public transport mobility has slowly but continuously increased partly because of the implementation of two new metro lines.

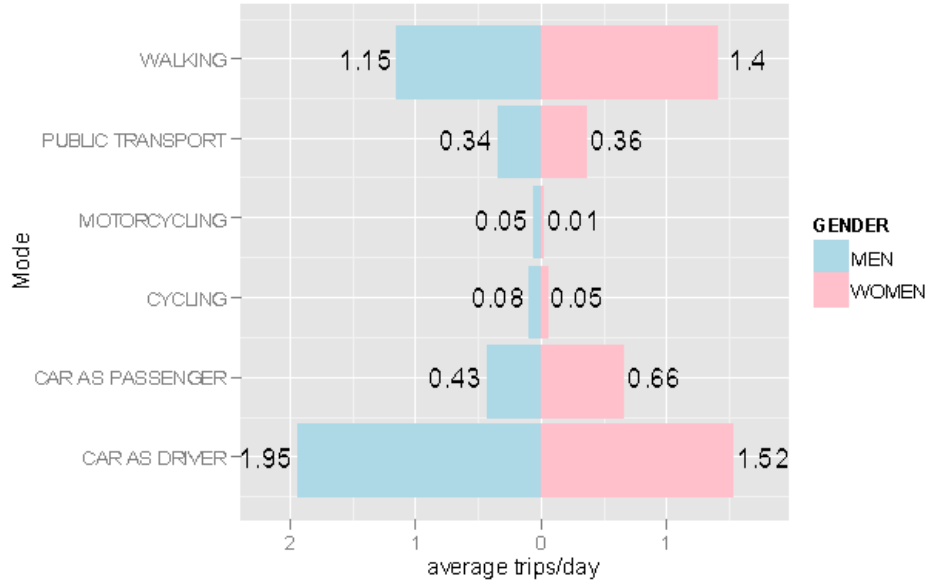

FIGURE 4 Mobility by mode and gender in Lille in 2006.

To sum up, women generally use public transport while men prefer using a car or a bicycle. On the contrary, the survey carried out for the first time in part of the Belgian Flanders in 2006 reports that women who live there use more the bicycle compared to men. Indeed, bike mobility in Flanders is ten times higher than in the Lille urban area.

The graphic indicates that mobility in public transport is always higher for women than for men regardless of the transport mode and the time of the day. However, the opposite situation is noticed at night : after 9pm, women mobility in public transport is remarkably low compared to men mobility. This result tends to confirm that women give up travelling at night because they are afraid of being assaulted. However, the lower mobility of women after 9pm is also observed for car as driver and walking. If insecurity is one of the possible reasons, it is not specific to public transport. The stability of mobility as car passenger could mean that women don't go out more often being accompanied . This results show that in Lille, the driver is preferentially the

man.

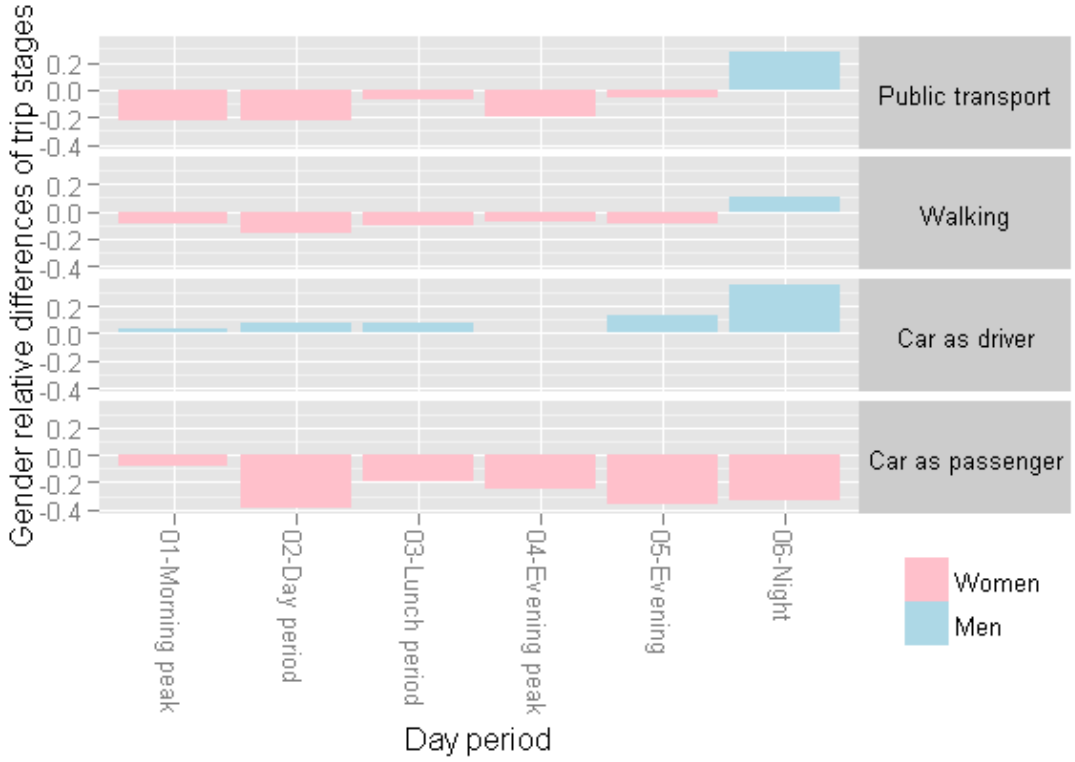

FIGURE 5: Gender relative difference of number of stages during the day per mode.

A more accurate analysis of public transport mobility based on gender and status shows that mobility behaviours are strongly linked with the status and gender of public transport users. At night, after 9 pm, male students and unemployed men are over-represented in public transport. On the other hand, many female students are travelling in evening from 7 to 9 pm. At night, public transport is an important issue for non-motorized shift workers. Women who mainly put up with part time job and shift work are particularly exposed when they have to travel at night using public transport.

Supplementary credibility would be brought to this report by showing up the causes of this confined mobility. Therefore, if the feeling of insecurity might be one of the reasons why women do not take the metro at night, it would not only concern public transport but more widely any other mode of transport. The women's mobility behaviours during the day is similar in Lyon 2006.

These results are valuable for collecting delinquency data that mention the type of act and differentiated mobility behaviours between men and women. Consequently, they confirm how useful a risk indicator can be.

RISK OF BEING ASSAULTED IN PUBLIC TRANSPORT

As Transpole delinquency data base does not provide any concrete figures on the effects of assaults committed on the network, risk assessment is hence restricted to the estimated probability of being a victim of an aggression in public transport.

Three exposure indicators per stages can be performed :

- The number of trip stages is commonly used in household travel surveys, which correspond to the number of boardings for PT.
- The number of passengers x km
- The number of passengers x hour

In household travel surveys vocabulary, a trip refers to going from one place to another by using the public way in order to reach the destination where the targeted activity takes place. Accordingly, in order to reach the next planned activity, one must operate a trip composed of one or more stages. One stage is defined by the use of one mean of transport. For example a worker executes one trip but two stages if he takes the bus and then the metro in order to go to work,, as well as if he goes there by subway after being dropped off by a car driver to the station.

The stage is the basic unit, but it has many defects. Firstly, it does not take into account the distance or time spent in public transport. Logically, the risk of being assaulted in a transport in two times higher for a trip that it two times longer than the standard stage unit.

Secondly, distances covered in different modes of transport have not been reported by the household survey. They are in fact a posteriori restored before being added to the survey data source. Thirdly, differences between the commercial speed of the various public transport and the distances between each inter station tend to mislead the indicator.

The best indicator appears to be the third one : passenger x hour. Unfortunately, information collected in the survey is not available at the level of a trip, but only for single stages. Moreover, given information are not precise enough as people usually round up or down their departure and arrival times. In order to adopt this indicator, we must estimate each stage duration. The measurement of each stage duration is based on the time necessary to reach and to leave public transport stations or stops, and waiting times between stages. This estimation is a tough task for trips composed of many stages.

GENERAL RISK DEPENDING ON THE TYPE OF EXPOSURE

Household mobility surveys have been carried out during school days and the reported trips are limited to the trips made during the week.

In order to estimate the risk on school days from holidays and on Saturday from Sunday, a simple risk indicator could be calculated by putting in concordance the number of offences by type of day and the number of boarding obtained from Lille Metropole statistics.

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	non physical offences	physical offences	*sexual violence*	*violence*	*robbery*	Total
holyday period	2.6	3.6	*0.1*	*0.8*	*2.8*	6.2
school period	3.6	3.2	*0.1*	*1.0*	*2.1*	6.8
Saturday	4.5	4.8	*0.3*	*2.4*	*2.2*	9.3
Sunday	8.6	7.9	*0.6*	*5.3*	*1.9*	16.5

TABLE 6 Level of Risk per Type of Day per millions of boardings

In 2006, it appears that the level of risk is higher on Saturday and even more on Sunday, especially for sexual violence which almost always affects women.

Mode	Offenses per million of stages		Offenses per million of km	
	Men	Women	Men	Women
BUS	4.0	3.1	0.8	0.7
METRO	9.3	8.0	1.7	1.5
TRAM	5.7	5.5	1.1	1.0
Total	7.5	6.3	1.4	1.3

TABLE 7 Risk by Transport Mode and Type of Exposure

Concerning the risk by mode and gender, the number of offences is very similar for men and women. The risk is higher for men, because they made a lower number of trips stages. However, the risk difference is less pronounced regarding the risk per km due to longer trips made by men.

RISK ASSESSMENT DEPENDING ON THE GENDER

	Millions of trip stages		Millions of km		Millions of hours		Millions of trips	
Type of offense	Men	Women	Men	Women	Men	Women	Men	Women
Snatching	0.5	0.4	0.10	0.07	1.2	0.9	0.7	0.5
Other cases of snatching	0.8	0.3	0.14	0.07	1.8	0.8	1.0	0.5
Petty violence	2.6	1.7	0.50	0.35	6.1	4.3	3.5	2.3
Attempted rape	0.0	0.0	0.00	0.01	0.0	0.1	0.0	0.1
Sexual assaults	0.0	0.2	0.00	0.05	0.0	0.6	0.0	0.3
Rape	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0
Pickpocketing	1.6	1.6	0.31	0.32	3.9	4.0	2.2	2.2
Petty thefts	0.6	0.6	0.11	0.12	1.4	1.4	0.8	0.8
Thefts with treatening	0.6	0.1	0.11	0.03	1.4	0.3	0.8	0.2
Insults	0.4	0.3	0.07	0.05	0.9	0.6	0.5	0.3
Threats	0.4	0.7	0.08	0.15	1.0	1.8	0.6	1.0
Sexual Exhibitionism	0.1	0.1	0.02	0.02	0.2	0.3	0.1	0.2
TOTAL	7.5	6.2	1.44	1.24	17.9	15.1	10.1	8.3

TABLE 8 Risk Assessment Depending on Gender and Type of Exposure

Globally, risk of being assaulted in public transport is higher for men than for women. Men are more concerned with violence and snatching and women with sexual assault and threats.

The smallish number of malicious acts is not sufficient to assess risk levels hourly. But at a larger scale, the risk assessment can be set on the basis of different periods of the day comprising the same number of trips and by assuming a higher risk at night.

Period	Definition
01-Morning peak	06h-09h
02-Day period	09h-12h 14h-16h
03-Lunch period	12h-14h
04-Evening peak	16h-19h
05-Evening	19h-21h
06-Night	21h-06h

TABLE 9 Time Periods Definition

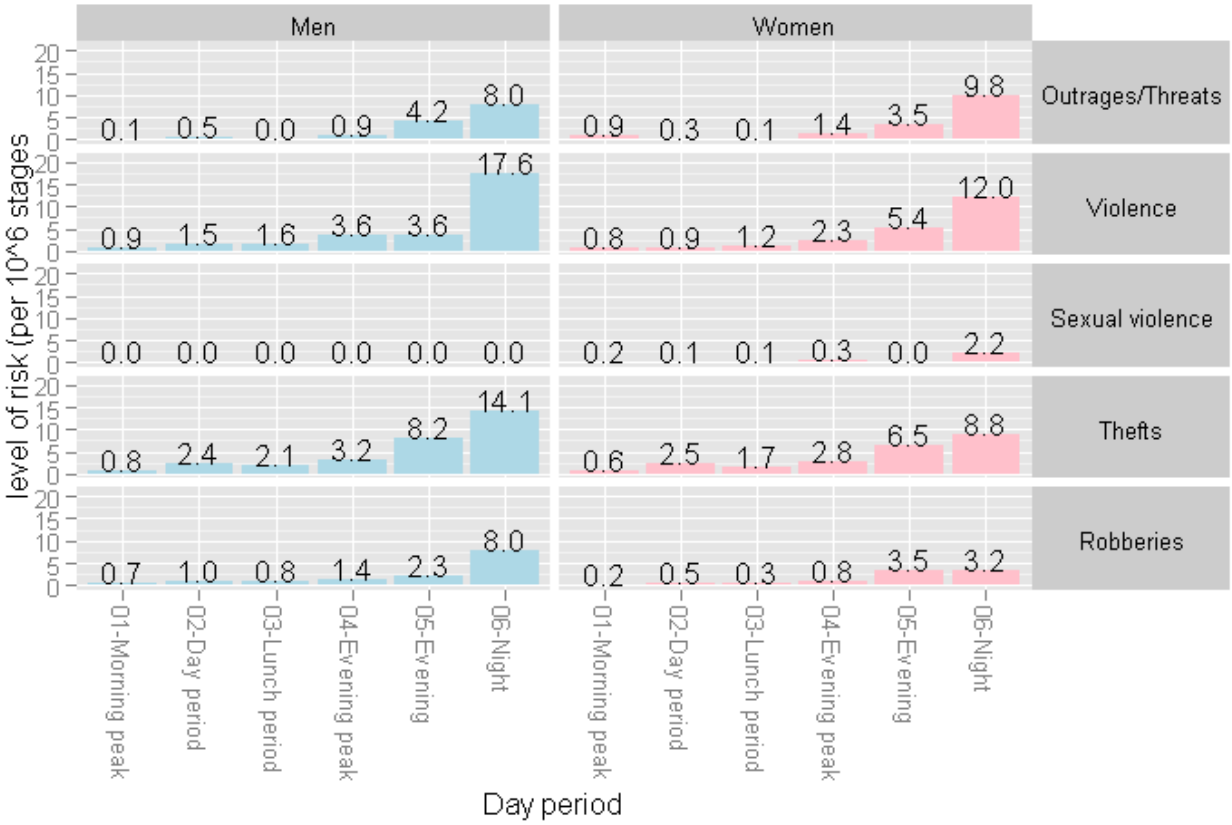

FIGURE 10 Level of risk by type of offence and period of day.

The level of risk is increasing continuously from the evening peak to the night period. Risk for men is significantly higher at night for violence, robberies and thefts, while the risk of sexual assault is largely specific to the night period. This method objectively confirms that the strongest feeling of insecurity at night is corresponding to a real higher level of risk.

GEOGRAPHIC REPARTITION OF RISK

In order to create an efficient indicator in a statistical approach, the territory of Lille Metropole has been partitioned in eleven large and homogeneous areas.

As the route is not mentioned for each trip and stage, it is often difficult to classify stages that start in one area and then finish in a different one. In these cases, we decided to split them in half between the two involved areas each time.

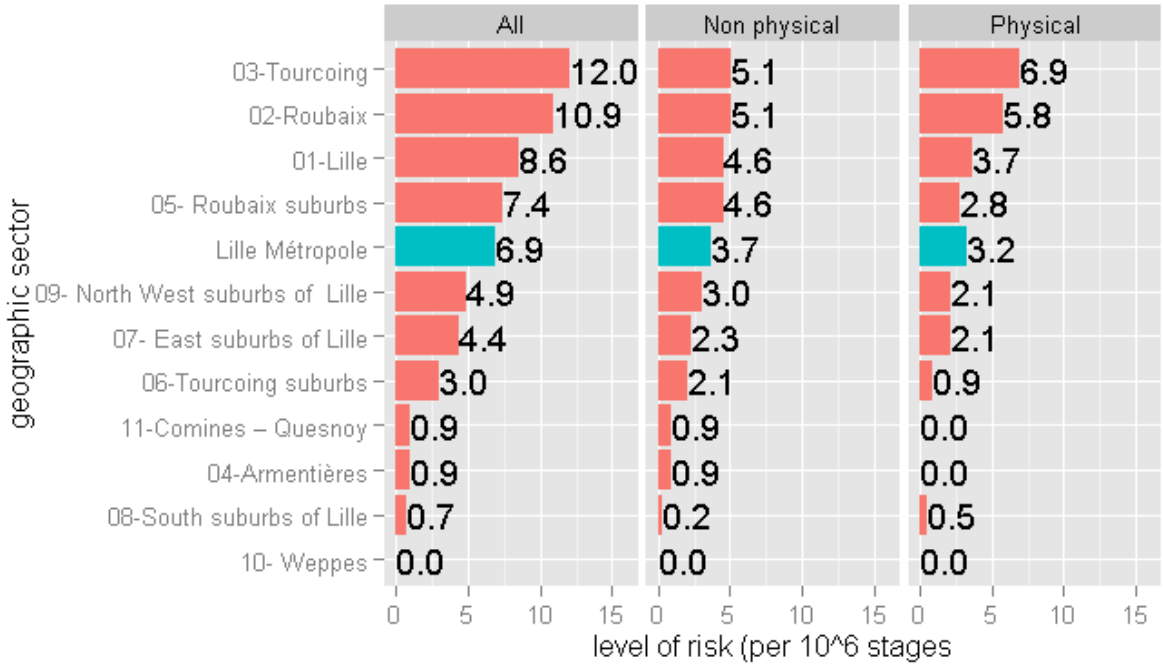

FIGURE 11 Geographic risk by type of offences per million of trip stages (10 zoning areas) .

While the risk of non physical offence is higher in urban zones, the risk of physical offence is significantly higher in Tourcoing and Roubaix than in Lille. The risk in Roubaix suburbs is also equivalent to Lille. In the same time, the risk of non physical offences is higher on dense areas, but without being significantly higher in specific sectors.

FURTHER APPROACHES

No further approach (such as risk based on age, job, trip activities, or the possibility to use a car, status) was possible because the available crime data is limited to the mention of the victims gender.

The unique suitable approach assumes that every man or woman have the same potential risk. Thus, only characteristics such as the transport used or the time of the day when it happened are analysed in order to demonstrate whether there is or not a higher risk for each categories given.

For example, if we assume that the risk is higher after 9 pm and that public transport are essentially used by girl students at night, as a result, girl students will have a higher risk than any other category. It can be explained by their mobility structure, regardless of the fact that they are women or young.

A risk budget can also be brought out by dividing the sum of risk per stage by the total of trips per day. People who travelled several times a day are more exposed to public transport crime, and have a higher level of risk. This analysis shows that the daily risk of public transport

users differs significantly with their status, due to their mobility profile, number of PT trips and period of travel. Male students who usually travell by PT are the most exposed, because of their mobility at night. Part-time workers are also exposed due to staggered hours.

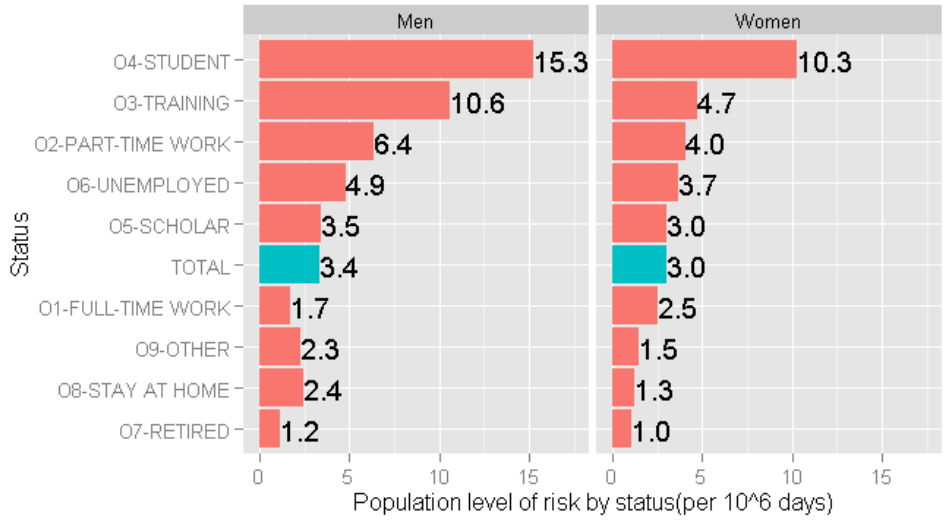

FIGURE 12 Global daily risk by population status.

If we analyse the risk of the complete categories of population depending on the status, whether they use PT or not, students are by far the most exposed. Indeed, most of them are regular users of public transport and travel at night. At the opposite, retired people have a very low risk. They travel mostly during the day, and only few of them use public transport.

COMPARISONS

The advantage of having a national general methodology about household surveys is to compare more easily the changes in mobility habits in different cities at any time. Assessing the risk between 1998 and 2006 is tempting, but the Transpole delinquency report is much more detailed today than before. The census is more exhaustive nowadays. Furthermore, the gender of victims was not mentioned at all and the organization of the list of malicious acts has changed in-between. The current report of the offences committed has been implemented in 2003.

Transpole used to classify data by the type of act in 1998. A general risk assessment, mixing up men and women victims can be carried out, after making compatible recent data and data from 1998. Nevertheless, it is possible to follow the recent evolution of the level of risk by calculating the number of offences over the yearly number of boardings in Transpole network.

Risk	Physical offences	Non physical offences	Total
2006	3.7	3.8	7.5
2012	3.4	4.9	8.3

TABLE 13 Level of Risk Evolution (Number of Offences per Million of Boardings).

The risk of being physically assaulted decreased slightly whereas the risk of non physical offence rose sharply, probably due largely to the thefts of smartphones.

Another asset of the standard household mobility survey is to be able to compare the level of risk from one city to another. However the relative small number of offences identified in Lyon probably points out significant differences in data collection procedures of malicious acts. This should be analysed in more details in a further study with complaint reports statistics from the police.

A similar risk indicator is being developed in France (*14*) (*15*) in order to assess the risk of being a victim of a car accident depending on each road transport. This analysis contributes in pointing up a higher risk when using the bicycle, and even more about two wheeled motorcycles. Studying both indicators jointly allows us to assess and compare risks of being a victim in car accidents and in public transport.

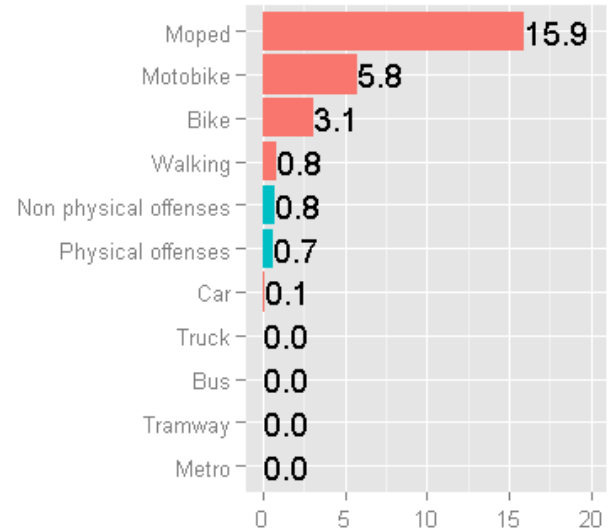

FIGURE 14 Comparison with road safety risk by mode per millions of km.

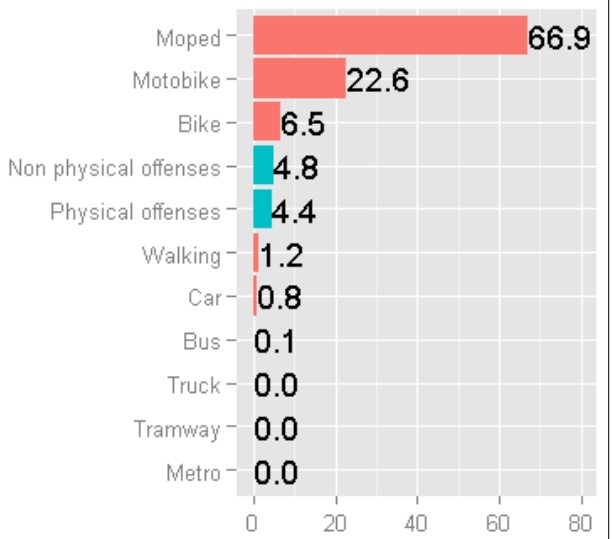

FIGURE 15 Comparison with road safety risk by mode per millions of trips.

PROPOSITIONS

This risk assessment method can be employed in other fields, such as assessing road safety risk, or operating the Environment Energy Assessment of Trips (EEAT) (*16*). To do so, results from household mobility surveys can become exposure indicators crossed with data collected in other fields. As a result, diagnosis and assessments undertaken could be enhanced by household surveys data that provide mobility information, characteristics about people and their housings. Thus, the global assessment method is improved and a better comprehension is possible.

Moreover, it can participate in producing public policies after assessing insecurity costs in public transport. It can also help to complete local mobility observatories by adding a security part, in order to make sure they are efficient. Beyond risk for passengers, this method is an asset for transport operators who can now take the best measures and control them in order to reduce risk of assaults on their staff and any deterioration on their equipment. To do so, the database will have to be deepened by reporting the effects of delays, suspended services, assaults on staff such as temporary work disability days and the financial impact of deteriorated equipment.

The reduction of risk for passengers is possible by collecting more information concerning victims, especially their age, maybe the social class and their residential area. In the same way, reporting the injuries suffered by victims might improve the assessment of insecurity costs and give new and specific solutions.

Concerning passengers security, more precisely women security, it was confirmed that the main gender specific risk for women was sexual assaults while more men were victims of violent aggressions and assaults in general.

In general, implementing specific services for women for example might restrain the number of sexual assaults by segregating victims from potential offenders. However, as the risk of sexual assaults in Lille is very low comparatively to other risks, like violence, such measure seems unsuited. On the contrary, diversity in public transport has a calming effect. The higher level at night matches with a lower diversity of users, with a higher proportion a male students and employed people, sometimes under the influence of alcohol and drugs, and nearly no more retired people and schoolchildren.

The implementation of ticketing and electronic payment will allow to follow the risk evolution, by having a better knowledge of the public transport users mobility and their characteristics.

Concerning future risk assessment studies, we propose to introduce the level of security in household travel surveys at a disaggregated level, in a similar way as it was done with EEAT and environmental impacts.

We can notice that there is no proportionality between the number of offences and the public transport usage, as the risk is higher at night and on weekdays when traffic is lower. Increasing the numbers of PT users will contribute to reduce the level of risk.

CONCLUSION

This report proves how important it is to build up tools such as risk indicators to assess security policies in public transport. In fact, they provide a neutral risk assessment that takes into account victims level of exposure. Such assessment can be tracked over time and be compared to surveys carried out in other similar cities.

Furthermore, the information given about impact and their monetisation contributes in assessing insecurity costs in public transport and implementing new safety policies.

About the risk depending on the gender, the report reveals that men in general have a higher risk than women. They have a larger probability of being the victim of a violent aggression whereas sexual assaults are almost always committed on women.

This report also demonstrates that the risk is much higher at night after 9pm. The risk is higher on urban zones, and significantly higher in Tourcoing and Roubaix than in Lille. But, the feeling of insecurity is overestimated as the risk of being assaulted in public transport is lower as being injured in a road accident as a cyclist or a motorbike rider, and only five times higher as a car driver.

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Anti-Harassment Campaigns for Mass Transit in the 21st Century US: A Critique from History

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ABSTARCT

This study uses the history of gender-based harassment in public spaces in the United States to evaluate anti-harassment campaigns recently launched in Boston, Chicago, and Washington, D.C. Historical sources, such as newspapers, oral histories, and organizational records, provide the foundation for a critical content analysis of sources related to current anti-harassment initiatives, including mainstream media and social media coverage, and anti-harassment advertisements, policies and public service announcements. American feminists in the 1970s identified "street harassment" as a persistent and systemic problem faced by women in public space, and particularly on public transportation. Their challenges led to scholarly research on the topic, growing awareness of the issue in the popular media, and, eventually, a revival of grassroots activism in the early twenty-first century. The current mass transit anti-harassment campaigns, which resulted from these recent grassroots efforts, are remarkably positive responses to a feminist-defined issue. They represent a more inclusive model for responding to gender-based harassment in public space than seen in many other countries today and they legitimate women's long-standing complaints about harassment. For all that is positive, however, earlier generations of activists' conceptualization of the problem point to a significant shortcoming in these current campaigns, particularly a failure to recognize the systemic causes and societal-level implications of gender-based harassment in public space.

INTRODUCTION

In 2008, the Boston T launched a campaign to end harassment, particularly gender-based harassment, on the city's major form of public transportation. Signs announcing the new initiative declared, "Rub against me and I'll expose you." The Chicago Transit Authority followed two years later, using the slogan, "If it's unwanted, it's harassment." Washington DC got on board in 2012, declaring, "It's not ok. Report Sexual Harassment on Metro." (Figure 1) These efforts included advertisements in stations, buses, and trains; new reporting tools for victims; better staff training; and a commitment to investigating complaints. As a feminist, it would be easy to declare these efforts a victory for women and move on to other issues. But as a historian, I would like to suggest that looking back at how earlier generations' grappled with the harassment of women in public space – particularly the work of activists and scholars who first defined and named the problem – offers useful tools with which to evaluate both the design and implementation of these recent institutional responses from American transit companies.

Figure 1: Washington D.C. Metro public service announcement, http://www.wmata.com/about_metro/transit_police/harassment.cfm. Accessed 5 November 2013.

Beginning the 1970s, feminists identified "street harassment" as a persistent and systemic problem faced by women in public space and particularly on public transportation. In seeking to challenge it, they encouraged scholarly research on the topic, raised awareness of the issue in the popular media, and, eventually, inspired a revival of grassroots activism in the early twenty-first

century. This study uses the history of challenges to gender-based harassment in public spaces to evaluate current anti-harassment campaigns in Boston, Chicago, and Washington, D.C. and offer suggestions for future stages in the campaigns.

METHODOLOGY AND THEORY

For the purposes of this study, "harassment" is an amorphous "group of abuses, harryings, and annoyances" that are unwelcome forms of touching, gestures, stares, or comments directed by one stranger toward another. (*1*) Archival methods based on historical sources, such as newspapers, magazines, movement newsletters, memoirs, oral histories, and organizational records, provide the foundation for a critical content analysis of current anti-harassment initiatives, including mainstream media, social media, and the anti-harassment, policies, and public service announcements (PSAs). While several attempts to gather statistics on harassment on mass transit have been made by various public agencies and advocacy organizations, they rely on non-scientific sampling techniques and are therefore unreliable measures of the prevalence of these experiences. (*2*) Numerical studies also tend to erase or flatten the ambiguity of a situation, but it is exactly the ambiguity that creates the vexing nature of street harassment. A fundamental assumption of this paper is that history and theory can help to shape public policy alongside data derived from surveys and quantitative studies. Qualitative sources can reveal the emotional texture of the experience of harassment and the social implications of how those experiences are represented in culture and policy. Perceptions of harassment, particularly on the societal level, matter more in this study than actual incidents. In line with Martin Wachs' 2009 challenge at a WIiT plenary to integrate "social science analysis with broader theories of social change and gender in society," the goal of this study is to perform a close read on qualitative sources related

to mass transit anti-harassment campaigns to better understand their social meaning, as well as to historicize and contextualize them. (*3*)

The work of feminist theorists on gender and public space provides the theoretical grounding for this study. Nancy Fraser (*4*), Nancy Duncan (*5*), Joan Landes (*6*), and Linda McDowell (*7*), for example, rework the theories of Jurgen Habermas (*8*) to illuminate the ways in which space influences experience and identity, shapes ideas about authority, and structures power relationships. These social critics note that in modern society, access to public space is a key factor in participating in the larger civic and political world, but social identity plays an important role in determining who has that access and under what circumstances. Judith Butler (*9*) frames gender as an active and negotiated category of social identity. Its meaning is fragile and slippery, and must constantly be performed. It is only through performance that the meaning is made. As sociologists Carol Brooks Gardner (*1*) and Elizabeth Stanko (*10*) argue, gender-based harassment is – or triggers – just such a performance of gender. Similarly, sociologist Erving Goffman posits that social interactions in public space are governed by a host of unstated rules that have to be learned and practiced – or performed to use Butler's term – in order for one to earn civil treatment when in public space. (*11*) Gender-based harassment in public spaces functions in compliance with many of these unstated rules, rules that allow for members of certain social groups to become the targets of attention – to lose their privacy – when they appear in places to which members of dominant social groups do not think they belong. From these theoretical underpinnings, I argue that unchallenged and ubiquitous practices that keep women off-balance or on guard in cities' public spaces, such as gender-based harassment on public transit, continue to undermine women's access to the public sphere and their claims to rights in legal, political, and economic settings. In other words, what has often been written off as acts of

individuals or experiences that are merely "annoying," are not minor, individual, or isolated acts. Rather, they reflect and reinforce women's position in society and therefore demand a more political interpretation and a societal-level response.

Why look at the U.S.?

Examining these campaigns in the U.S. is particularly important in light of the increasing international interest in the issue of gender-based public harassment. Considering the substantial legal, religious, and social barriers women in countries such as Saudi Arabia, Mexico, and India face, one might wonder what is the point of worrying over harassment in a country like the United States where women have relatively easy access to public space. It is precisely because conditions are not so dire in the U.S. that it is an interesting place to experiment with ways to challenge harassment. While women's presence in American public space is certainly not entirely unfettered, law and custom do acknowledge women's right to be there. This pushes the debate in the U.S. toward how that right can be exercised and what must be done to protect it. There is also a history of problematizing gender-based harassment that has created a rich dialog on the issue and a legacy of activism, both of which drive these current anti-harassment campaigns. In other words, there is a base from which current advocates and policy makers can work.

The United States also presents intriguing cases to study because the approach is markedly different than that being undertaken elsewhere. In the 21st century, a number of countries around the world are turning to "women only" options as a response to violence perpetrated against women in public space, an option discussed and often endorsed in several

WIiT papers at previous conferences. (*12, 13, 14*) Exclusive train cars, buses, and sometimes even taxis are reserved, labeled, and often flagged in pink for women in Tehran, Mexico City, Tokyo, Rio de Janerio, New Delhi, Cairo, Dubai, and Seoul. These efforts, while well-intentioned safety measures, are problematic. Not only are they ripe for ridicule (see examples of how women-specific parking spaces have been received), but they also reinforce ideas that women need special accommodations or even their own public space – so that if a space is not defined specifically FOR women, one might argue it must be male space. Segregated spaces, notes feminist author Jessica Valenti, "are mired in paternalism…hiding us behind closed (or sliding) doors." "Just how equal (are) the sexes," she continues, "if women's safety relies on us being separated?" (*15*) The segregation of public space also reinforces rigid notions of gender propriety and a gender binary, creating potentially violent repercussions for non-gender-conforming, trans, and intersexed individuals who do not comfortably fit into categories of "men" or "women" but must exist in a public space that continues to be bounded by such designations.

What has been happening in the U.S. in the last few years, both in terms of a revival of grassroots activism and new mass transit anti-harassment campaigns represents a very different model for responding to gender-based harassment in public space. The current initiatives in Boston, Chicago, and D.C. focus on the more controllable space of mass transportation as a means of tackling harassment in a way that assumes that public space should be for everyone – or at least everyone who follows the law and the rules of civil behavior. While not perfect, these policies and the campaigns behind them, then, have the potential to reinforce women's right to equal access to public space. They might even be expanded to do the same for trans and gender queer people. They represent, then, an important counter to the segregation trends that have

become so popular of late. If developed further, they might also have the as-of-yet unrealized potential to gain wider public recognition of gender-based harassment as a social, and not individual, problem.

Why Look at Harassment on Mass Transit?

Gender-based harassment, particularly that aimed at women, exists throughout public space. It happens on sidewalks, in parks, on the streets, in parking lots, on elevators, and anywhere else that space is relatively accessible and at least theoretically open to the general population. Public space has few economic, physical, or social barriers, it provides services to the broader population, and connects private elements of a city. Public transportation, which might be publically, privately, or jointly owned, is a particular type of public space with features that greatly contribute to the ubiquity of gender-based harassment. Trains, streetcars, and buses are confined spaces with limited entry and exit points, crowding patrons close together for short stints of time. Crowds and noise obscure individual actions. The physical design of stations, platforms, and cars can also offer cover to perpetrators and reduce avenues of escape or avoidance for victims.

Beyond the physical setting, the combination of anonymous crowds and conventions of public behavior allow harassment to go unrecognized or unchallenged. "It is extremely hard in a crowded subway station to tell right from wrong when somebody is up close to somebody else," argued a defense lawyer in a groping case. (*16*) Modern etiquette instructs all individuals to mind their own business and not to make eye contact in public, which often translates into fellow riders not outwardly reacting to what might – or might not – be harassment happening around

them. Women's gender training (always being expected to act like the "nice girl") further guides women, encouraging them to choose responses that would not embarrass or cause discomfort for those around them. They often will not confront a harasser or ask those around them for help. (*11*) These factors leave the targets of inappropriate touching, staring, and exhibitionism unsure of the intentions behind what they experience and even more uncertain that anyone around them will notice, care, or assist if they complain or ask for help. Not surprisingly, women often choose to exit a car or move away in an effort to stop the behavior without calling others' attention to what was happening, perhaps not even sure themselves of what had happened. (*1*)

For as much as the design, conditions, and social customs might contribute to harassment on mass transit, public transportation systems also have several advantages as sites for intervening to stop such behaviors. Mass transit, for example, generally requires patrons to pay to enter a system with defined spaces (cars, buses) and controlled entry/exit points, all of which makes surveillance physically and legally possible. As paying customers and not just passersby or visitors, patrons feel more entitled to better service and a comfortable environment than in other public spaces. Transit companies also train and maintain staff and security officers. Most have also developed explicit rules for patrons' behavior. While public transportation might be particularly prone to gender-based public harassment, then, it is also conducive to implementing policies and practices to challenge such behavior in a way that more transient and open public spaces are not.

WHAT CAN HISTORY TELL US?

Harassment Has a History

What history tells us first and foremost is that gender based harassment in public spaces is not something unique to the 21st century city. Evidence of the harassment women experienced in urban America shows up in novels, memoirs, and letters that stretch back as far as the 18th century. Historian Patricia Cline Cohen argues, however, that only in the 1830s did "a rising preoccupation with sexual danger for women in public" emerge. "Women were not 'out of place' in public," she concludes, but this new preoccupation meant that women "were not traveling on the same terms as were men." (*17*) Historian Mary Ryan uses the 1840s as her "benchmark" for the emergence of a "gender geography of public urban space," that was characterized, in part, by the harassment of women. (*18*) While these scholars differ from each other by a decade, they agree that the emergence of the industrialized city in the first half of the 19th century brought new and gendered interpretations of urban space that marked women's presence there as unusual and problematic, setting women up to be harassed.

Unease about women in public space increased with urbanization. New technology appearing in the latter half of the 19th century allowed urbanites to travel greater distances from home with relative ease and fed urban growth and the creation of new public spaces. Trains brought visitors and migrants into the city. Subways, elevated trains, cable cars, and streetcars moved them around within it. Women's particular vulnerability on these conveyances serves as the opening trope in Theodore Drieser's turn of the century novel, *Sister Carrie*. The protagonist is accosted by a 'masher' – a man who preys on lone women in public – during her train journey from the rural heartland of Wisconsin to the big city of Chicago. This encounter was symbolic of the dangers many 19th century Americans came to believe awaited women, particularly those who were young, single, and searching for paid work in the nation's cities. As middle class

women began to take advantage of new consumption and leisure opportunities downtown, similar concerns rose that they too would be “jostled” or “insulted” by working class men. (*19*)

Alongside these concerns over innocent country girls seeking honest work and respectable matrons out for a bit of shopping, however, existed narratives of ‘public’ women; prostitutes, of course, being the most recognizable threat and near universal symbol of “dangerous” women. The bifurcated image of women actually allowed for the toleration of some harassment of women, justifying it as behavior warranted by women’s disruptive presence in the male spaces of 19th century urban America. If ‘good’ women could be protected, then harassment would police the behavior and presence of ‘bad’ women.

A smattering of laws and accommodations created in the 19th and early 20th century attempted to mitigate dangers and protect ‘respectable’ women. Some municipalities, for example, enacted ordinances forbidding insults against women in public, in an effort to curb the “dangerous and offensive” behavior of “ruffians” loitering in American cities. (*18*) Many cities and private organizations also began offering sex-segregated spaces where women might rest when away from home and some American businesses sought to shield women by offering them separate ticket windows, sales counters, show times, and entrances. A few transit companies responded to gender-based harassment on public conveyances by offering ‘ladies only’ cars.

These measures quickly ran into difficulties, however. Women themselves did not help matters. With the ‘ladies-only’ subway cars, example, ridership patterns made it clear that women did not use the designated cars consistently or in great numbers. Women also did not behave in ways that made the distinction between well- and ill-bred women apparent. On the subways, for example, suffragist Harriot Stanton Blatch noted, “the women crowd as well as the

men," (*19*) reflecting the argument of many riders that did not need or merit special accommodations.

Gender specific laws and most services were quickly abandoned in the 20th century urban U.S. In place of this short-lived practice of reserving cars for women, most transit systems instead offered commercial amenities designed to allow travelers to purchase services. For women, these services would allow them to maintain their privacy from fellow travelers by obviating the need to sometimes allow (male) strangers to assist them with packages, luggage, directions, or tickets when traveling. (*20*) Since interaction with strangers could leave them vulnerable to unwelcome advances, commentary, or worse, women were advised to function independently while in public. (*21*) Women's magazines, newspaper articles, and etiquette manuals published throughout the late 19th and 20th century also evidenced continued harassment of women by advising women to be on guard; "a lone woman can't be too careful," female readers were advised. (*22*) As this advice and these services made clear, women who wished to protect themselves from potential harassment in public space needed to essentially buy the privilege of privacy in public. Those who could not afford to purchase services or their own private transportation would be less able to insulate themselves from the notion that at least some women deserved the ill-treatment they received in public – because they were alone, because of how they were dressed, because of where they were going. For these women, ventures into public space carried the possibility that they would be perceived of as not moral enough, not appropriately feminine, or not respectable. By the 1930s, buses would join subways and streetcars to round out the mass transit options available for American city dwellers. Public transportation supported the growing numbers of women in the paid labor force (upwards of 40%

of urban women worked for wages by 1920) but it also offered few ways by which women could insulate themselves from scrutiny.

Race and Gender: Intersectionality and Harassment

For African American women, public transportation proved a crucial tool for transitioning away from live-in domestic work, common in the 19th century, to the increasingly common "day work" domestic positions of the 20th century. Racial residential segregation, common in all American cities, necessitated a reliable means of transportation if African American women, 90% of whom worked as domestics, hoped to get from their own homes to those of the white families that employed them. This almost daily reliance on public transportation, particularly in southern cities where blacks often represented a far greater portion of the population, exposed African American women to harassment driven by both the racialized and gendered practices of the city during the Jim Crow era (the period of extreme legal and social discrimination and violence toward African Americans that began in the 1870s and lasted until the 1960s). Despite their numbers, black women found themselves the target of harassment and outright attacks precisely because of the intersection of their race and gender. Black women traveling too freely into white spaces and the intimate setting of white homes created anxiety in whites who enacted their patriarchal racial domination on these independent women.

African American women, however, sometimes responded in surprisingly confrontational ways to both institutional and individual harassment on public conveyances. When a white conductor attempted to remove journalist and activist Ida B. Wells from the first class 'ladies car" to the "Negro car," she sunk her teeth into the hand he placed on her shoulder and then sued

the railroad company. (*23*) During the 1906 Atlanta, Georgia race riot, white mobs rampaged through the city's public spaces and black women traveling through the city's downtown became targets of white male violence. One woman was pulled from a car and stripped, while those who attempted to assist her were beaten away with barrel staves. Others, however, more successfully fought back. A black woman riding a streetcar defended herself like "a savage wildcat" with her umbrella; another wielded her hat pin as a weapon. (*24*) In the Southern city of Birmingham, black women bus riders suffered curses and punches from both drivers and white passengers. Focusing specifically on the women who fought back, historians have argued that these "daily guerilla skirmishes" served as a crucial foundation for the modern mass-based civil rights movement of the 1950s and 1960s. (*25*) These are the cases that make it into the historical record, they often led to arrests of the women and/or formal complaints against the transit companies and they became the rallying cry for mass-based protest. By viewing these incidents as precursors to the civil rights movement, however, the gendered nature of black women's experiences – and the daily-ness of the slights, insults and humiliations women of color faced at the hands of men of any race – gets erased. In a rare moment of recognition, the editor for a black newspaper in South Carolina referenced the "commonplace experience" of women's harassment, saying "you can pick up accounts of these at a dime a dozen in almost any community." (*26*)

Naming the Harm, "Street Harassment"

Race, age, ethnicity, class, and other visible social groups shaped some aspects of public harassment, but gender links these experiences. The frequentness with which women across the

social spectrum experienced harassment actually meant that it generally went unrecognized as a social problem. As late as the 1960s, the harm caused by harassment had not yet been explored, there was not yet language to connect groping, staring, and flashing as part of a systemic repression of women. As a woman commented on a recent online story about harassment, "My mother recounts being groped by men in business suits on a daily basis." (*27*) Susan Brownmiller, a white author and long-time New York City resident, described mid-20th century harassment in this way in an oral history interview:

> Furtive touching was so much a part of … life. It was a part of the life on the subway. If you took the train in the morning, it seemed there was a molester in every car… And you'd move away, you'd scuffle, sometimes you *might* say something out loud but it was the experience of all young women and probably older women too that you step on to the train in the morning to go to work and somebody's in that car to give you a feel… It was part of … life. (unpublished)

Brownmiller's recollections are indicative of the ubiquitous nature and blatantness of these types of experiences for urban women. She obviously found the encounters distasteful, threatening, and intrusive. She later mentioned she expected they were far worse for women of color, but she dismisses them all as merely "a part of… life," something to be expected and endured.

Unlike the more overtly political and legal focus of first wave feminism (focused primarily on suffrage) second wave feminism sought to redefine issues that had been labeled "personal" as social and political issues. The emergence of second wave feminism in the late 1960s and 1970s, then, provided an opportunity for women to challenge harassment in public spaces collectively. Women did not come to feminism because they had been whistled at on the street or flashed in a subway station, but once in the movement, and once the issue was raised, women quickly tapped into the hurt from, in Brownmiller's words, "a lifetime's accumulation of these petty assaults" and eagerly added it their growing list of grievances. (*28*) The issue

surfaced frequently in informal feminist discussions, poetry, art, essays, and organizational newsletters. They named it “street harassment” but they were keenly aware that it could happen in any public space from an elevator, to a sidewalk, to a subway car.

From these conversations, feminists learned to name the harms caused by gender-based harassment in public space. Once named, the practice could not remain invisible or be so readily dismissed as merely a petty annoyance or an individual aberration. Evidence of this conceptualization appears throughout radical feminist newsletters of the late 1960s and 1970s. Street harassment, wrote members of a Chicago women’s group, “makes us consider, in ways that men never have to, where we go at night, with whom, how late we’ll be and when and how we’ll get home.” Feminists also learned that their own feelings of “suspicion and mistrust” caused by harassment in public space were widely shared. These discussions often triggered great wells of anger from women, who then declared their “rage” at the treatment they received from men in public spaces and the way it made them “feel powerless and dehumanized.” White Boston feminist Roxanne Dunbar captured the conclusions many feminists had reached: “Our oppression and suppression are institutionalized, all women suffer the ‘petty’ forms of oppression. Therefore they are not petty or personal, but rather constitute a widespread, deeply rooted social disease. They are the things that keep us tied down day to day, and do not allow us to act.”

From examinations of the individual toll women paid to be in public, feminists in the 1970s developed a three-pronged analysis. First, they declared that the intrusive and unsolicited comments, the leering, and touching to which women were prey objectified women. Secondly, feminists suggested the ways in which gender-based public harassment curtailed women’s autonomy by forcing women to “choose the hours, and choose the circumstances that you can be

out." The implication behind this point was that limited geographic mobility in turn restricted women's political, social, and economic mobility and their ability to function as independent members of society. Finally, feminists placed touching, exhibitionism, and the verbal harassment women experienced on one end of a continuum of male violence toward women that, on its other end, included rape or even murder. (*29*)

This third line of reasoning resonated especially heavily with women – on the pages of movement newsletters women readily recounted the fear they felt when a man stared at them or spoke to them in public – but it also located the source of harassment and violence in a society that tolerated and even encouraged the subjugation of women. Recognizing both the individual harm of harassment and the larger societal underpinnings of the phenomenon, second wave feminists encouraged women to reject the behavior rather than seek to avoid or minimize its existence. They further advocated a crowd-level, public response to stop harassers and support victims: In one scene from the 1983 feminist utopian film "Born in Flames," for example, a woman emerging from the subway is "checked out" by two men, who then start making comments to her and eventually push her to the ground, presumably to rape her. The woman is rescued by a group of whistle-blowing, bicycling feminists who surround and drive off the perpetrators and then comfort the woman who had been attacked. The scene is earnestly feminist in its portrayal of how a verbal confrontation could lead to physical violence, but it also demonstrates how an aware, activated, society could successfully intervene in the moment to save someone from victimization.

By the 1970s, ending street harassment of all kinds had come to symbolize for feminists what NOW president Karen DeCrow defined as "the right to human dignity, the right to be free from humiliation and insult, and the right to refuse to wear a badge of inferiority at any time or

place." (unpublished March 6, 1971, NOW Collection, Schlesinger Library, Radcliffe College) In response, feminists in the 1970s and 1980s organized "ogle-ins" where women turned the tables and harassed men on the streets, created self-defense classes, and published handbooks encouraging women to resist and demand better treatment.

Scholars and the Popular Press

By the 1980s and into the 1990s, feminist scholars, mostly sociologists and legal scholars began to research the issue. Their studies documented women's experiences, analyzed the perceptions of both the harassers and the harassed, and interrogated the culture of fear that street harassment fueled among women. The resulting studies assessed the ramifications of the "sexual terrorism" that street harassment created and maintained a focus on the macro-level impact of how these practices produced a "ghettoization of women" in American society. (30, 31)

When the issue crept into the popular press in the 1980s and early 1990s, however, feminists' critique of a culture of violence toward women was co-opted by a focus on the individual. Women were being told by women's magazines not to tolerate harassment anymore and to actively challenge it. "Don't 'Hey, Baby' Me," announced *Glamour* magazine in 1992. (*32*) What female readers were not being told was that they might consider society's permissive or dismissive attitude toward harassment as an expression of a larger structural inequality they faced as a result of their gender. African American commentators, who had been remarkably absent for earlier discussions, did join this part of the conversation. Calling attention to "the ugly sounds of summer," one author reminded readers that even just 'girl watching' was "the kind of violation of black womanhood that black men had once died to prevent." They admonished

black men for practicing it, but cast the harassment of black women more as a reflection of racial inequality, continuing to overlook its gendered components.

21ST CENTURY ANTI-HARASSMENT CAMPAIGNS

A new generation of feminist activists, coming mostly out of the third wave and transnational feminist movements began a renewed grassroots campaign against gender-based harassment in public space at the turn of the millennium. Their campaigns were more conscious of race and Lesbian Gay Bisexual Trans Queer (LGBTQ) issues, and more connected to an international movement to stop violence against women than their predecessors in the 1970s. While they acknowledged many of the themes from that earlier generation of feminists, they pioneered new tactics for addressing harassment, taking advantage of new technology to foster communication and publicity. Hollaback!, an organization founded in New York City in 2005 that has since spread to over sixty cities in twenty-two countries, urged women to use their cell phones to take pictures of anyone who makes them "scared or uncomfortable" with anything from "comments (such as) 'You'd look good on me' to groping, flashing and assault" and post them to the web. Other groups created blogs where women could post their stories of harassment; some started interactive maps to identify 'harassment zones'. These organizations then used these stories and their own research to target gender-based harassment on public transportation, in particular. Feminist, grassroots organizations demanded that transit companies become more responsive to the problem. Collective Action for Safe Spaces, for example, a D.C. organization formed in 2009, conducted a "safety audit" around the city in 2011 and then, in

early 2012, launched a successful campaign to lobby the Washington Metropolitan Area Transit Authority to address harassment on the city's public transportation.

The responses of some transit officials and the general public to this work against gender-based harassment on mass transit is particularly revealing of how much there was (is) to be done. When sexual harassment was raised as a serious problem on the city's transit system by the grassroots organization Collective Action for Safe Spaces, WMATA spokesperson Dan Stessel testified to the DC city council that "it really isn't a big issue." (*33*) Metro Transit Police Chief Michael Taborn's testimony dismissed uninvited comments and leering stares as being "not a crime," leading one columnist who attended the hearings to conclude that he "seemed oblivious to the fact that many Metro riders, especially women, were feeling uncomfortable when riding the trains." (*34*) Tabor further minimized the problem when he later told a local TV reporter, "One person's harassment is another person's flirtation." (*35*) Local anti-harassment organizations jumped to exploit these gaffes and the public relations nightmare they created helped to launch the Metro's official anti-harassment campaign.

In the largely anonymous realm of the internet, however, victim-blaming and individualization of the problem is harder to counter. On-line comments posted to a 2007 survey of harassment on NYC subways, for example, admonished women for "asking for" harassment through their clothing choices, while others faulted women for not reporting sexual harassment. Some called for better policing, but many expressed the belief that "catching these people is virtually impossible," implying that it was a waste of resources to even try. A number of commenters used the forum to tell stories of being harassed on the city's subways and name the emotional harm these incidents caused them, but just as many dismissed harassment as nothing more than the kinds of "odd occurrences" one should expect living in a city.

Pushed by feminist grassroots organizations, however, a few transit authorities in large U.S. cities finally began to directly address harassment on public transportation. Boston debuted its public service announcements and a press campaign in 2008; Chicago in 2010. WMATA, the entity in charge of D.C.'s bus and train system created a new email and web portal for reporting harassment in March of 2012. Their PSAs drawing attention to the problem and encouraging victims to report incidents debuted a month later. The two waves of feminist organizing (1970s and 2000s) and the scholarly attention they generated help to explain why U.S. transit companies launched anti-harassment campaigns. Feminist grassroots organizing also offers a means for evaluating the structure and implications of these campaigns. Some aspects of feminist problematizing of gender-based public harassment have been incorporated, some have not. Probably the closest resonance between anti-harassment campaigns in Boston, Chicago, and D.C. and feminist analyses can be found in the rejection of negative feelings victims might experience. Next to the image of a lone, wary-looking African American woman, for example, one poster declares, "I'm not the one who should be ashamed." Placards reassured riders that "no one should make you feel uncomfortable." These messages hint at the psychological harm victims of harassment might experience, feeling guilty for being a target of harassment or feeling unsure that they had a right to challenge behaviors that left them ill at ease.

Figure 2: Washington D.C. Metro public service announcement, http://www.collectiveactiondc.org/programs/wmata-anti-sexual-harassment-campaign/. Accessed 5 November 2013.

Reflective of the most recent grassroots efforts on the part of organizations such as Hollaback! there is an obvious attempt on the part of transit companies to make the anti-harassment campaigns appeal to a diverse audience. While young women predominate in the posters and placards, some ads also feature older women, lone men, and people from many races. Five years after the campaign's launch, the Boston T now displays two different ads featuring lone men and bearing the same text as the earlier ads featuring women, "Hey you, you are not entitled to my space. Sexual harassment is a crime and if you make me uncomfortable, I will…report you." These posters do not clearly indicate who might be the source of the "sexual harassment," and what might be motivating this harassment. This ambiguity suggests that anyone could be the target of harassment, but it does so in a way that de-genders the problem. The re-framing of an issue in a way that depoliticizes it is even more clear in a poster that debuted in the Spring of 2013: a picture of an attractive and fit-looking young man of color is even accompanied by the classic feminist anti-rape slogan, "No means no."

Transit companies have also expanded their anti-harassment campaigns to include a host of other behaviors that trouble transit riders. Chicago, for example, uses the same slogan that originally called out gender-based harassment. "If it's unwanted, it's harassment," appears on a second poster that specifies "bullying, soliciting, and panhandling." (Figure 3) While these attempts to demonstrate the benefits of the campaigns to all transit patrons might lower resistance to recognizing gender-based harassment, they too depoliticize the issue by removing the connection to harassment motivated the power imbalance between different social groups. Without a specific reference to individuals being targeted because they are a part of group that is

perceived to be less powerful, it therefore severs the connection between harassment and hierarchies of power.

Figure 3: Chicago Transportation Authority public service announcement.

The design of the campaigns and the content of the PSA signs suggest that, despite feminist arguments to the contrary, the "problem" being addressed is located primarily at the level of individual behavior. "Rub against me and I'll expose you," declares a poster developed for the Boston T and then licensed to the D.C. Metro. (Figure 4) Next to the image of a young woman pointing her finger into the camera lens, a slogan declares, "respect my space." Both slogans stress the first person singular in their appeal. (Figure 5) In Chicago's media campaign, multiple people, representing diverse backgrounds, stare squarely out of the frame, most with

defensive postures of arms crossed, but all positioned as individuals rather than as part of a cohesive group. YOU should not do this – "touching, rude comments, leering" – is often the message, but the subtext is clearly that YOU, as an individual, should not have to take it if someone does this to you. The signs are meant to empower victims to reject behaviors they deem as unwanted ("say 'no'"), and report incidents to authorities ("Tell a CTA employee immediately if you are a victim of harassment").

Figure 4: Botson T (Transit) public service announcement.

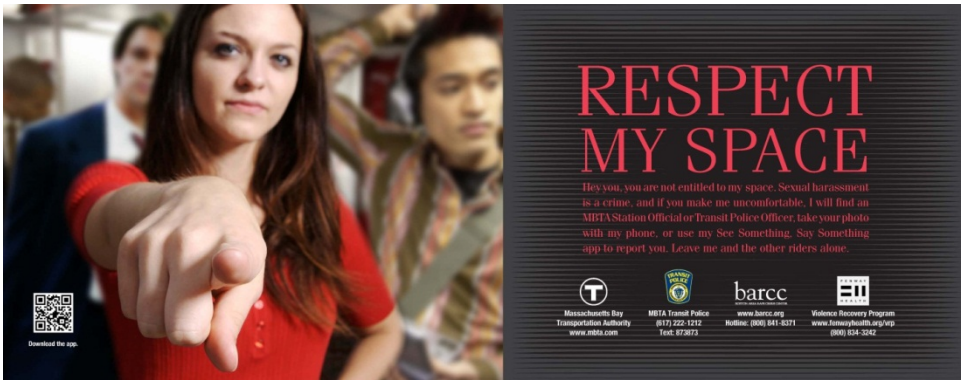

Figure 5: Botson T (Transit) public service announcements.

The design of the campaigns and press coverage of these initiatives often direct the riding public to view harassment as a problem individuals face and one that should be addressed only by law enforcement officers. Transit riders were given new tools to report incidents through web sites, cell phone applications, email addresses, and phone numbers, so that transit police could respond and investigate. When Chicago Transit Authority signs intoned, “if you see something, say something,” they clearly meant a person should “say something” through one of these mechanisms or to a transit officer directly, not to the other people on the train or bus and not to the person they perceive as a harasser. Similarly, the public placed the responsibility for combatting harassment on transit officers. “It sure would be nice,” commented one reader on a newspaper article, for example, “if the transit police would do more about this problem – and not just every now and then, but constantly.” (*27*) One implication of leaving harassment in the

individual realm in a space that has overtones of 'consumer rights' (patrons pay to ride most public transportation, after all) is that the problem is likely to then be dealt with through increased policing and state-sanctioned surveillance rather than a sense of community engagement and civic responsibility. Nowhere in the transit authority messages, and only rarely in the public response to them, is there an expectation that individuals could count on those around them to offer assistance to a person who felt victimized and had challenged their harasser. Ultimately, then, individuals are left to determine for themselves if they are being harassed and to decide how to act. Even if their fellow passengers are texting pictures of perpetrators to transit officials, the target of the harassment could be completely unaware of how those around them are reading the situation. (*36*)

CONCLUSION

The focus of this paper has been on how recent transit campaigns frame the "problem" that harassment poses and how they assign responsibility for how the problem can/should be addressed. These initiatives do represent a more inclusive model for responding to gender-based harassment in public space than seen in many other countries around the world today and they legitimate women's long-standing complaints about harassment. For all that is positive, however, earlier generations of activists' conceptualization of the problem point to a significant shortcoming in these current campaigns, particularly a failure to recognize the systemic causes and societal-level implications of gender-based harassment in public space. What is still missing from these campaigns are the larger political implications of gender-based harassment. Fully exploring these implications would require recognition that groping, flashing, and harassing commentary are more than just annoying behaviors. They are worth stopping precisely because

they are connected to and representative of a host of other types of discrimination and, as researchers who have presented at previous WIiT conferences have clearly demonstrated, they will discourage women from using public transportation. (*13*) The transit company campaigns in Boston, Chicago, and D.C. are not yet asking why we, as a society, have allowed these behaviors to develop. These campaigns are not yet presenting public harassment as a shared, societal-level problem. And while they acknowledge harassment as a problem that might cause victims shame and discomfort, they do not show a recognition of why this is. Early feminists articulated the relationship between street harassment and rape, offering an explanation for why "harryings" and "annoyances" could cause fear and lead women to curtail their presence in public spaces, but that argument has yet to surface in mass transit anti-harassment campaigns. While these transit companies have taken important steps in interrupting the victim blaming that has long accompanied street harassment, the individual psychological aspects of harassment continue overwhelm the issue and thereby depoliticize it and overlook how and why harassment creates fear and limits mobility for its victims, particularly women.

Knowledge about how women have experienced and interpreted gender-based harassment in public spaces, particularly on public transportation, and how society has silenced these experiences is required if transit authorities, law enforcement, and municipalities wish to further advance travelers' sense of comfort and safety. Feminist theories and histories, and other radical critiques of how power relationships are embodied in time and space, suggest how official responses to gender-based harassment in public space might continue to evolve. As public benefit corporations with missions to move people efficiently from point A to point B, transit authorities might not be viewed as having a responsibility to solve societal problems and might need to be convinced that doing so could help advance their missions. Campaigns against

gender-based harassment on mass transit could be improved by approaching riders as a community, rather than as individuals. To do this, they would need to leverage the greatest strength of public transit, the public. PSAs that work to define harassment could frame the issue as a social or community problem, requiring a response at that level. This is where the continued involvement of grassroots organizations is needed to create pressure for this kind of reframing.

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Gender, mobility and travel behavior in Pakistan: Analysis of 2007 Time Use Survey

ABSTRACT

Pakistan's national economic growth framework views connectivity between people and settlements as an engine of economic development. However, a little is known about the patterns of mobility across socioeconomic segments ofthe country. The study aims to explore gender differences in travel behavior across urban and rural areas that remain unexplored due to the non-availability of suitable data. Thepaper employs national dataset of 2007 Time Use Survey (TUS) carried out to measure gendered time use in paid and unpaid work activities. In TUS, a national sample of 37830 respondents living in 19380 households,ageing 11 and above, was selected for household and time diary surveysduring the whole year 2007. Time use diary recorded various activities carried out by respondents in forty eight 30-minute long episodes of the past day, their context locations and simultaneity, according to 125 activity codes based on UN designed International Classification of Activities for Time Use Surveys. PreprocessedTUS, that ispublically available from Pakistan Strategy Support Program, was analyzedusing longitudinal data analysis techniques. According to the results, large gender differences are found in travel behavior related to trip rate, travel mode, duration and purpose of travel. Female are more likely to be immobile as 55 percent female respondents did not report any trip in the diary day as compared to just 4 percent male respondents. Women make lesser daily trips (2.8) than men (5.4) and the greatest difference exist for leisure and sociocultural trips. Women are more automobile dependent as their share of automobile trips (13 %) is greater than men's share (10 %). Period of adulthood and marriage seems to restrict female mobility and leisure travel strongly. Female travel behavior is largely shaped by sociocultural, economical and built environment of the country. The findings points out the need for gender sensitive transport and land use policies in the country as women are more likely to be immobile or travel less due to theirconcerns related tosafety, security and quality of transportation. Potential sources of bias and research directions are pointedout at the end.

1. INTRODUCTION

Desire to travel is intrinsic to human being and mobility is considered a basic right of all individuals(Yago, 1983). Growing literature on travel behavior highlights significant differences gender in mobility and travel patterns (Law, 1999).In the developed world and many developing countries, women make more trips than menandin less developed countries, women travel longer and carry loads on their heads(Gething et al., 2012, Mark Blackden and Wodon, 2006).However, in some developing countries, women may be less mobile than men, andas a whole, their travel patterns are more complicated and often include short distance travelling, trip chaining and time crunched household serving trips (Pucher and Renne, 2003, Dobbs, 2005). Women mobility needs are also significantly different from men and literature shows that women are more concerned about personal safety, security and quality of service(Li et al., 2004, Vokolkova and Michalek, 2007, Cottrill and Thakuriah, 2009, Dupont and Krakutovski, 2009, Vaughn, 2009, Whitzman, 2013). These differences in attitudes and needs are rooted in gender differences in activity participation, roles and responsibilities in daily lives and sociocultural norms of the society(Mauch and Taylor, 1997). Understanding gender difference in travel behavior is important to identify women transportation needs and mobility requirements(Meyer, 2004, Kalter et al., 2009, Dupont and Krakutovski, 2009). Our transport systems may not recognized these important

differences and thus become less responsive to women needs and requirements. While gender differences in travel behavior are relatively well known in developed countries; this phenomenon has got far less attention in the developing world, where it is believed that the differences might be wider and even unique in some aspects(Duchène, 2011, Peters, 1998 , Nobis and Lenz, 2004, Julie Babinard and Scott, 2009).Porter (2007) noted that *"transport remains a surprisingly neglected area among gender specialists and transport specialists are still reluctant to take on gender issues"*. Therefore, this paper seeks to extend current research on travel behavior in developing countries by examining gender disaggregated travel patterns in Pakistanusingactivity time use data.Time use data is considered a key set of information for activity based travel behaviormodeling (Kitamura, 2001, Kitamura et al., 1997). While household travel surveys form the primary source of information for it, they often provide an 'incomplete' set of information on daily activity patterns due to their 'travel only' nature of enquiry(Pinjari and Chandra, 2011, Bhat and Koppelman, 1999). Time use data provides a more complete spectrum of human activity participation including travel, in-home and out of home activities (Harvey and Spinney, 2012, Kitamura et al., 1997, Levinson and Kumar, 1995, Acharya, 1982).Many of travel behavior researchers argue combining data from household travel surveys and time use surveys in travel behavior analysis due to the unique set of information provided by the time use surveys(Hubert et al., 2008, Michelson, 2005). The fact that time use datasets are 'harmonized' for inter country comparisons(Converse, 1972, Esquivel et al., 2008, Harvey and Spinney, 2012), makes them more useful for modeling travel behavior across geographies. Pakistan's Time Use Survey provides a good starting point for measuring patterns of mobility and activity participation in the country,and this study aims to do so. The specific questions,this paper addresses are:-

1. Do women and men have different mobility and travel patterns across urban and rural areas of the country?
2. How do travel patterns (trip rate, mode choice, travel purpose and duration) vary byage, marital status and main role across gender
3. Whatare the implications of these differences for country's growth and transport policy?

The followingSection 2 'Study Area' provides socio economic background for transport and mobility in Pakistan, to give the reader an opportunity to grasp the contextual base of the study. Section 3 'Data and Methods' describes design, collectionand processing of data; and the methodology to extract travel behaviorinformation from the time use diaries. The later Section 4 'Gender, Mobility and Travel Behavior' explores patterns of travel behavior in detail and how do they vary across geography and demographic groups defined by age, marital status and income level of the respondents. At the end, Section 5 'Conclusions and Recommendations' summarizes the new findings of the study, implications of results for country's transport related policy of economic growth,further researchdirections and potential sources of biases in the study.

2. STUDY AREA

Pakistan housesnearly180 million people with 37 % of them living in urban areas(Planning Commission, 2011b).Aided by high population growth rate and constant rural to urban migration, its cities are constantly increasing in size and numbers(Planning Commission, 2011c). From 1951 to 2005, number of small cities of population below 100,000 increased from 238 to 515, medium cities with population up to 500, 000 increased from 10 to 59 whereas the number of large cities, housing more than 500,000

people,increased from 2 to 12(Government of Pakistan, 2009). Consistent increase in population, size of cities and decrease in rail based transportation has put extra pressure on demand for road based transportation in the country (Kosec et al., 2012, Mehdi et al., 2011, Addleton, 1984, Burki, 1973, Planning Commission, 1960). Since early 1960s, road based transport has taken a central role in country's transport strategy as itcarried, in year 2010, more than 92 percent passenger transport and 95 percent of cargo movement in the country (Planning Commission, 2011d).A study estimated that country's current transport demand will triple by 2025 (JICA, 2006). With every passing year, transportation is considered an even more important factor in country's economic growth policy that emphasis connectivity between people, cities and places of production (NTRC, 2011, Planning Commission, 2011a). The work by international donor organizations such as World Bank indicated that nearly 85 % villages and nearly all cities are connected with major road network (Essakali, 2005). The government of Pakistan also aims to double the current road density of 0.31 to 0.62 km/km2 till 2018 (Planning Commission, 2011d). However, due to lower automobile ownership, majority of its population is dependent on public transport for personal mobility. In the strategy of road, urban flyovers and highway construction, the goal of providing adequate public transport based mobility is somehow not reached.Transport authorities of the country are unable to cater for the transportation needs of its growing population. Quality of road network and non-availability of adequate mobility options consistently obstruct the mobility and connectivity in the country's ever expanding urban and rural areas(Imran, 2009, Qureshi and Huapu, 2007, Russell and Anjum, 1997). A panel study by International Food and Policy Research Institute (IFPRI) and Pakistan Strategy Support Paper (PSSP) found that commuting behavior in country is moving towards 'personal automobile' based mobility(Nazli and Haider, 2012). Motorcycles are replacing Bicycles and usage of 4 wheelers vehicles like Bus/Van has also decreased since 2007(Nazli et al., 2012). Ownership of motorcycles has rocketed in the dominate middle class being a 'quicker and reliable' mean of transport than busses and vans (Imran, 2010a).

While the country's booming urban population has started to create a mark on political and cultural stage of the country (seeKugelman (2013) for brief discussion), their mobility issues are also becoming increasingly persistent and chronic in nature(Imran, 2010b, Haider and Badami, 2004). Major cities are unable provide an acceptablepublic transport network for their residenceAvailable means of public transport are generally categorized as 'inadequate' due to major issues with service quality, coverage, fleet shortage and poor enforcement(Imran, 2010b).The users of public transportation are often left at the mercy of private bus operators(Citynews Lahore, 2010). However, female travelers are more severely affected than male due to their special mobility needs in the conservative sociocultural settings of the state. Women are considered 'family honor' and often require permission of travel from head of household(Sathar and Kazi, 1997). While travelling without male, women are sometimes charged with extra fare or sometimes taken to wrong bus stops.They often face harassment, stalking and poor travel environment in public transport and walking on urban roads(Pakistan Television, 2011, Express Television, 2012, Aurat Foundation, 2012, Population Council, 2003, Sohail, 2000). Knowing this hostile travel conditions, families do not allow women to travel without male especially the young adults.Urban female might be the most affected intersection of gender and geography as urban areas are considered more conservative in their social settings. In this way, women travel horizons are spatially and temporally restricted and demand attention from the policy makers(Hoodbhoy, 2013).In the ongoing attempt to realize a road based transportation system for economic growth and connectivity in the country, study of gender differences in travel behavior and mobility requirements have got little attention. Assessments of

travel and issues of mobility are few andarea-specific mostly for big cities (Rizwan Hameed and Nadeem, 2006). Such studies are not a statistical and theoretical representative of the entire country due to their area-specific nature and scope of data collection. While Pakistan, as in many developing countries,does not conduct national level transport surveys like National Household Travel Surveys in many developed nations, there is a need to utilize alternative sources of data which can provide reliable description of travel behavior and mobility levels.Such studies, like time use surveys, can provide sound basis for gender sensitive policy intervention in mobility and transportation issues (Adeel and Feng, 2012).

3. DATA AND METHODS

The study is based on time use diary data collected through Pakistan's first ever national Time Use Survey 2007 (TUS), carried out by the PakistanBureau of Statistics with funding from UNDP. The purpose of carrying out TUSwas to measure the role of women in labor force,paid and unpaid work activities in order to draw women friendly welfare programs and budgeting(Pakistan Bureau of Statistics, 2008). The data has been collected from a nationally representative sample of 19600 households surveyed during the whole year 2007by door to door questionnaire survey. TUS questionnaire has two parts, a household part and a time diary part. The household part of questionnaire enquired household's socioeconomic status like household size, type of housing, income andaccess to various facilities. The time diary part enlisted demographic information of the respondent and activities carried out by him or her in the past day. Respondents were asked to recall and mention upto three activities for each of 48 pre-defined episodes of half hour duration from 4:00 am to 4:00 am.Recalled activities were classified according to the UN recommended ICATUS (International Classification of Activities for Time Use Surveys) scheme detailed in United Nations (2005)that was first proposed by Harvey and Niemi (1993). Based on the guidelines, a maximum of 144 activities were recorded per respondent along with their context location and simultaneityin each episode.Context location for each activity was recorded in two variables; 'Location Code 1' thatidentified activity location by broad land use type (own residence, other's residence, agricultural workplace, public place, travelling or waiting and other places)whereas 'Location Code 2' described general location 'inside' or 'outside' of the building or the type of modeused (walking, personal automobile, taxi, train, bus, bicycle and other modes),if travelling.

TUS representscountry's urban and rural population in each of the four provinces. For this purpose, entire stratum of country's urban areas published in 2005 Economic Census (Pakistan Bureau of Statistics, 2005)and rural areaspublished in 1998Population Censuswas taken as sampling frame. As nearly 40 percent population is urban, 40 percent of the sample size was surveyed from urban areas and remaining 60 percent was surveyed from rural areas. A three stage stratified random sampling procedure was applied for sample selectionsimilar to other national surveys. At first stage, 652 urban and 736 rural Primary Sampling Units(PSU) were selected from the sampling frame byprobability proportional to size method where a larger PSU had higher chances of selection.PSUs are the entire Enumeration Blocks (each consists of 200-250 households) in urban areasand village/mouza in rural areas. At the second stage, sample households were selected from the PSUs through systematic sampling using published list of houses andevery 16^{th}urban and 12^{th}rural householdwas selected for survey with a random start. At the third stage,two respondents were selected from each selected household for time use diary by Kish grid selection. This method, developed byKish (1949),is a probability sampling technique used to select individuals from multiple potential respondents(Laurie, 2004). Using this method, a table of household size and member's rank enabled selection of respondents systematicallyfor time use diary

survey.Household questionnaire was asked from adult member of the household whereas the time use diary was surveyed from two respondents above 10 years of age from each household.TUS sample was distributed evenly over four quarters to account seasonal variation in time use.

The sample excluded few administrative areas like Federally Administered Tribal Areas (FATA) andsome districts of Khyber Pakhtunkha (the then called as North West Frontier Province) that were mostly located at difficult terrain or in places with security vulnerabilities.Homeless population and those who cannot be categorized as a household, for example day time household workers and children living away from home, were also excluded from the sample. All the excluded population forms nearly 3 percent of the sampling universe.The survey was carried out by hiring local female surveyors and facilitation from local political leaders and multiple visits to the household increased the response rate of survey up to 98.9 percent. A total of 19380 household questionnaires and 37830 time use diaries were filled completely and data was digitized and processed in STATA. Pakistan Strategy Support Program has provided TUS data free of cost on their website for research purposes. Key demographic characteristics of the sample are given in table 1 below showing distribution of respondents by area, province, age group, education, main activity and source of income, feelings about diary day and availability of transport mode in the household across gender.

Table 1 sample characteristics

Socioeconomic Characteristics	male		female		Overall	
	n	%	n	%	n	%
Sample size	*18,321*	*48.4*	*19,509*	*51.6*	*37,830*	*100.0*
Urban	*7,422*	*40.5*	*7,495*	*38.4*	*14,917*	*39.4*
Rural	*10,899*	*59.5*	*12,014*	*61.6*	*22,913*	*60.6*
Province						
Punjab	*8,092*	*44.17*	*9,000*	*46.13*	*17,092*	*45.18*
Sindh	*4,615*	*25.19*	*4,424*	*22.68*	*9,039*	*23.89*
NWFP (Khyber Pakhtunkha)	*2,986*	*16.3*	*3,828*	*19.62*	*6,814*	*18.01*
Baluchistan	*2,628*	*14.34*	*2,257*	*11.57*	*4,885*	*12.91*
Age group						
10 to 19	*5,860*	*32.0*	*5,636*	*28.9*	*11,496*	*30.4*
20 to 29	*3,593*	*19.6*	*5,045*	*25.9*	*8,638*	*22.8*
30 to 39	*3,359*	*18.3*	*3,812*	*19.5*	*7,171*	*19.0*
40 to 49	*2,415*	*13.2*	*2,316*	*11.9*	*4,731*	*12.5*
50 to 59	*1,446*	*7.9*	*1,346*	*6.9*	*2,792*	*7.4*
60 to 69	*1,008*	*5.5*	*868*	*4.5*	*1,876*	*5.0*
70 to 79	*462*	*2.5*	*342*	*1.8*	*804*	*2.1*
80 to 89	*139*	*0.8*	*116*	*0.6*	*255*	*0.7*
90 & Above	*39*	*0.2*	*28*	*0.1*	*67*	*0.2*
Education level						
No formal education	*5,762*	*31.5*	*11,252*	*57.7*	*17,014*	*45.0*
K.G. but below primary	*2,181*	*11.9*	*1,669*	*8.6*	*3,850*	*10.2*
Primary but below middle	*3,548*	*19.4*	*2,489*	*12.8*	*6,037*	*16.0*

Middle but below matric	*2,359*	*12.9*	*1,371*	*7.0*	*3,730*	*9.9*
Matric but below intermediate	*2,210*	*12.1*	*1,363*	*7.0*	*3,573*	*9.4*
Inter. but below degree	*1,093*	*6.0*	*749*	*3.8*	*1,842*	*4.9*
Degree and above	*1,168*	*6.4*	*616*	*3.2*	*1,784*	*4.7*
Marital status						
Never married	*8,084*	*44.1*	*6,736*	*34.5*	*14,820*	*39.2*
Currently married	*9,775*	*53.4*	*11,648*	*59.7*	*21,423*	*56.6*
Widow/widower	*413*	*2.3*	*1,058*	*5.4*	*1,471*	*3.9*
Divorced	*49*	*0.3*	*67*	*0.3*	*116*	*0.3*
Main Role						
employed	*12,691*	*69.3*	*3,270*	*16.8*	*15,961*	*42.2*
student	*3,726*	*20.3*	*2,789*	*14.3*	*6,515*	*17.2*
Unpaid worker	*123*	*0.7*	*11,483*	*58.9*	*11,606*	*30.7*
doing nothing	*1,781*	*9.7*	*1,967*	*10.1*	*3,748*	*9.9*
Main source of income						
Wage/salary	*5,781*	*31.6*	*1,270*	*6.5*	*7,051*	*18.6*
own business	*5,504*	*30.0*	*435*	*2.2*	*5,939*	*15.7*
Government grant	*167*	*0.9*	*39*	*0.2*	*206*	*0.5*
Investment	*34*	*0.2*	*13*	*0.1*	*47*	*0.1*
Other household member	*1,027*	*5.6*	*2,456*	*12.6*	*3,483*	*9.2*
Remittance	*88*	*0.5*	*268*	*1.4*	*356*	*0.9*
Compensation	*27*	*0.2*	*21*	*0.1*	*48*	*0.1*
Other	*256*	*1.4*	*64*	*0.3*	*320*	*0.9*
No personal income	*5,437*	*29.7*	*14,943*	*76.6*	*20,380*	*53.9*
Diary day						
Monday	*2,929*	*16.0*	*3,120*	*16.0*	*6,049*	*16.0*
Tuesday	*3,060*	*16.7*	*3,167*	*16.2*	*6,227*	*16.5*
Wednesday	*3,021*	*16.5*	*3,157*	*16.2*	*6,178*	*16.3*
Thursday	*2,738*	*14.9*	*2,868*	*14.7*	*5,606*	*14.8*
Friday	*2,403*	*13.1*	*2,716*	*13.9*	*5,119*	*13.5*
Saturday	*1,744*	*9.5*	*1,675*	*8.6*	*3,419*	*9.0*
Sunday	*2,426*	*13.2*	*2,806*	*14.4*	*5,232*	*13.8*
Feeling about diary day						
Busy	*5,641*	*30.8*	*4,550*	*23.3*	*10,191*	*26.9*
comfortable	*6,785*	*37.0*	*7,743*	*39.7*	*14,528*	*38.4*
not too busy	*5,895*	*32.2*	*7,216*	*37.0*	*13,111*	*34.7*
Transport mode in household						
Car	*1,265*	*6.9*	*1,241*	*6.4*	*2,506*	*6.6*
motorcycle	*3,592*	*19.6*	*3,449*	*17.7*	*7,041*	*18.6*
cycle	*6,531*	*35.7*	*6,543*	*33.5*	*13,074*	*34.6*

Source: Author's calculations using Time Use Survey (2007)

Sample characteristics show that urban population is 40.5 %, female subsample is 51.6 %,young adults from 10 to 29 years of age make 53.2 % while elderly aging 60 or above form9% of totalsurveyed population. Being the largest province in the country, Punjab province covered 45.18 % and combined share of Baluchistan and KPK was 30.9 % of the total sample. On marital status, 39.2% reported being unmarried, 56.6 % reported currently married while 4.2 % reported being divorced or widowed. On main source of income, 60.6 % of respondents reported having a job or personal business, 29.7 % expressed no personal source of income; 5.6% reported receiving income from other household member and remaining 3.2 % reported income from government grants and other sources. On vehicle type ownership, 6.6 percent of respondents reported having car, 18.6 % reported motorcycles while 34.6 % of the sample reported having cycle in their house. 60.3 % sample reported being employed; and from the rest not having an employment, 20.3 % reported being student, 9.7 % people reported 'doing nothing' and 0.7 % reported doing unpaid household works. Main role of the respondent other than employment was extracted from the questions '5.21: if not available for work, then why?' And the expressed reason behind not working was taken as the main role of respondent. Time diaries were prepared for the whole week period with least respondent share of 9.7 % for Saturdays, nearly 13 % for Fridays and Sundays and 15 to 16 % for rest of the days. Least diaries were reported for Saturdays due to the general holiday on next survey day. TUS sample characteristics show that, as compared to male respondents, larger proportion of female interviewees reported being in adult age group, having lower education levels, currently married or divorced, doing unpaid work, dependent on others for income, and feeling 'not enough busy' on the diary day. As the analysis section highlights, these demographic factors play an important role in women travel decisions in the country.

Measuring Travel Behavior

The paper measures four characteristics of activity travel behavior: trip rate, mode choice, duration and purpose of travel. TUS recorded time use in 125 detailed 3-digit activity codes that, when combined, form 10 broad activity categories defined by ICATUS. Each of 10 broad activity categories describes 'travel' activitywith at least onedistinct 3-digit activity code, usually ending with '80'. These travel related activity codes were identified and the ten broad activity categories were divided into 20 broad groups, 10 representing the activity and 10 representing travel for that activity. The data was recoded to separate 'activity' and 'travel' time use and summarized for travel duration, number of trips, mode choice and trip purpose for each respondentby longitudinal analysis techniquesdescribed inSinger and Willett (2003) and Michelson (2005). For simultaneous activities, 30-minute episode time was allotted to each of the activities while in case of non-simultaneous activities; episode duration was divided equally among them. As a result activity time for the diary day was 1440 minutes or higher. This method helped preserving actual time spent by each activity as if a person was sleeping during travel in an episode, both travel and sleep activities were given 30 minutes each. Detailed ICATUS activities are often reduced to small number of activities in activity behavior modeling(Acharya, 1982, Pentland et al., 1999). For travel behavior analysis, this study converted ICATUS activity classification into 3 activities of Reichman classification, developed by Reichman (1976), namely subsistence, maintenance and leisure activities. As the official report does not provide a detailed description of the travel activity due to its focus on work duration assessment, the overall figures reported in this work may differ from the official summary of travel patterns due to methodological differences in data analysis. For example, in the official report, activity time has been equally divided between simultaneous activities which may under represent travel time whereas in this reported research, simultaneous activities have been treated differently to preserver

travel activity time. Similarly this paper carries detailed analysis of travel activity which has not been provided in official final report,(Pakistan Bureau of Statistics, 2008),due to their limited scope of work.

4. GENDER, MOBILITY AND TRAVEL BEHAVIOR

Out of total 37830 respondents, 26441 (69.89%) reported travelling during diary day while 11389 (30.11 %) did not report any trip. A total of 120173 trips were recorded from the survey, including 103999 (86.5 %)by walk, 7626 (6.4 %) by automobile, 2905 (2.4 %) by cycle, 2500 (2.1 %) by bus, 2175 (1.8 %) by taxi including rickshaw, 912 (0.8 %) trips by other modes (e.g. animal driven carts) and just 56 trips by train. While rural dwellers reported more trips by walk (67389 or 90.6 %) than urban residents (36610 or 79.9%), their share of motorized trips was smaller (6.3%) than urban areas (16.7%). Table 2 below details total trips by mode of transportation used across respondents in urban/rural and gender categories.

Table 2Total trips by mode across geography and gender reported in Pakistan Time Use Survey 2007

	Overall		Urban		Rural		Male		Female	
Mode	n	%	n	%	n	%	n	%	n	%
Walking	103999	86.5	36610	79.9	67389	90.6	82696	86	21303	88.6
personal automobile	7626	6.4	5032	11	2594	3.5	6099	6.4	1527	6.3
taxi	2175	1.8	1109	2.4	1066	1.4	1551	1.6	624	2.6
train	56	0	31	0.1	25	0	47	0	9	0
bus	2500	2.1	1465	3.2	1035	1.4	2038	2.1	462	1.9
bicycle	2905	2.4	1306	2.9	1599	2.2	2838	3	67	0.3
other	912	0.8	257	0.5	655	0.9	842	0.9	70	0.3
Total	120173	100	45810	100	74363	100	96111	100	24062	100

Source: Author's calculations using Time Use Survey (2007)

Gender and Mobility Decisions

On average, 30 % respondents (11389) did not report travel in any of their 144 activity episodes. However, the mobility decisions and the number of trips vary considerably across gender. A large number of female respondents (10722)did not report travel activity as compared to relatively small (667) male respondents. Female were one third (8787) of the total travelers (26441) and their immobility rate was nearly 55.4%as compared to 3.64 % for men.Other than higher immobility rates, female are less likely to make more than 2 trips per day as compared to male population (table 3). 29 .7% of female respondents (i.e. 66 percent of mobile women) reported one to two trips in diary day,11.1 % (or 24.5 percent of mobile women) reported making three to four trips whereas only 4.2 % female (9.1percent of mobile women) reported more than 4 trips in diary day.From male sample, 25.5 % respondents (i.e. 21.8 percent of mobile men) reported one to two trips, 20.3 % (31.3 percent of mobile men) reported three to four trips, 10.3 % (i.e. 18.6 percent of mobile men) reported making five to six trips whereas 13.8 % respondents (i.e. 28.3 percent of mobile men) reported 7 or more trips in their diary day.

Table 3 Total daily trips across gender

	Overall		Male		Female	
Total daily trips	N	%	N	%	N	%

Zero	11,389	30.1	667	3.6	10,722	55.0
1 to 2	9,641	25.5	3,845	21.0	5,796	29.7
3 to 4	7,673	20.3	5,517	30.1	2,156	11.1
5 to 6	3,881	10.3	3,285	17.9	596	3.1
7 to 10	3,373	8.9	3,139	17.2	234	1.1
More than 10	1,873	4.9	1,868	10.2	5	0.0
Total	37,830	100	18,321	100.0	19,509	100

Source: Author's calculations using Time Use Survey (2007)

More than half of the women reported immobility which is almost doubles than previously known immobility levels in the developing world. Similar levels of immobility have been reported inShefali (2000)in their Dhaka metropolitan area sample.The time use data highlights thatnearly 79 % of male population made more than two trips per day while approximately 85 % of total female respondents reported making less than two trips in the time use diary. Nearly half of the male respondents made more than 5 trips as compared to less than 5 % female respondentsas detailed in figure 1 below.

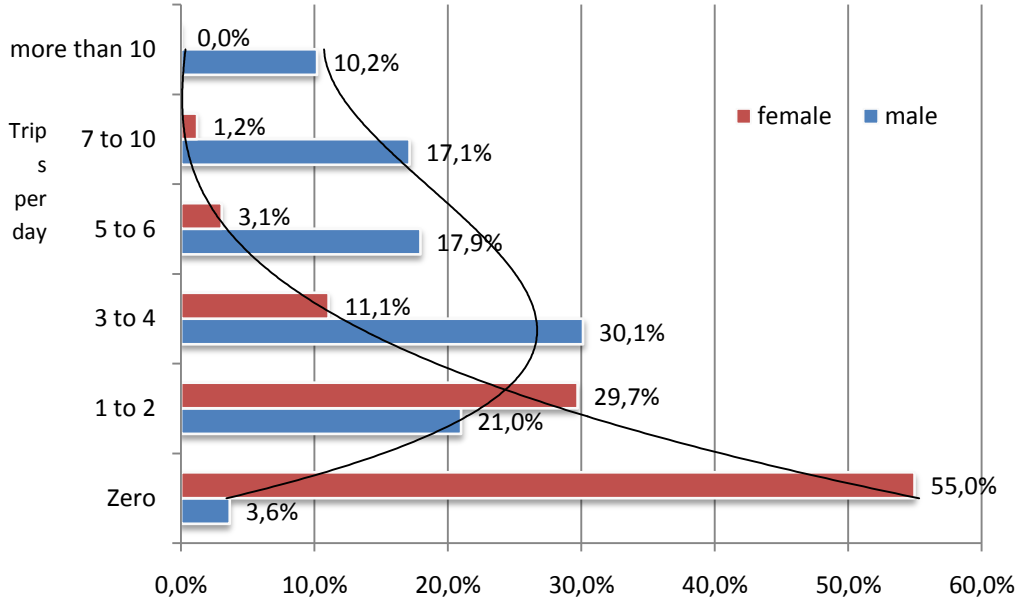

Figure 1 Percent of respondents by mean daily trip across men and women in Pakistan

One-way ANOVA results verify significant gender differences in trip rates (at Pr>Chi2=0.0 and F Stat =5621) with mean trips per day of 5.5 and 2.8 for male and female respectively). While immobility is concentrated on female side of gender, urban areas seem to carry larger immobility burden than rural areas. Urban female were more immobile (56.9 %)than rural female (53.7 %) and urban male were slightly more immobile (3.9%) than rural male (3.5 %) as shown in table 4.

Table 4 Mean daily trip distribution by men and women

	Overall		Urban male		Rural male		Urban female		Rural female	
Mean Daily trips	N	%	N	%	N	%	N	%	N	%
Zero	11,389	30.1	286	3.9	381	3.5	4,266	56.9	6,456	53.7

1 to 2	9,641	25.5	1,744	23.5	2,101	19.2	2,254	30.1	3,542	29.5
3 to 4	7,673	20.3	2,233	30.0	3,284	30.1	760	10.1	1,396	11.6
5 to 6	3,881	10.3	1,260	17.0	2,025	18.6	168	2.3	428	3.6
7 to 10	3,373	8.9	1,149	15.5	1,990	18.3	46	0.6	188	1.6
More than 10	1,873	4.9	750	10.1	1,118	10.3	1	0	4	0
Total	37,830	100	7,422	100	10,899	100	7,495	100	12,014	100

Source: Author's calculations using Time Use Survey (2007)

Other than higher immobility in urban areas, larger share of urban men and women make 1 to 2 trips per day (23.5 % and 30.1 % respectively) as compared to rural men and women (19.2 % and 29.5 %). For the respondents reporting more than 2 trips per day, rural men and women reported greater trip frequencies than their urban counterparts. The results show that rural people are more out-going than urban residents and that there may be various socioeconomic and accessibility factors associated with this mobility differences across urban and rural areas.

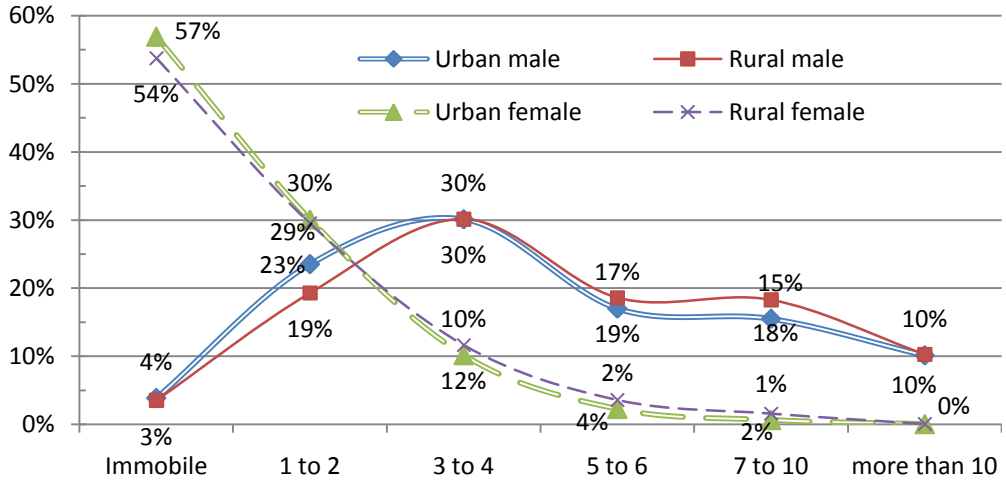

Figure 2 Percent respondents by mean daily trips across urban and rural areas

One-way ANOVA shows significant gender differences in trip across geography (F Stat =2136.1).Bonferroni, Scheffe and Sidak multiple comparison tests show that the trip rate differences betweenthe four groups are significant and that the male-female differences are larger (1.18 trips per day) than the rural-urban differences (0.12 trips per day) at 0.00 significant level.

Gender, Geography and Mode Choice

On average, mobile population of the country makes 4.5 trips per day out of which 3.9 (86.5%) trips are done walking, 0.3 (6.3 %) are done by private automobile like car and motorcycle etc., 0.1 trips are done by bicycle, bus and taxi (2.4 %, 2.1 % and 1.8 % respectively), and less than 1 percent trips are done by other means of transportation whereas train trips remain near to negligible.On average, public transport and bicycle/other modes trips were found 3.9 % and 3.2% of the total trips.

Table 5 Modal split for mean daily trips by gender and area

	Overall		Female		Male		Urban		Rural	
Mode	n	%	n	%	n	%	n	%	n	%
By mode										

1. Walking	3.9	86.5	2.4	88.5	4.7	86.0	3.5	79.9	4.2	90.6
2. Private automobile (Car, Motorcycle)	0.3	6.3	0.2	6.4	0.3	6.4	0.5	11.0	0.2	3.5
3. Taxi	0.1	1.8	0.1	2.6	0.1	1.6	0.1	2.4	0.1	1.4
4. Train	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
5. Bus	0.1	2.1	0.1	1.9	0.1	2.1	0.1	3.2	0.1	1.4
6. Bicycle	0.1	2.4	0.0	0.3	0.2	3.0	0.1	2.9	0.1	2.2
7. Other	0.0	0.8	0.0	0.3	0.0	0.9	0.0	0.6	0.0	0.9
Total	4.5	100	2.7	100	5.4	100	4.4	100	4.6	100
By type of transport										
Walking (1)	3.9	86.5	2.4	88.5	4.7	86.0	3.5	79.9	4.2	90.6
Private automobile (2)	0.3	6.3	0.2	6.4	0.3	6.4	0.5	11.0	0.2	3.5
Public transport (3,4,5)	0.2	3.9	0.1	4.7	0.2	3.7	0.3	5.7	0.1	2.9
Other Non-motorized (6,7)	0.1	3.2	0.0	0.6	0.2	3.9	0.2	3.4	0.1	3.0
Total	4.5	100.0	2.7	100.0	5.4	100.0	4.4	100.0	4.6	100.0

Source: Author's calculations using Time Use Survey (2007)

As table 5 showsabove,women make nearly half of the daily trips (2.7) as compared to men (5.4). This difference is mainly due to reduced walking trips by women (2.4) as compared to men (4.7). Women trip characteristics vary significantly from men by modal split as well.Their share of walking trips (88 %) is higherthan men (86 %) and share of motorized trips (1 %) is lower than men (4%). This phenomenon is linked to their limited access to modes of transportation and ability to pay for motorized trips.Women's share of private automobile trips is similar to the men (6 %) but they make higher percent of public transport trips (4.7 %) than men (3.7%)showing their increased dependency on public transport. Similarly, women's share of non-motorized trips by 'Cycle and other modes' is also lower than men (0.6 % and 3.9 % respectively) as women are not expected to ride bicycles or use other (less common) means of transportation e.g.,intermediate modes of transportation (IMTs). While differences in trip rates are larger between men and women, mode choice differences are somehow greater between urban and rural areas of the country. Rural dwellers make more trips per day (4.6) as compared to urban residents (4.4) and their share of walking trips (4.2 or 91 %) is also greater than urban residents who make 3.5 or 80 % trips by walk. Use of private automobile is greater in urban areas (11 %) as compared to rural areas (3%) and public transport based trips are also higher in urban areas (6 %) than rural area (3%). Greater use of motorized means of transportation in urban areas is probably due to the fact that the urban dwellers have higher income levels, greater dependency and easier availability of public means of transportation.High percentage of walking trips is already known in Pakistan, however, this study finds a much lower share of public transport based trips in the national sample as compared to the city specific studies like NESPAK (2012) and Imran (2009). This is probably due to the fact that most of the previous studies have been undertaken in large metropolitans like Karachi and Lahore with ever-stretching urban areas and gigantic urban population that rely on public transport for daily commute. Such studies of metropolitan areas tend to ignore mobility characteristics in smaller size cities and rural areas.

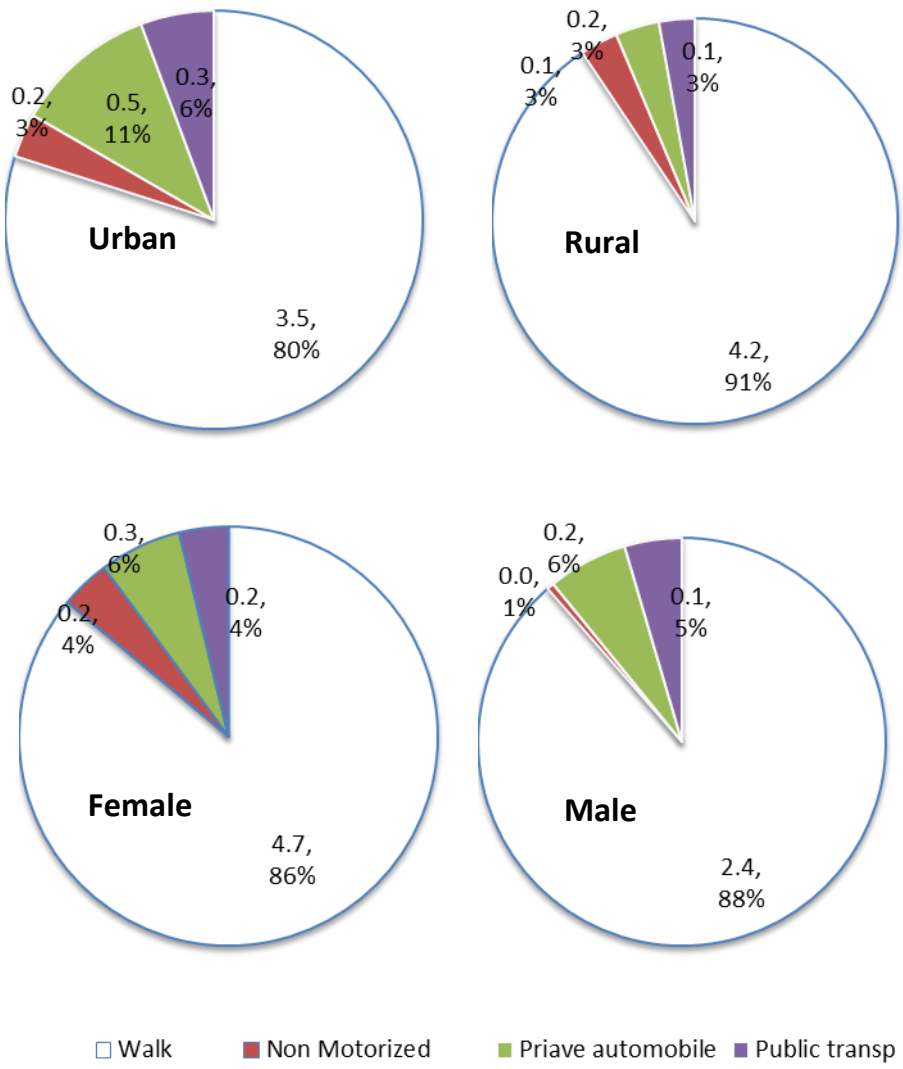

Figure 3 Mean daily trips by mode by gender and area in Pakistan

Gender and Travel Purpose

While gender to a large extent and geography to a small extent seems to effect travel decisions and trip rates in Pakistan, socioeconomic status and personal characteristics of respondents also effect mode choice more and travel purpose.Automobile usage in Pakistan varies considerably by main role of the respondents between genders which, to some extent, is linked with their age and access to resources. Overall, female reported greater share of travel by automobile than male travelers. Within female group, share for automobile and public transport based trips is highest for female students (10% and 5 %) second highest for unpaid female workers (6% and 5%) and reduces for female doing nothing 5% and 4% respectively. Ironically, share of automobile based trips was found lowest for employed women (4% each) among all female.It shows challenge of travel for female students and house ladies doing household care work. Employed women also made highest percent of non-motorized and walking trips (93%) among all female. On the other hand, situation is different among male travelers. Employed men experience greatest share of private automobile and public transport, 7 % and 4 % respectively, and least share of walking

trips (84%) among all male travelers.Whereas, male unpaid workers and free timers reported lowest automobile trips (3 %) and highest walking trips (93 %) that might be due to their reduced access to economic resources and personal means of transportation. However non-motorized trips are highest among employed male that shows their extra usage of bicycles and other modes of transportation for quicker mobility and reduction of transportation cost.

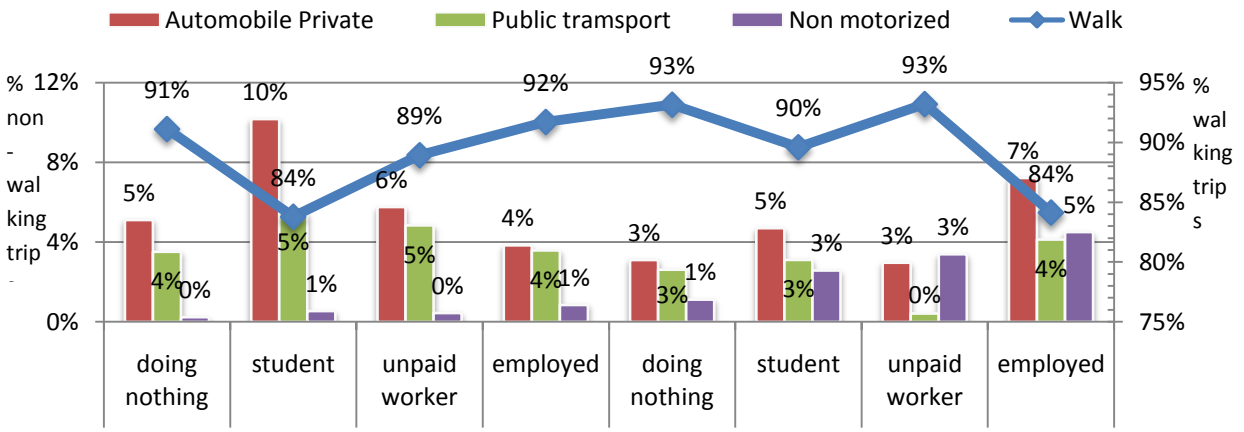

Figure 4Modal split by role and gender of the travelers

One-way ANOVA andBonferroni, Scheffe and Sidak multiple comparison tests verify mode choice differenceacross gender and geography with a few exceptions;that the gender differences in personal automobile and walking trips were only significant in rural areasand trips by other modes were statistically similar between the male travelers across urban and rural areas.Data shows that the young female students are more dependent on personal automobiles probably due to security issues and fear of crime. This issue might be more significant for ethnic minorities and communities facing social exclusion and violence in the country. Other than their lower walking trips and difficult travel conditions for women, the data shows that women travel less than men for leisure purpose as well. On average, female reported 0.8 trips per day as compared to 2.4 trips by male respondents in the diary day.It is expected that patriarchal system in the households and concerns of security at public places like parks and bus stops plays a significant role in female mobility to leisure activities. Leisure activity travel is largely affected by marital status of the women and men. Unmarried respondents made more trips per day than married respondent's probably due to the lesser household and childcare activities. However female leisure travel is more affected than male members (Figure 5). While unmarried women reported more than 2 trips per day for leisure activities; married, divorced or widow female respondents reported on average 1 trip per day as compared to 3.5 and 2.9 trips per day respectively for male respondents.

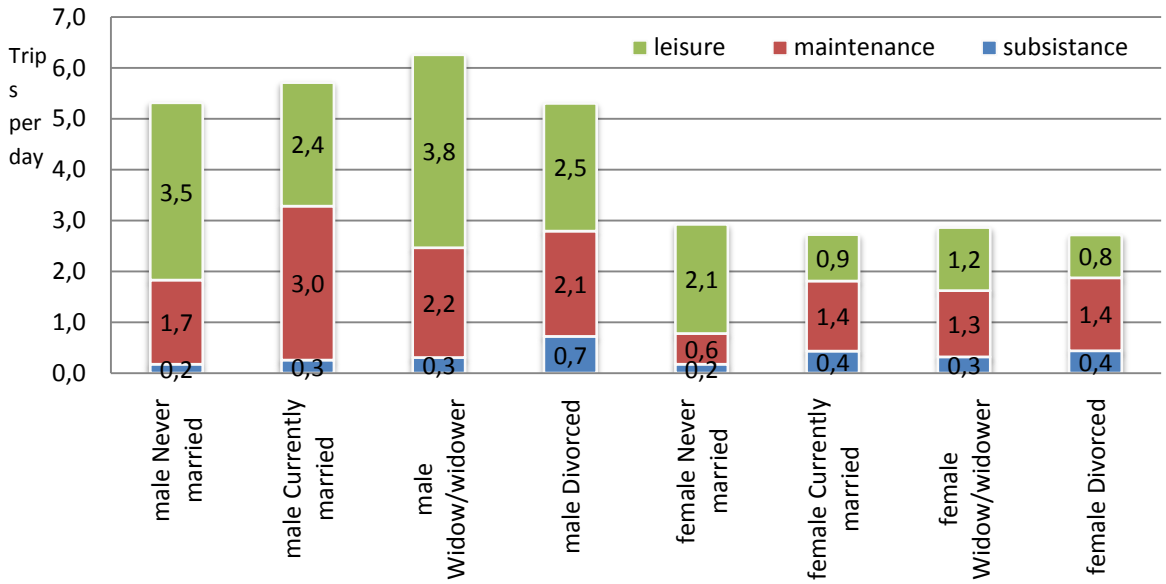

Figure 5 Mean trips across male and female by their marital status for different activities

Subsistence travel dominates the travel patterns of students and employed female (2.4 and 2.1 trips per day) that account for 70 to 80 percent of their daily travel budget. However they undertake fewer leisure trips per day (0.3 and 0.4 trips per day or nearly 10 % of total trips) as compared to free timer and unpaid worker female respondents who reported 1.4 and 1.2 trips per day respectively that make 50 % of their daily total trips (figure 6). On the other hand, leisure trips dominate the daily travel purpose of male population in all roles and accounts 50 to 70 percent of their total daily trips. When we compare trip rates between gender, male students and employed make more maintenance trips per day (0.5 and 0.7) than female counterparts (0.2 and 0.5) however subsistence trips were found slightly greater for male than female respondents. For male population, subsistence trips are statistically different for after marriage and before marriage stages.

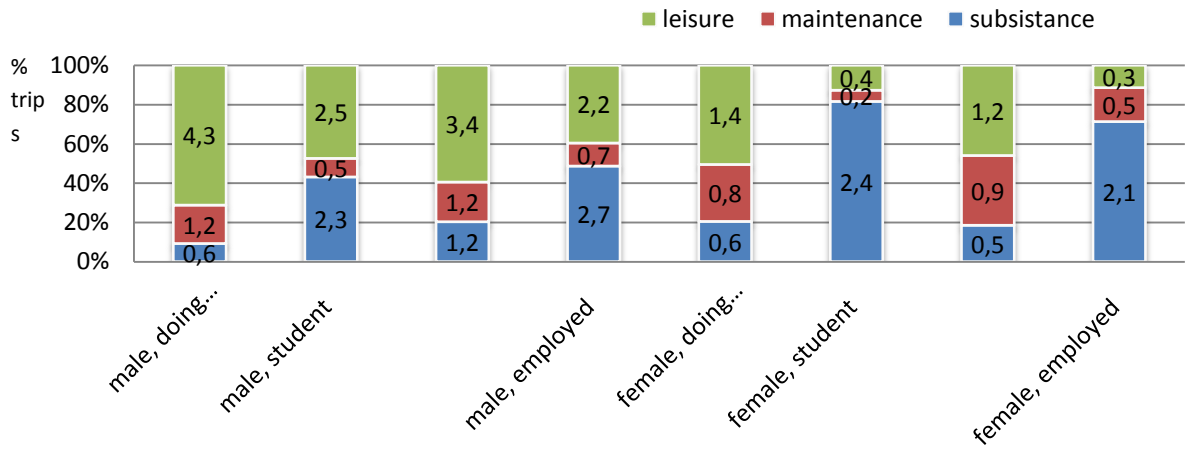

Figure 6 Mean trips across male and female by their main role

Among female, travel activity is considerably affected by her age and marital status. Generally female leisure travel is reduced to half after wedding and eases with the age however they travel considerably less than men for leisure activities. Marriage seems to affect the leisure trips of female due to their increased household care and child bearing responsibilities while their maintenance trips are doubled. In this way women try to combine maintenance trips with social activities and there are chances that women try to find leisure within their maintenance purpose travel by visiting friends during trip or out of home activity participation. However, reduction is greater for female as compared to male who still make multiple leisure trips daily. There are chances that enhancing mobility needs especially walking environment in urban and rural areas might increase the leisure trips like early morning walk for female population.

Trip Durations and Travel Time Budget

While female trip rates are nearly half of the male travelers, their daily travel time budget is also less than men at the national level.On average, female travel daily for 65 minutes as compared to 117 minute travel time for male travelers representing that female travel time budget is 44.4 percent less than men. There are evidences that in villages of Balochistan, women travel for hours to fetch water and firewood, but the data shows that more than 90 percent of country's households have water, electricity and natural gas inside their house. At the national level, female daily travel duration is not much affected by these extremes and their mean daily travel duration is less than men confirming the hypothesis that the female travel less and nearer to their residential places than male travelers.

ANOVA results show that Mean trip duration is slightly higher for female (24.4 minutes) as compared to male (23.5 minutes)but different are significant in urban areas only. Mean daily travel duration by men and women forten broad activities is given in figure 7 below. It shows that, as compared to men, female travel duration is 19 to 20 percent shorter for work and community services, 4 to 6 percent shorter for education and household care whereas 28.3 percent shorter for sociocultural activities. However, female travel duration was found longer than men for personal care travel by 21.4 percent, for maintenance travel by 51 percent.

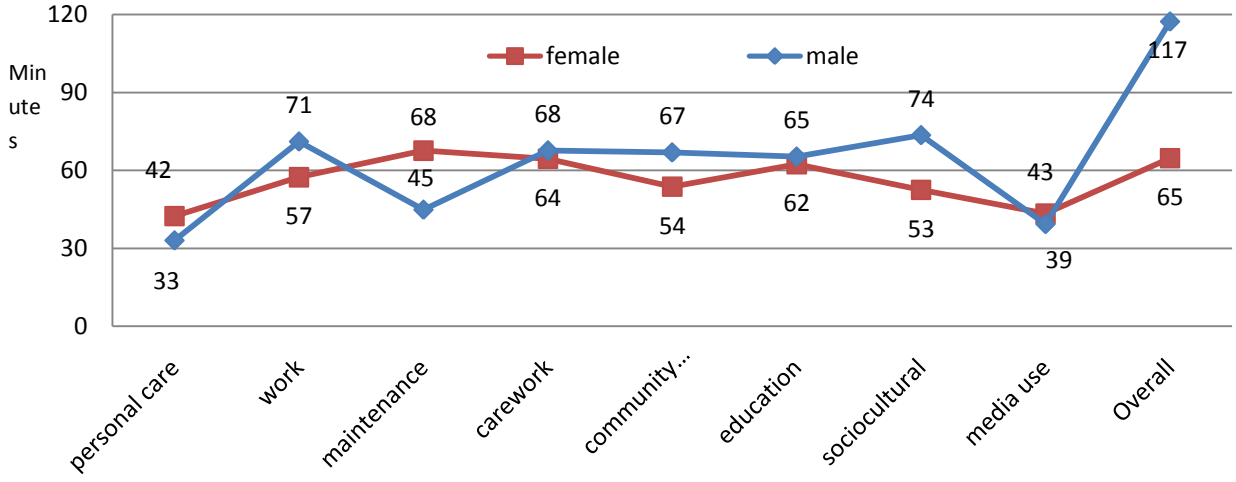

Figure 7 mean daily travel duration by purpose across men and women

Results highlight that majority of Pakistani women carry responsibilities for household maintenance related tasks outside home. Other than personal care travel, women face a restricted mobility environment for work and sociocultural travel. It seems that the poor condition of public transport and lack of affordability to personal automobiles has restricted women mobility for work most significantly than for access to education. Female student sometimes travel by escort or in groups to the nearby school whereas the adult female mobility to workplace is restricted due to the non-availability of suitable travel conditions. Female mean trip duration is also shorter than male by bus (41 versus 49 minutes per trip), by bicycle (28.8 versus 26.4 minutes per trip) and other means (24.9 versus 34.3 minutes per day of transportation. However, female trip duration was found greater than male for train, personal automobile and walking trips. Increased mean trip duration by personal automobile shows the increased reliance of women on personal means of transportation for mobility.

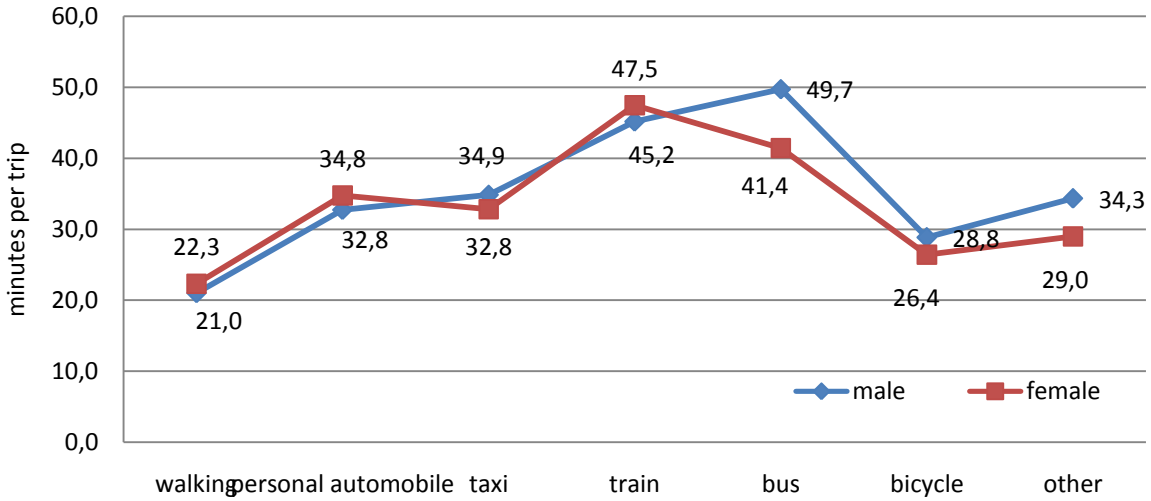

Figure 8 Mean trip duration by mode across area

Keeping in view that women do not drive motorcycles and mostly travel as passengers, increased trip duration by personal automobiles might be due to the fact that women carpassengers might be more than men. Increased walking trip duration in women may represent a number of reasons including their short period socialization with other female during walk and the time spent in shopping food and other necessities from street hawkers and open air stalls on the road. The fact that rural female tend to spend more time walking for buying household goods from urban areas and due to their longer travel duration as compared to urban residents, may also increase their mean walking trip duration. One-way ANOVA,Bonferroni, Scheffe and Sidak multiple comparison testsfind that mean travel duration for train and taxi is statistically not different across gender; and for the other modes, differences are statistically significant. The indifferent can be attributed to low demand for travel in train and taxi due to availability and costs issues with these modes of transportations.

5. CONCLUSIONS AND RECOMMENDATIONS

Thispaper quantifies the differences in mobility and travel behavior across male and female population of the country. While the study reaffirmspreviously known facts about travel behavior,it also contributesunique information to existing literature on travel behavior in Pakistan specifically and in

developing countries in general. Most of the previous studies on the subject focused urban travel behavior of major cities,rural travel patterns were somehow overlooked and the already known literature needed fresh evidences for knowing current travel behavior differences across urban rural areas. Similarly, few previous studies have explored gender differences in travel behavior and activity participation and the current paper fills that gap too. The results highlight wide mobility gaps between men and womenacross the country andit appears that gender mobility differences are much greater than the urban rural differences. While rural people appeared more mobile than urban residents, female freedom of mobility is somehow restricted in the country. Nearly 55 percent women were immobile in the diary day as compared to less than 4 percent men and theinstances of immobility were higher in urban women (57 %) than the rural women (54 %). Overall, female made half of the trips (2.7) as compared to male respondents (5.4) and the differenceswere mainly due to walking trips (men made 2.3 more trips). Similarly, menperformed more leisure trips (2.4) than women (0.8). Female daily travel time budget is 44 percent shorter than male and their travel time for subsistence and leisure activities is also shorter. Female mean trip duration is slightly higher for walking and personal automobile trips whereas considerably lower for travel by bus, bicycle and other means of travel. Female students reported highest dependence on personal automobile and public transport while the male students reported the lowest. Female mean travel duration by bus and bicycle is much shorter than male due to the potential issues with public transport and bicycle based travel in the country. Risk of security and interaction with unwanted men seems to affect female trips and mode choice, the most. Socioeconomic variables like age, marital status and main role of respondents seem to affect the trip characteristics of women more than men.

A number of research directions can be drawn from this work. Firstly, there is a need to explore the widespread phenomenon of female immobility in detail. What is female opinion about immobility? Does it represent a form of ‘transportation disadvantage’ which reduces female access to various services and opportunities? How do the current mobilityand travel patterns affect her access to economic resources, personal wellbeing and social inclusion in the city? Is there a ‘latent demand’ for women mobility? If yes, then to what extent? How transport and land use policy can help facilitate women mobility, reduce their automobile dependency and promote leisure trips? And what cost effective interventions are needed?Land use policy, probably, has a more important role for facilitatingactive transportation and leisure travel of women because of the nature of spatial growth andcultural norms of the society. Gender aware land use policy is needed to provide women friendly streets and land use in newly planned housing estates in the country.For the areas already developed, like inner city areas, transport policy should also facilitate mobility and accessibility for the non-motorized travelers as 80 to 90 percent of travel is done walking. For enhancing physical connectivity of people and destinations,there is a need to consider walking environment as important as the construction of roads and flyovers in the urban areas. Female tend to travel less due to various issues of accessibility and mobilityand increasing walkability in is expected to favor women more than men. Increasing walkability can help reducing female immobility and automobile dependence and may increase their leisure travel as well. Walkable streets should be encouraged within the social norms for better social acceptance. This can be done, for example, through segregating pedestrian walkways by gender. If a road has dual walkways on both sides, female securitymight be improved by promoting one walkway as female and children – priority walkway. Gender segregation at public places is a common phenomenon in the country. However, the degree of gender sensitivity in transportation environment seems the least as compared to the other built environments like schools, offices and even public parks. Gender sensitive interventions will help creating safer streets that is also a

common desire for mobility in country's religious culture. Similarly, there is a need to bring rural areas into transport policy and connectivity framework. Rural people are in clear majority and so is their travel demand however they lack access to public transport and important services like healthcare, educational centers and good shopping places. The wide geographical differences in accessibility have been rarely pointed out in terms of travel demand in rural areas and their actual level of access to public transport. The authors aim to discussit in their ongoing research on transportation disadvantage in Pakistan. Country's development policies should also utilize national level datasetsto their full potential for well informed decisions in urban planning and transportation projects.

The study attempts to quantify travel behavior of Pakistanis for the first time in country's known history of transport planning.The quality of results might beaffectedsomehow, if not greatly, by the quality of dataset used. TUS was designed to calculate gender based working hours and the travel information was not the focus point of this data collection strategy. Travel activities were noted to get a more complete picture of activity time use and thus the study design can generate potential source of bias in the results. At first, the data collection might omit some of the travel activity on the diary day. TUS collected 3 activities per half hour episode however there is a possibility of existence of more than three activities in an episode (unreported activity). Secondly,there may be other instances of unreported travel where respondents might change their location without specifying a travel activity or the respondent might not even mention the change of location at all (unreported travel and activity both). Similarly the time use might be upward biased as all activities of an episode were given equal time. Measurement of the nature of bias and its impact on travel behavior data needs further analysis. However, the results are expected to be sufficiently reliable in their level of detail and convey a meaningful picture of the travel behavior patterns. By quantifying the travel behavior through a nationally representative dataset, the results provide a comprehensive set of information as a first step on the long road of travel behavior analysis in the country. Similar efforts can be carried out in other countries using their time use survey datasets. Because of the ability of time use surveys to be 'harmonized' across countries and regions, it is possible to compare patterns of activity travel across space and time. Studying travel behavior through time use data can provide a useful bench mark for measuring travel behavior in developing countries and it can enhance the utility of expensive time use surveys well beyond the calculation of time use in paid and unpaid work activities.

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Does the city's pulse beat at the same rate for men and women ? A gender time-geography

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Abstract

Since the mid-70s, Household Travel Surveys (HTS) in France have been a major source of knowledge of the mobility of inhabitants within a territory. Since 2010, a tool called "Urban Pulse", developed by CETE de Lyon, has offered new perspectives for the use of travel survey data. Like the work based on gender time-geography, the tool enables an accurate understanding of the schedules of each individual within a territory, and focusses not only on trips, but also on what happens between two trips: who is where? For what type of activity? Thus, this paper focuses on gender-based spatio-temporal analyses of daily mobility in conurbations of the Rhônes-Alpes region. What are the patterns / specificties in the spatial and temporal location of men and women in the cities of Lyon, Grenoble and Saint-Etienne ? The "Urban Pulse" tool offers a new perspective on the diversity of urban areas, in the true sense of the term. Finally, these analyses highlight public policy issues that are raised when gender-based mobility is taken into account.

Keywords: mobility ; gender time-geography ; Household Travel Surveys (HTS); schedule

Résumé

Depuis le milieu des années 70 en France, les Enquêtes Ménages Déplacements (EMD) constituent une source importante de connaissance des pratiques de mobilités des habitants d'un territoire. En 2010, l'outil « pulsations urbaines » développé au CETE de Lyon, offre des perspectives nouvelles d'exploitations des données des EMD. A l'image des travaux issus de la time-geography, l'outil offre la possibilité d'appréhender finement les emplois du temps de chaque individu d'un territoire et de ne pas s'intéresser qu'aux seuls déplacements, mais aussi à ce qui se passe entre deux déplacements : Qui est où ? Pour faire quelle activité ? Ainsi, cette contribution porte sur l'analyse spatio-temporelle de la mobilité quotidienne par genre dans le cas des métropoles rhônes-alpines. Quelles sont les régularités/singularités dans la localisation spatiale et temporelle des femmes par rapport à celle des hommes dans les agglomérations de Lyon, Grenoble et Saint-Etienne ? L'outil "pulsation urbaine" propose ainsi, un nouveau regard sur la mixité, au sens propre, des territoires urbains. Au final, ces analyses mettent en évidence les enjeux de politiques publiques que pose la prise en compte des approches de mobilité par le genre.

Mots-clé: mobilité ; espace-temps des genres ; Enquête Ménage Déplacement (EMD) ; emploi du temps

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1. Observe the urban rhythm of men and women

The society evolves, modifies, and changes the rhythm of life of each society member. The mobility behaviours will be, more or less, shaped by factors of population ageing, of working time reducing, of family breakdown, of transport costs' evolution… Public policy-makers should take into account the reality of rhythm of life in order to plan out administrated territory with full knowledge. The « pulsations » which regulate the daily tempo of the "urban anthill", are, among other things, the reflection of the person's main occupation (active, student, retiree…) of the family situation (single or couple, with or without children…) buts also of the gender identity.

The gender appears as one of important factors to explain mobility behaviour. The significant differences between men and women were particularly identified within the framework of commuting from home to work. Women's commutes are generally shorter than men's (Madden 1981, Hanson and Pratt, 1988 ; McLafferty and Preston, 1991 ; Lee & McDonald 2003) and more in relation with home (Carron, 2007). It's particulary true for suburban households, where the woman is suffering from strong local anchoring, which contrasts with longer commutes of husband, working in a distant town (Cailly and Dodier 2007). The crossed observation of regularities/singularities in the men's and women's practices helps to understand how the city moves.

Beyond the single issue of access to employment, we propose to go further into the men's and women's rhythm of daily mobility throughout the activity programs during the day. We have chosen to relate this analysis to the "time-geography" research works. This approach, developed by the Swedish geographer Torsten Hägerstrand (1970), allows to analyze the interactions between temporal and spatial constraints and experiences of individuals during their daily activities. This theory is based on a representation of accessible space to individuals activities at a given time of day which attests of any potential accessibility to urban resources and which depends on the capability constraints, which individual meets (Chardonnel, 2001). With regard to other contributions (Bondi and Domosh, 1998 ; Scholten, Friberg, Sandén, 2012), we assume that the time-geography provides a useful set of analytical tools which works successfully with the theory of social sciences, such as gender studies : « time-geography shares the feminist interest in the quotidian paths traced by people, and again like feminism, links such paths, by thinking about constraints, to the larger structures of society » (Rose, 1993). It therefore seems pertinent to observe the men/women differences in the daily mobility framework, using the time-geography principles as in recent works (Kwan, 2007 ; McQuoid, Dijst, 2012 ; Scholten, Friberg, Sanden, 2012).

Therefore, this article focuses on spatial-temporal analysis of the daily commuting travels in urban areas by gender. What are the major factors of temporal and spatial differentiation of men' and women' everyday commutes .? The aim of this analysis is to identify convergences and divergences in the activity programs between men and women, and from there, their spatial distribution in the city. The analysis approach is based on tool of a individual' rhythm modeling, drawn from the data of mobility' s surveys. Since 2010, the"Urban Pulse" tool, which has been developed by CETE de Lyon, give the detailed understanding of each individual's schedule in a given territory, it also lets to go beyond of trips and to see, what happens between two trips ; in other words, the analysis allows us to know, who is present in the city, where, at what time and for which activity. It is a spatial's and temporal's location analysis, also known as "City pulsations", which has produced a visualization tool, for observing the evolution of a population, which is present in the city. This spatial and temporal location analysis consists to shape from the HTS (Household Travel Surveys), the schedule and the location of each interviewee.

The raw material of the urban pulse tool is provided by the data from Household Travel Surveys, carried out in French cities. As a picture of the day before commutes (all kind of trips for all reasons) of inhabitants of a given area, this survey allows to describe a reliable daily mobility. Indeed, interviewees must describe accurately the trips, which they made the last day before interview, to obtain on average the representative information, that exceed the frameworks of usual mobility. With a sampling rate of 1 to 2%, we know the exact schedule old interviewees, for over 5 years and their sex (declarative). With over 150 HTS interviews, conducted in French cities since 1976, it is an important source of information to describe the mobility and observe differences based on multiple criteria, such as the gender.

The field of application is the Rhone-Alpine metropolis area: Lyon, Grenoble and Saint-Etienne cities, which have a recent HTS data2. The choice of this agglomerations is justified by two main argues: the first one arises from the need to compare these neighbouring, but different cities: Lyon, capital of Rhone-Alpes, is an European level metropolis; Grenoble is a dynamic regional center, focused on research and innovation; while Saint-Etienne which has a population equivalent to Grenoble, is marked by an industrial past and has more disadvantaged populations in comparison with the two other agglomerations. The second reason consists in mitigation of local singularities. By comparing the three cities data, we can establish what could be a local regularities or singularity. Given contrasted character of the three cities population, we can easily determine the gender factor importance in the everyday commutes analysis. Could it be used occasionally or systematically to undertake the city rhythm understanding?

This analysis is carried out in three stages. First, it is important to present the main social demographic data of the analysed territories. This information should be put into the perspective with the knowledge of the man-woman mobility at the national level. Once that is done, we can apply the "urban pulse" tool to examine the convergences and divergences in the men and women schedule in three Rhone-Alpes agglomerations. Finally, the activity program analysis is completed with a spatial dimension that allows to view more in details the daily processes of "feminization" or "masculinization" of the areas in the three agglomerations; depending on the time of the day, can we discern a city of men and a city of women? Eventually, the "urban pulse" tool provides a new look to the diversity of urban territories. These analysis highlight the issues of public policies, which are taking in account the gender approach of mobility.

2. Activity and mobility by gender: situation in the Rhone-Alpine metropolis

2.1. The main occupation by gender: a lower rate of activity to women

Comparing the main occupation of the inhabitants according to the last EMD in Lyon, Grenoble and Saint-Etienne, there is generally few differences: about 40% of the population works (full-time or part-time), 25% is «retiree» and 25% is «students, apprentice, schools». Only Saint-Etienne differs slightly from Lyon and Grenoble with a lower rate and conversely a stronger rate of retirees, unemployed and women remaining at home. In the three cities studied, there is the same difference in the main occupation between men and women. The share of the active men is higher than that of women, but the contrast is especially gripping based on the work length: the «full-time» are largely dominated by men (In Lyon 44% for men, 30% for women), while the «part-time» is very feminine (In Lyon 3% for men, 11% for women). In addition, the occupation «stay at home» concerns only women and reached 12% in Saint-Etienn. The other main occupation are relatively balanced even though there are slightly more men «Students, apprentice, school» and more women «retiree». These contrasts are homogeneous between Lyon, Grenoble et Saint-Etienne which tends to prove that differences genders are pretty little dependent on locals contexts.

2.2. The travel daily: women also mobiles but less motorized

Mobility, the number of travels per day and per person, is quite close between men and women in three cities: around 3.65 in Lyon, 3.9 in Grenoble and 3.8 in Saint-Etienne. Women are slightly more mobile than men in Grenoble and slightly less in Saint-Etienne. The differences between men and women are more visible if we observe the mobility based on the main occupation. Women working part-time are those who execute on average the most travel in one day of a week (4.88 for the Grenoble agglomeration), substantially more active than men (4.44 for the Grenoble agglomeration) while on average an inhabitant of the Grenoble agglomeration realizes 3.9 travel per day. In the « students » and « retiree », men appear slightly more mobile.

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[2] Unless otherwise stated all data used in this article are :

- exploitation of the EMD standard CERTU of the Lyon metropolitan area realized in 2006 on the perimeter of Grand Lyon (1 100 000 inhabitants) ;
- exploitation of the EMD standard CERTU of the great Grenoble region realized in 2010 on the perimeter of the community Grenoble (370 000 inhabitants) ;
- exploitation of the EMD standard CERTU of life basin Saint-Etienne realized in 2010 on the perimeter of the community Saint-Etienn (350 000 inhabitants).

To avoid overloading the text, we use shorter references to data sources : « EMD Lyon 2006 », « EMD Grenoble 2010 » et « EMD St-Etienne 2010 ».

In terms of modal share, men appear as the largest users of private car (in Lyon agglomeration 52% for men, 46% for women) while women are more incline to walk (29% for men, 36% for women). Public transport users are mostly females while the bike and even much the "two wheels motorised" are dearly the men. The 3 agglomerations have the same trends although the volumes of each mode vary: in Saint-Etienne, the use of the car is higher while the part of the TC is more important in Grenoble and in Lyon. The biking modal share is also stronger in Grenoble.

These observations are consistent with the national trend that reflect a more and more important car use for travel from home to work (almost 41% in 1973 and a little more than 72% in 2007). According to the national HTS, men are more numerous to travel by car even if women catching their late (Roux, 2012). Women, who on average live closer from this workplace, use more public transport as well as the walk compared to men. Two-wheels motor are marginally used by women (Roux, 2012). Same observation with data INSEE of commutes: whatever the french region, employed women leave less frequently their commune of residence to get to their workplace (Houillon, 2004). Special analysis of the EMD of Lyon (CERTU & Grand-Lyon, 2005) or metropolis Savoie (CETE de Lyon & Métropole Savoie, 2010) have however shown that discrimination in the uses of the different modes of transport is not so much linked to sex or to the professional activity.

The difference between men and women in the distribution of the modal shares is mainly linked to a smaller possession of driving licenses among women, whatever their age. In total, in the Grenoble agglomeration 23% of women of driving age do not have the permit against 10% of men. Analysis by age group reveals two categories for which the possession rate is lower: more than 65 years and less than 24 years where more than 35% of women did not have the opportunity to drive a car. Even if the difference between men and women tends to reduce with a more important access of the women to the driving licence3, the contrast is still an explanatory factor of mobility differences. As a summary, we can say than women travel as much as men (sometimes more: part–time job) but differently: more by foot or by public transport and less often by car, which is explains by a lower driving licence rate.

2.3. Activity programme: differences to deepen by " urban pulse"

The analysis of activity programme offers a more accurate reading of the order of one day of a man and women. Leaving home (or in returning), activities effected by women concerns mainly the purchases (16%), the accompaniment (14%) and the work (13%). Men go more often from to workplace (19%) or to school (14%). Women mainly do the activities accompaniment and purchases.

Other studies allow to deepen this estimate of differences between men and women in the distribution of daily activities. In particular, " schedule" survey 2009-2010 INSEE shows that, in the "private" sphere and the management daily activities linked to the family, leisure and children, divisions remain important. Although today women tend to catch up with men in possession of driving licenses, differences still exist on the use of modes of transport4 or the use of time.

To go further than a simple cumulative estimate activities and travels, it is interesting to use the "urban pulse" tool to differentiate the practices in the daily time and space. The analysis of the urban rhythm allows to look at the activity program of the residents of the three agglomerations, and in every moment of the day. Unlike «survey schedule» 2010 of INSEE, the «urban pulse» from the EMD does not allow us to know precisely the activities exercised within the home. However, they help provide more spatial vision that the national survey, even if it remains on major types of activities in personal schedule.

3. Time distribution of Men/Women : who does what?

3.1. Time spent by activity : differences between active male and female

To refine the activity program during one day, we did a calculation of the time spent by activity. Through the EMD's information, we know that Mrs X left her home at 8:00 to arrive at her workplace at 8:20, etc...We can

[3] If in 1974, a woman of three had not the driving licence in France, 76% of the women had it in the first years 2000 (INRETS-DEST, 2001). Robin (2010) shows from the national survey transportation (ENTD) that 76% of women more than 55 years old possess the licenses against 64% in 1994 and 47% in 1982. It shows also that the catching up phenomenon is also reflected in the frequency of conduct since women have the licenses are 80% to drive regularly (every week) in 2008 against 77% in 1994 (+3 points)

[4] Some authors suggest, within the household, discrimination for car access (Paulo, 2007)

deduce that, between 4:00 and 8:00 she was at her home, she was traveling between 8:00 and 8:20 and from 8h20 she was at work, etc...Daily activities (9 categories) have been crossed with the main occupation retaining only the people who have been traveled at least once during one day. For example, according to the survey of Lyon in 2006, a woman working full-time spends 6h32 at work and 46 minutes on the travel in her day.

The analysis of this data, the table presents only an excerpt, allows to deepen the differences of schedule between men and women. First, we observe that man or woman spend most of their time at home, about 16 hours a day on average. However, the time spent at home is more important for women while she works (30 minute to 1hour20 difference) then it is equivalent to the schools/students and retirees. In Saint-Etienne, women spend on average 30 minutes more at home than their counterparts in Lyon or Grenoble : we will probably see an effect of the structure of the population since the Saint-Etienne agglomeration has proportionately more women retiree or at home than the 2 other agglomerations.

Figure 1- Average time by activity of the inhabitants of Lyon agglomeration who travelled (source: standard HTS Certu, Cete de Lyon)

Grand Lyon 2006	Full-time work			Part-time work		
	Women	Men	Diff. women-men	Women	Men	Diff. women-men
1- Home	14h 57	13h 46	+ 71 min	17h 06	16h 13	+ 53 min
2- Work	6h 32	7h 12	- 40 min	4h 09	4h 11	- 2 min
3- Study	0h 01	0h 00	+ 1 min	0h 00	0h 05	- 5 min
4- Purchases	0h 20	0h 12	+ 8 min	0h 28	0h 13	+ 15 min
5- Accompaniment	0h 09	0h 05	+ 4 min	0h 11	0h 03	+ 8 min
6- Leisures	0h 14	0h 15	- 1 min	0h 15	0h 19	- 4 min
7- Others	0h 35	0h 35	0	0h 41	0h 58	- 17 min
8- Traveling	0h 46	0h 55	- 9 min	0h 46	1h 01	- 15 min
9- Outside	0h 22	0h 56	- 34 min	0h19	0h 54	- 35 min

The time spent at work, about 6hours for full-time and 4 hours for part-time, is globally equivalent for men and women but situations are variable : a man working full time will tend to work more than women (especially in Lyon agglomeration where man remains 40 minutes more at work). Conversely, the presence of a woman in part-time at her workplace is equivalent to significantly superior to the presence time of a man : in Grenoble they spend 1hour more at work than men. Less contrasty, the time spent in studies for students/schools about 6hours is slightly longer for males than females.

In the three agglomerations, the time spent in purchasing is systematically more important for women when they work but equivalent to the students/schools and retiree. The same observation for the time spent in accompaniment which is doubled for women working full-time or part-time than men, while the difference does not appear for the other categories. On the other hand, women spend less time for the leisures activities than men. The difference man/woman is especially marked for the leisures for the students/schools and the part-time job. For example, a woman of the Grenoble agglomeration on part-time spends on average 15 minutes per day to execute the activities leisures against 24 minutes for men in the same situation.

The time spent in traveling is generally less important for women. Once again this difference schedule concerns the employed while other categories are not contrasts. We can think that men, more motorized, spend more time in transportation, because they work far away from home. The study showed that, for women, the conciliation of the domesticat obligations and professional life and the practicability of the daily routines necessitate the proximity of the workplace to the home place (Nelson, 1986). At last, the time spent on the « outside » of then investigation area is also significantly less important for women who work. A employed man spends 30 minutes to more 1 hour outside the area of investigation than women. The result is inverted for the students/schools where it is the women who spend more time outdoors than their male counterpart. Let's note that in Saint-Etienne, the active men working on full-time spend more than 2 hours per day outside the perimeter of the EMD. That's double their counterpart Grenoble or Lyon and probably a sign of a more difficult access to local employment.

Figure 2- Average difference in the time presence average for the activity of the inhabitants of Lyon, Grenoble and Saint-Etienne agglomeration who travelled (source: standard HTS Certu, Cete de Lyon)

Presence time	Home	Work	purchases	Accomp.	Leisures	Others	Traveling	Outside
Female full-work	15 h	6 h	18 min	9 min	14 min	38 min	44 min	31 min
Female part-work	17 h	4 h	26 min	12 min	15 min	42 min	46 min	19 min
Difference in comparison with the male	1 h less for the men	= / time in more for the men on full work; time in less for the men on part work	10 min less for the men	5 min less for the men	10 min more for the men	=	15 min more for the men	45 min more for the men

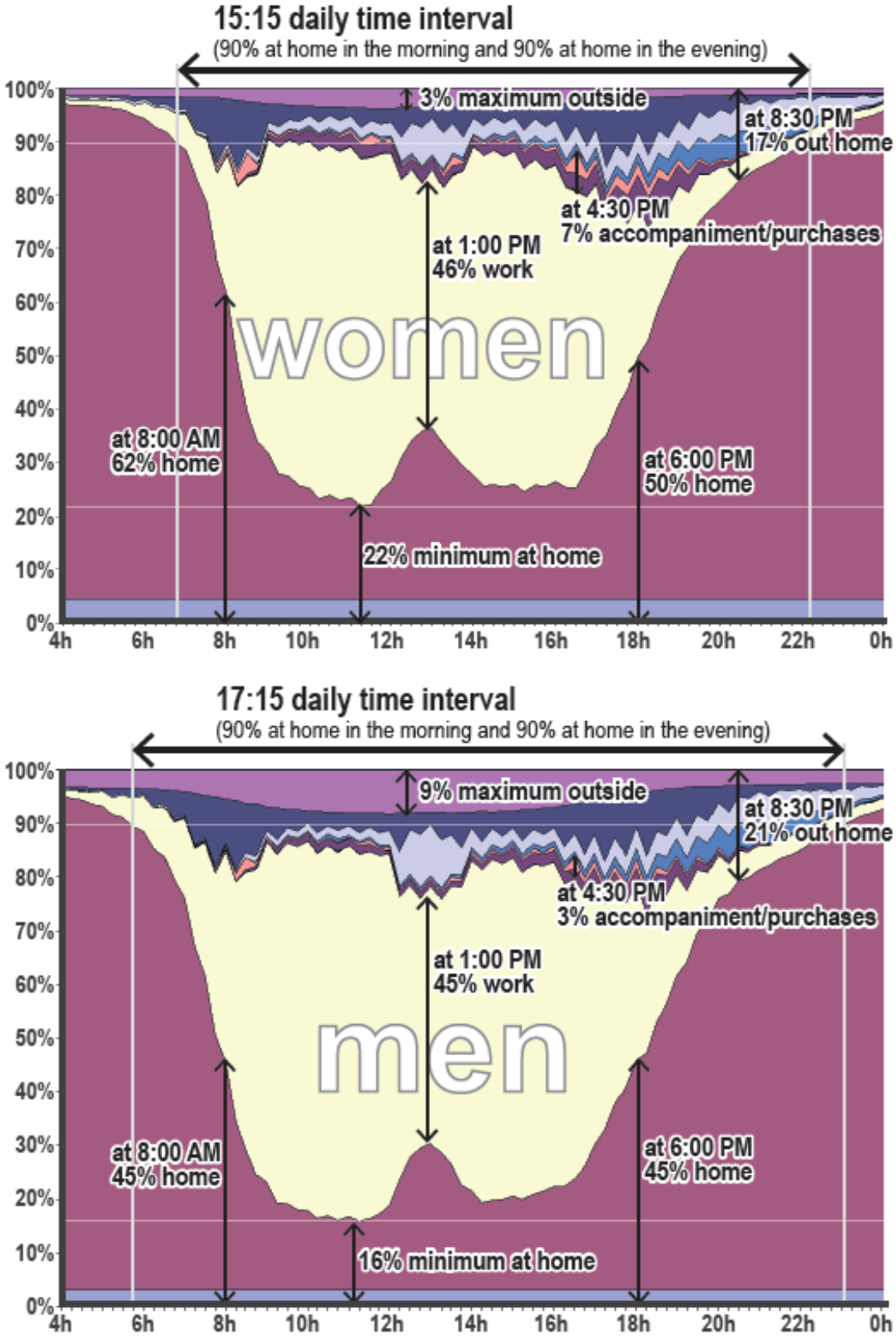
Thus, for a time broadly equivalent to work, a woman spends always more time at home. The active woman whether full-time or part-time job spends more time to execute the activities «purchases», «accompaniment» than an active man and less time to execute the activities « leisures» and «travels». A man has conversely more likely to go outside, generally to attain more qualified jobs. The working period coincided in family life in the period where one has children. Obviously, it is women who still today take care most often of the daily management of the family. The distribution of the daily activities of the women and men confirm that even with the employed ones, it is the women who manage the activities or the tasks domesticate household. The time released by the people working on part time takes advantage to the children in the case of the women and to themselves (leisures) in the case of the men5.

3.2. The activities during one day : a more intense program for the women that work

It is possible to refine the analysis of the daily times passed by activity offering a reading in two dimensions. We cross in a graph the rate of presence of men or women in the one of the 9 categories of daily activities with the schedules of the day. The form of the graph testifies precisely of the part of men and women according to the main occupations that execute such or such activity. The students/schools and retiree categories present few gender differences in the schedule. For students/schools, we note a daily distribution quite similar between men and women. The travel peak towards 8:00 is very strong with the students/schools male or female, while the presence at home is rather close : at least 13% men, at least 15% women. For the retiree, the life rhythm between men and women are rather similar. Once arrived at the age of the retirement, the life rhythm of the couples is the subject to a (re)synchronization. Thus, the men/women schedule are relatively close for the categories that do not have or have no more children. Conversely, among the employed, contrasts appear in the sequence of daily activities that we have sought do deepen.

[5] The schedule survey realized by INSEE in 2010 tends to confirm since employees man spends 2h06 every day for « home time » against 3h27 for woman; conversely man spends 3h28 for leisures against 2h48 for woman.

Figure 3- Diagramme of the daily distribution of the activity of the women/men working on full-time in agglomeration of Lyon, Grenoble and Saint-Etienne (source: standard EMD Certu, Cete of Lyon)



Reading : at 7:00, 90% of women are in their home, 4% will not leave their home while the remaining 86% will realize (or have have already made) at least one activity during one day.

The first criterion differentiating the employed men and women concerns the time spent at home. We already found that on the whole, the women remain at home 1hour more than the men. We find this trend in the sequence of daily activities as at any time of the day at least 20% of women working full-time at home against 16% of men. Same finding for the lunch break of the employed where the women are more numerous at home : 38% of the women against 31% of the men. Lyon agglomeration and Grenoble posts close profiles to the average value while these rates of presence at home are systematically higher for the inhabitants of Saint-Etienne agglomeration.

Outside of the home, the accompaniment (to the nanny, to nursery, to school...), more frequent for the women, is very concentrated in the day to the 4 school time slots 8:30, 11:30, 13:30, 16:30. Similarly, the purchasing is clearly visible among the women from 10hour but focuses mainly late afternoon, between 5 pm and 7 pm. The leisures take place mainly at the end of the day and are more marked for the men. The « others » activities (gaits, looking for a job, eating outside the home, visits...) are generally concentrated during the lunch break and the evening for the men while they are distributed more homogeneous during all the day among women. The explanation of this phenomenon relates back to the nature of the classified activities « others » of which can do the hypothesis that they are different between men and women. For the first lunch off-home explains the concentration of the pause meridian time and concord with the fewer male presence at home during this period. For women, the realization of other activities (administrative gaits for example...) can explain a higher rate of the « others » activities in the morning and during the afternoon. The distribution of these activities in one day tends to confirm that the chores of women are more numerous and more sensitive to the time constraint than those insured by men (leave school, meals for ones, handiwork for others) (Mac Donald et al, 2005).

The sequence of the activity « work » present the same forme to the men and the women. The presence to work is therefore approximately the same with on difference: time of arrival to work, earlier for men. In Grenoble agglomeration, 32% of the men working on full-time are at work in 8h00 against 22% of the women. The ladies “catch up” the time presence at work of the men at the time of the pause meridian: at 13h00, about 45% of men remain on their workplace against 48% of the women. We note equally that the ditto « exterior », that generally corresponds to a professional activity outside the zone of investigation varies 4 to 8% for the men (it means that at least 4% of the men are at the exterior of the zone of investigation all the day) and 2 to 4% for the women with a peak in the middle of the day. Finally, the travels are much marked for the men, more earlier in the day and the peak hours and lunch primarily. For women, the transportation time is quite similar although their distribution is much homogeneous in the day. Indeed, they execute visibly more travel off peak.

The principal piece of information provides by the graphs of the schedule concerns the interval during which the men and the women realize their daily activities. For this, we observe the period of the day which less than 90% of the employed are at their home, in others words the time that begin to leave the home and the time at which they are almost all returned. In average, for the men, this period spreads from 5h45 to 23h10 and for the women from 6h45 to 22h15. In all the agglomerations, the interval is more tightened for the women. The period which the women execute their activities out home is reduced (at least) 2hours in comparison that of the men! In others words, women make as much, or even more activities on an amplitude shorter schedule.

4. Spatial distribution Men/Women : who is where?

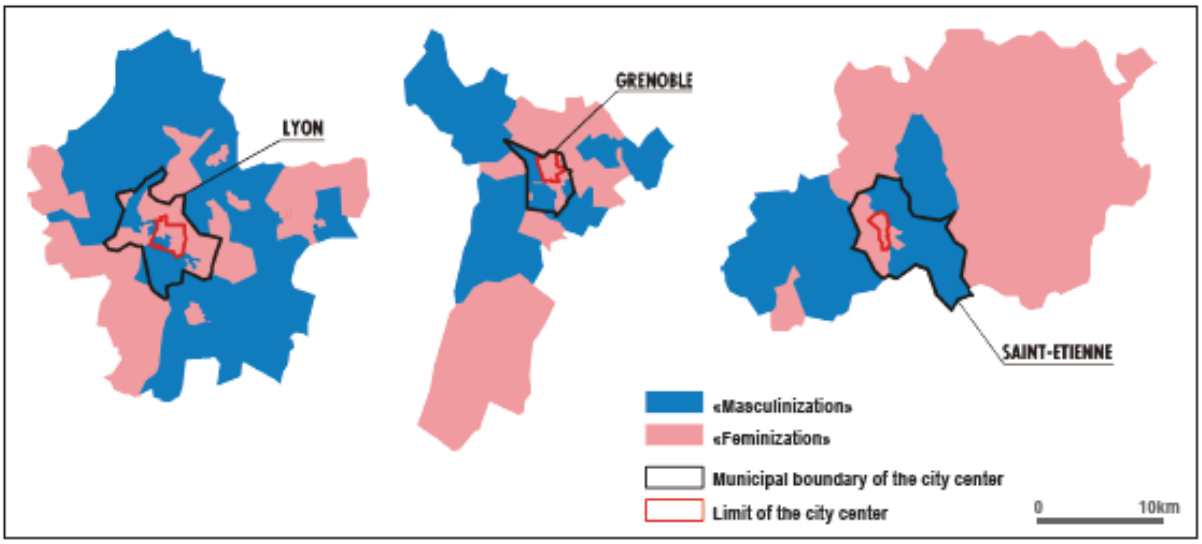
4.1. The localization during one day : more feminine sectors than the others?

Territorial approaches show that based on the dwelling place (urban or peri-urban), the mobility practices remain relatively homogeneous6. The peri-urbans use more their cars and execute more distance but the activity program of the living household in the city and peri-urban is rather close. One of the explanations concerns the double membership territorial of the household; in other words, the differences of behaviors of mobility between men and women level spatial differentiation urban/peri-urban. It remains to understand how “double membership affiliation” of men and women is translated from a point of view of spatial? If we look at the territories based on the presence places (and not only the residence), is it the temporal differences in the daily activities of the men and women double of a spatial differentiation? According to the moment of a day, is it the “territories have a gender” to resume the expression of Bard (2004) ?

[6] See the works of thesis of Clotilde Minster (IFSTTAR) “ Analyzes mobility of the people in the rural spaces as a contribution to comprehension the demographic revival of these spaces and durability”

Today, the reflections about urban planning, for example, base essentially on diagnosis that analyze the resident population in a city. The tool of the « urban pulse » allows to observe the present population and know if between two periods of one day, areas became more feminine than others, or inversely if zones became more masculine. Always though the informations of the EMD, we know that Miss X left the place A (origin of the travel) at 8:00 to arrive to the place B (destination of the travel) at 8:20, etc... We can deduce that between 4:00 and 8:00 she was at the place A, that between 8:00 and 8:20 she was traveling and that from 8:20 she was at the place B, etc... The analysis proposes to observe at two moments of one day the part of the women present by sector. The comparison is done between : 4:00, time which the great majority of the inhabitants are still at their home and 10:30, time which the most of the activities have begun (school, work, stores, ...). Between the densities of inhabitants such as they appear at 4:00 and the densities present in the morning, the gender of the territories obeys a daily pace. Certain majority masculine sectors at night become feminie in the morning and inversely. We can define if a district or a town is « feminized » (it means than the ratio of present women increased) or if it is « masculinized » (it means the ratio for present women decreased).

Figure 4- « Feminization » ou « Masculinization » of the territories of the agglomeration of Lyon, Saint-Etienne and Grenoble (source: standard EMD Certu, Cete of Lyon)



On the whole, we survey the common tendencies to the three studied agglomerations : according to the nature of this activity, the centrals sectors the densest tend to feminize while the suburbs shows the part of men grow. As confirmed by the data of INSEE, the nature the employment per zones seems to explain why a zone becomes feminize or masculinize. However, even if the job affect the travel of the population, it is not the only element of daily migrations men-women. Indeed, the location of the shops, services, especially those related to children (nurserie, schools,...) can also complete the reasons of masculinization or feminization of the zones.

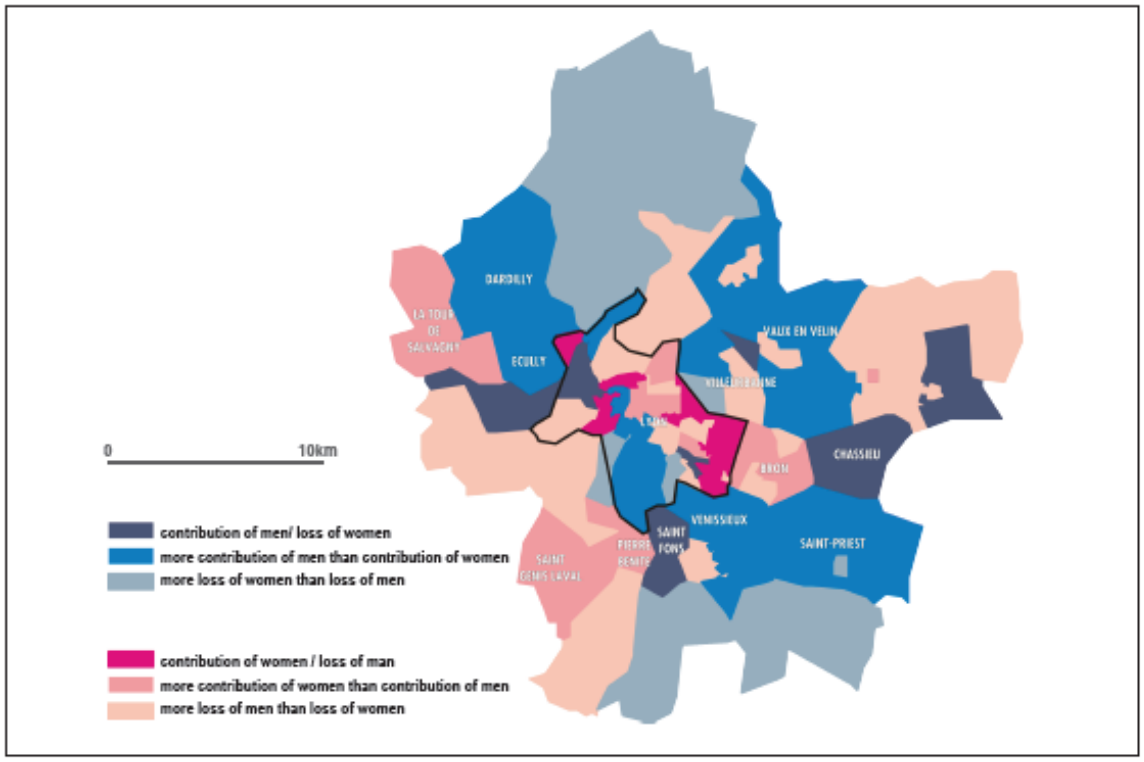
4.2. « Masculinization » or « féminization » of a city : towards a typology of urban areas

Beyond the general tendecy, we can deepen our study creating a typology that precise the intensity of the dynamics : does the sector feminize itself by a “contribution” of women or by a “ loss of man”?

The spatialization of the travels for Men/Women in the city shows, in the case of Lyon agglomeration, that the sectors of the city center feminize or masculinize due to a contribution of population in favor of the gender or other. These sectors dispose in fact of a large member of jobs and are characterized by contrasting economic activities. In certain zones, the men and the women cross literally : some come when others leave. For example the edge East of Lyon (Sectors of the hospitals) is marked by an arrival of women and a loss of men while in the cities near the peri-urban as Chassieu or St-Fons (Industrial Job) follow by the inverse travels. The kind of peri-urban, space not very attractive in terms of job, is essentially linked to the differential between the departure of man and the departure of woman. The cities at the edge of the agglomeration suffer departure of women more important than men (in edge North and to the South) or an inverse travel where the loss of man is more

important (in edge East and the West). We rediscover this tendency in Saint-Etienne where the sectors to the east Saint-Etienne Metopolis (around Rive-de-Gier and Saint-Chamond) feminized due mainly to loss more men than women; the men leaving their home to work in Lyon agglomeration.

Figure 5- Typology of sectors according to the dynamics of « Feminization » or « Masculinization » in Lyon agglomeration . (source: standard EMD Certu, Cete of Lyon)



The rhythm of the daily activities and the trajectory of women boost the debate on the type of location of the household. It appears that a center position appears as an asset for women in the current state of their program or activity. The best conciliation of the different spheres of the activity households would be located in the environments both dense and mixed, with all achievable types services for each(Carron, 2007). Central location, more « women friendly », would facilitate conciliation private and professional life of women and the preservation of the daily routines (Butler and Hammett, 1994). On the contrary, to live in the peri-urban areas makes the daily activities more difficult especially for women and will often necessitate a part-time job, more frequent in these territories(Carron, 2007). The work identified the risk of " spatial entrapment" of women in the suburban areas (Nelson, 1986; England, 1993) : the women would accept lower-paying jobs near their home to reconcile more easily work and family.

5. Conclusion: a time-geography of gender

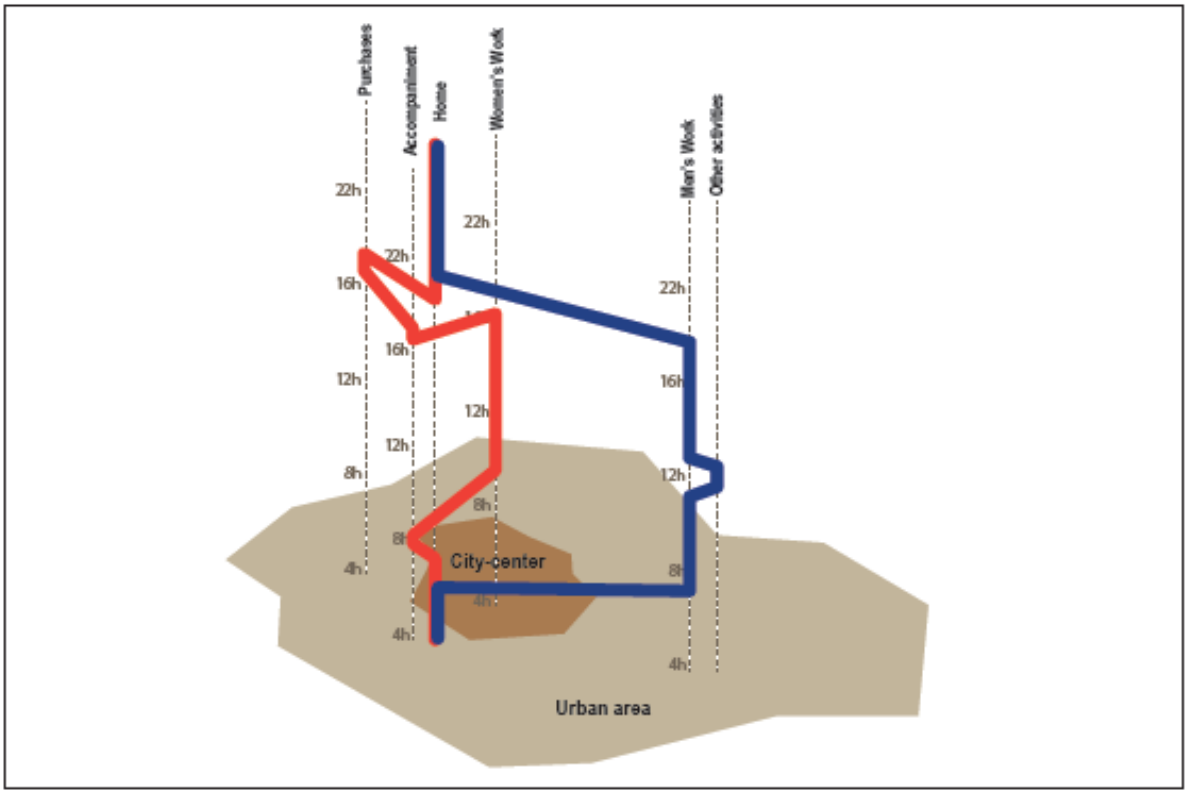
This article aims to deepen the spatial-temporal dynamics of the daily mobility of men and women through an original tool called "urban pulse", developed by the CETE of Lyon. The modeling of the daily rhythm applied to the metropolis Rhone-Alpines (Lyon, Grenoble, Saint-Etienne), allows refining the knowledge of differences behaviors between men and women.

The analysis shows first that there are differences in the life rhythm between employed men and women, but not for students and retiree. If working differentiates the employed from the other occupations, we can also wonder if the observed differences between men and women for this category are not related to the presence or not of a child. In fact, the activity period corresponds equally to the period of life during which one raises his children. It would therefor be useful to follow the investigations by integrating, for the employed the composition of the household : couple with or without child, mono parental family, single, ...

This analysis also shows that the location of men and women in time and space is a reflection of the territorial structure. It is intimately linked to the nature and the layout of the economical activities, but certainly also to the distribution of equipments and services. Thus, the public decision-maker must think that the men and women do not have the same activities and that their geographic distribution is different. The equipments and services must adapt to the difference men - women and be declined according to the territories that are rather feminine or rather masculine.

These works supply especially a « time-geography » of the gender which may be characterized by the most caricatured traits : the schedule of active women takes place on a shorter period than men, with a program more constrained by fixed times and therefore more rhythmic. The distances are shorter and less dependent on the car while the destination is more often the city center than the man because of the typology jobs and other possible activities. The space-time prism of men and women drawn by this analysis, indicates daily practices still well differentiated.

Figure 6- Simplification of the trajectories space- time of the men and women (CETE Nord-Picardie)



Thanks

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Gender Differences in Travel Behavior in the Arab World: Comparison of Case Studies from Jordan and Israel

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ABSTRACT

This paper extends the research on gendered differences in travel patterns in the Arab world by studying similarities and differences between Israeli Arab and Jordanian Arab communities in relation to travel behavior. We try to explore differences in travel behavior between women and men in the two communities and their potential causes. Although this work focuses on two countries, it serves as an important early study of travel behaviors in general in the Arab world, a topic deserving of more research.

The similarity of factors characterizing the Israeli Arab minority and Jordanian society—culture, language, religions and sets of beliefs—makes their comparison interesting. The study is based on a survey of 300 households in Israel and 200 households in Jordan. A descriptive statistical analysis was employed to understand the differences in travel behavior between the sexes in each country, and a daily activity pattern model was developed using a multinomial logit model.

The results of this study show significant differences in travel behavior between women and men in both countries but there are also differences between the two countries. Men make more trips, use the car as a driver more, spend more time travelling, and participate more in the workforce than women do. One of the principal findings of the analyses of the two communities is that demographic and socio-economic factors have a significant effect on the diversity of daily activity patterns; nonetheless, these variables are not sufficient to explain these gender disparities.

Keywords: Travel behavior, Daily activity pattern, Gender, Arab, Israel, Jordan

INTRODUCTION

In recent years, a great deal has been learned about gender differences in travel patterns in developed urban societies. However, little is known regarding this aspect in the developing world, and there are insufficient studies that look at the complexity of women's daily travel pattern in developing countries. This dearth of knowledge impairs the effective design and implementation of transportation policies.

One vast understudied population is the Arab community of the Middle East and North Africa, whose roughly 325 million people compose the vast majority of citizens in a swath of nations extending from the Atlantic Ocean in the west to the Persian Gulf in the east. In Israel, Arabs constitute a substantial minority population.

General questions can be raised in regard to women's daily activity pattern. In which activities are women engaged, and how do they get to these activities? Are socio-economic characteristics sufficient to explain gender differences in travel behavior, or do differences in accessibility and culture contribute the most to gendered disparity?

The purpose of this research is to extend the research on gendered differences in travel patterns in the Arab world by studying similarities and differences between Israeli Arab and Jordanian Arab communities. We try to explore differences in travel behavior between women and men in the two communities and their potential causes. This paper focuses on Israel and Jordan, but it serves as an important early study of travel behaviors in general in the Arab world, a topic deserving of more research.

The study is based on a unique data set that includes activity and travel diaries collected by personal interviews in three Arab communities in the Galilee region in northern Israel—Majd-al-Krum, Rami, and Shefaram—and in the town of Al-Husn in Jordan. Similar factors characterizing the Israeli Arab minority and Jordanian society— culture, language, religions and sets of beliefs—make this comparison interesting.

The paper is organized as follows: Section 2 reviews the literature regarding gender differences in travel behavior and factors affecting this behavior in developing countries, with a focus on the Arab countries. Section 3 presents some background about the Israeli and Jordanian communities. Section 4 discusses the methodology, including the case-study towns, the survey and the main characteristics of the sample. Section 5 analyzes the data collected from the two surveys (Israel and Jordan) and estimates the results of the daily activity model. The final section offers conclusions.

LITERATURE REVIEW

There have been relatively few studies about gendered differences in travel behavior in developing countries. Turner and Fouracre (1) note that "the roles that women have in society must inevitably have a powerful influence on their travel patterns, though there is little documented evidence which clearly demonstrates this [in developing countries]." These authors do cite earlier research in Brazil, which revealed that women make only a third of the work trips, but half of non-work trips. They also cite earlier research in Kenya, which revealed that women's travel is mostly local and on foot. In both of these studies, women reported a higher transit-mode share than did men.

Srinivasan (2) finds that in Chennai (formerly Madras), India, men spend more time and money on travel than do women although women walk more, make more trips, and complete more shopping tours than do men. The researcher advocates improved transit to reduce travel times and improve access to opportunities. Peters (3), who reviewed case studies from cities in India, Mali, Bangladesh, Turkmenistan and Peru, concluded that women had less access than did men to individual mechanized modes, ranging from bicycles to automobiles, and that women who did have access to public transport were more dependent on it than were men with similar access.

In the Arab world, Abuhamoud et al. (4) show that males in Libya are more likely to use public transport than to drive. In Jordan, Hamed and Olaywah (5) studied the use of buses, service taxis and private cars in Amman, but did not examine gendered differences; they found that bus commuters were less likely to pursue social activities than were private vehicle commuters.

Few studies focus on Israel. Blumen and Kellerman (6) find that women in Haifa commute shorter distances than do men. Both of these studies include data from Israeli Arabs, but only as a small part of a larger sample. Mansfeld and Ya'acoub (7) focus exclusively on the Arab community of Northern Israel and find that tradition and cultural affiliation are more influential factors than are socio-economic characteristics in affecting tourism travel. However, their study did not consider either gender or daily travel behaviors. Elias et al. (8) find that women in Israel make fewer trips, travel less time and walk more than do men.

The literature provides some debate on the role of a variety of factors influencing gendered differences in travel behavior. These studies reveal that most influential of the demographic and socio-economic characteristics are age, household size, education, driving license, income and car ownership (9; 10).

Abuhamoud et al. (4) find that in Libya as one becomes older, he or she is more likely to drive than take a bus. They also found that driving license and access to a car had traditionally been among the most significant determinants of mode choice. Elias et al. (8) found that demographic and socio-economic factors affected gendered defenses in travel behavior in Arab communities.

In the past few decades, cities have expanded tremendously owing to fast-paced economic growth and urbanization. Currently shopping center, residential areas, schools and even job opportunities are spread all over a city. This change in urban form and in the geographical distribution of activities generated significant effects on people's travel behavior (11), especially that of women, who normally take more responsibility for child-serving stops, such as picking up their children from schools/daycare centers and bringing them to/collecting them from other social and leisure activities (12). These findings demonstrate the need for a better understanding of the entire daily activity pattern and its complexity, including trip-chaining decision-making, which is necessary for transportation researchers and policy-makers alike. Both Turner and Fouracre (1) and Peters (3) call for improved surveying and a more holistic understanding of travel behavior that considered the interplay of activities within the household.

Rosenbloom and Burns (13) pointed out that women's travel patterns differed from those of men both because of the former's household and child-care roles and because of their norms regarding appropriate travel behavior.

Several studies have examined commuting patterns, which are becoming more complex because of an increasing tendency to make non-work stops during the commute to work, especially in the evening (14). Some research results show differences in commuting trip-chaining behavior between men and women and among different household structures (15). Women are more likely than men to trip-chain on the way to and from work, and they make more trip chains with stops to serve passengers (12; 16). Strathman and Dueker (15) determined that the more school-age children there were in a household, the more trip-chaining would be performed. Working mothers are more likely than working fathers to link trips, especially when there are younger children in the household (15). McGuckin and Murakami (16) determined that trip-chaining was predominantly the domain of women, even when women entered the workforce. These chaining trips have been found to structure women's travel patterns and to have significantly impacted commuters' in-vehicle travel time and route choice (distance) (17). Nevertheless, there are insufficient in-depth studies of these issues in developing countries in general, as well as among the Arab minority in Israel.

Elias et al. (8), using a tour-based approach to analyze travel behavior in Arab-Israeli villages, found that gender constituted a significant predictor of travel. Men were found to make more tours.

Subbarao and Krishna Rao (18) examined the effect of household and individual socio-economic characteristics and travel choice on individual trip-chaining in India's Mumbai Metropolitan Region. Their study recognizes that decision-making on trip-chaining varies significantly by age group. It was found that drivers in the 36 to 50-year-old age group made more trip chains than did other age groups and that people in the age group of 21 to 35 years did not show interest in making complex, non-work-related trip chains. People age 50 and older create fewer work trip chains, and more trip-chaining is associated with maintenance and leisure activities. It was observed that men tended to make more work-related trip-chains, whereas women undertook more trip chains involving maintenance or leisure activities. This last finding supports the notion of gender division of household in developing countries.

Many researchers have turned to activity-based analysis, whereby travel is a derived demand from the desire for personal activity. Travel decisions, therefore, form part of a broader activity-scheduling process. The basic travel unit is a tour, which is defined as a sequence of trip segments that start at home, proceed on time to activities and end back at home. Activity-based

research emphasizes that activities may change on a daily basis, thus influencing travel choices. Copperman and Bhat (19) showed that explicitly considering children's activity patterns was important when accounting for the linkage between children's and adults' activity-travel patterns and for accurately forecasting activity-travel patterns in general.

BACKGROUND

Table 1 presents the main demographic and socio-economic characteristics of Israel and Jordan. The State of Israel had a population of 7,374,000 in 2008 (CBS, 2010). The state is populated primarily by Jews, with a sizable Arab minority, both groups being non-assimilating (20). The Arab community contained 1,487,000 million people or 20.2 percent of the Israeli population in 2008. This community is primarily Moslem (82.9 percent), but includes prominent Christian (8.6 percent) and Druze (8.3 percent) minorities (Statistical Abstract of Israel, 2007). The Druze are a religious sect numbering between a half million and a million adherents and, in addition to living in Israel, reside in Syria, Lebanon and Jordan. They trace the origins of their beliefs to Islam, but have been a distinct community for almost a millennium.

These three religious communities have distinct socio-economic characteristics. Christians most resemble Jewish Israelis in terms of levels of education and household size, and they form the highest-earning Arab group; however, on average, the wage rates of Israeli Arab Christians are only 86.3 percent of those of Jewish Israelis. In contrast, Moslems and Druze have lower levels of education and larger household sizes than do Christians. Interestingly, despite very similar levels of education between Moslems and Druze, the latter earn far larger salaries (CBS, 2008). Arab Israelis account for the majority of the population in the Galilee region of the country, which contains the three surveyed communities: Shefaram, Majd-al-Krumand Rami. Yiftachel (20) noted that Israeli planning policy has viewed this area as an "internal frontier" and sought to constrain the spatial and economic growth of the Arab towns located in the region. As a result, Arab towns do not enjoy the same level of development as do other Israeli towns as a whole. One example is the virtual absence of public transit service in Arab towns (8).

Jordan has a population of about 5,800,000 people, more than 92 percent of whom are Sunni Muslim. Official government figures estimate that Christians make up 6 percent of the

population; there are between 12,000 and 14,000 thousand Druze, a small number of Shi'a Muslims and approximately one thousand Bahá'ís.

The population distribution in Jordan is affected by a variety of factors, among which are reciprocal migration streams and regional disparities in socio-economic development. Almost two fifths of the total population (37 percent) lives in the Amman Governorate alone, followed by the Irbid and Zarqa governorates (18.4 percent and 14.8 percent, respectively). The surveyed city, Husn, is in Irbid.

Table 1 shows that in both communities, Israel and Jordan, the young population, those 18 years old and younger, comprises more than 40 percent of the total population; however, the share of young population is higher in Jordan. Both communities have a high growth rate and a relatively large household size.

The annual household income in Israel is about three times that of the Jordanian. Jordan, like most other countries and like the Arab population in Israel, records a lower average wage for women than for men. On average, women in Jordan earn 379 JD, 11 per- cent less than Jordanian men, while Arab women in Israel earn 23 percent less than Israeli Arab men (CBS, 2010). The participation rate of the women in the workforce in Jordan and Israel is very similar: 23% and 24.9%, respectively. Table 1 also shows a considerable difference in the motorization rate between Jordan and Israel.

TABLE 1 Demographic Comparison between Jordanian and Israeli Arabs (2008 Census)

Feature	**Jordan**	**Israeli Arabs**
Population size	5,850,000	1,487,600
Religion		
Moslems	92%	82.9
Christians	6%	8.6
Druze	0.3%	8.3
Population Growth Rate	2.2	Moslems=2.8 Christians=1.3
Household size	6.1	5.04
Percentage of population under 18	47.0%	44.4%
Annual household income	572 Dinar (1 dinar=1.14$)	8,578 1 shekel=0.277$
Average Monthly Wage (paid employees)		
Women	379 JD (2010)	4395 Shekel
Men	429 JD	5756 Shekel

Rate of Participation in the Workforce		
Women	23.0% (2011)	24.9%
Men		72.3
Motorization Rate*	147 per 1000 vehicles	187 per 1000 vehicles

METHODOLOGY

This study is based on a unique data set that includes activity and travel diaries collected following personal interviews in three Arab communities in the Galilee region in northern Israel and in Al Husn, a town in northern Jordan. The database includes 300 completed questionnaires from Israeli households and 200 from Jordanian households.

The samples were randomly selected from a set of spatially distributed zones within each surveyed community. The spatial distribution is critical to ensuring the inclusion of clans, which have specific living standards and which reside in specific areas based on historical land ownership. The interviewers telephoned each household in advance to set up an interview time and then visited the home to personally record demographic information and to complete travel diaries for the preceding day for each member of the household over age six. A typical surveying session took an hour and a half per household.

A descriptive statistical analysis was employed to understand the differences in travel behavior between the Israeli and Jordanian Arab communities, as well as gendered differences. In addition, a daily-activity-pattern model was developed by using a multinomial logit model. The structure of the daily-activity-pattern model, shown in Figure 1, includes two choices: the highest level estimates the choice of the main activity of the day. There are three activity alternatives: Work (W), Education (E) and Other (O), the last representing such activities as shopping, leisure, dropping off a child or staying at home.

For days in which the main activity is work, another model estimates the probability of the daily–activity pattern (DAP). This choice consists of three alternatives: simple daily activity pattern, meaning only one trip to and from work; a stop on the way back from work for non-work activity (HWH, HWOH); and a complex daily activity pattern, which includes more than one more trip in addition to the trip to work.

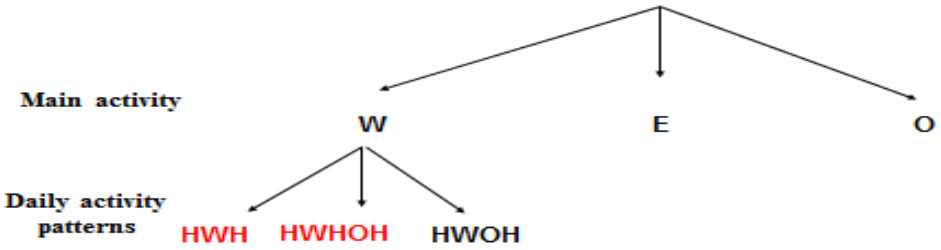

Figure 1 Structure of the daily- activity-pattern model

The Case Study Sites

Shefaram and Husn are medium-size cities, whose populations are 33,600 and 20,000, respectively, while Majd-Alcrum and Rami are small towns, whose populations are 12,700 and 7,800, respectively. Majd-Alcrum is entirely Moslem while Shefaram is mixed, with a Muslim majority (58.8%), a significant Christian community (27.0%) and a Druze minority (14.4%) (2). Rami is mixed, with a 51.5% Christian majority, 30.3% Druze and 18.3% Moslems.

Al Husn, located 65 km (40 miles) north of Amman and about 7 km (4 mi) south of Irbid, has a mixed population of Muslims and Christians, with a higher percentage of Christians.

Main Socio-Economic Characteristics of the Samples

Table 2 presents the main demographic and socio-economic characteristics of the samples, which consisted of 753 and 1,164 individuals in Jordan and Israel, respectively; 52% of the Jordanian sample and 49% of the Israeli sample are males, the average age being 30.9 (S.D =16.22) and 33.0 (S.D =18.9) in the Jordanian and Israeli samples, respectively. Table 2 shows that the income level among the Israeli Arab communities is higher than that of Jordan. Among the Israeli communities, 56.0% of the households had an income above the average, whereas only 22% of the households in Husn have incomes above the average. In contrast, more than half of

the households in the Jordanian town have an income below the average, compared with 30.6% among the three Arab communities in Israel. In addition, the average number of cars among the Israeli Arab communities is 1.12, compared with 0.82 in Al Husn.

Most the men in Israel have a driving license (90.0%), whereas only 50.4% of the women do. In Jordan, about half of the men have a driving license, while only 20% of the women do. In other words, the percentage of Arab Israelis who have driving licenses is about twice that of the Jordanians.

In contrast, the percentage of women and men with university degrees in Jordan is higher than that among the Israeli Arab communities. As Table 2 shows, most of the women in both Jordan and Israel work within their towns of residence, while most of the men work outside their home town; however, the percentage of Jordanian who work outside their towns is higher than of the Arab Israeli men.

TABLE 2
Demographic and Socio-Economic Comparisons of Jordanian and Israeli Arabs

Demographic Characteristic	**Gender**	**Jordan**	**Israel**
N	**Women**	**358**	**593**
N	**Men**	**394**	**571**
Age (mean)		**30.95**	**33.02**
S.D.		**16.228**	**18.968**
Participants Age 18 and older	**Women**	**263**	**418**
	Men	**272**	**408**
Income			
Below the average		54.0%	30.6%
About the average		**24%**	**13.4%**
Over the average		22.0%	56.0%
Percentage of population with a driver's license (age 18 and older)	**Women**	**20.9**	**50.4**

	Men	**59.6**	**90.0**
Percentage of population with a university degree	**Women**	**47.9**	**34.9**
	Men	**44.5**	**36.8**
Work status (entire sample)		**N=746**	**N=1164**
Salaried		**22.1**	**35.9**
Self-employed		**8.7**	**2.7**
Unemployed		**4.5**	**4.4**
Pensioner		**9.5**	**6.8**
Housewife		**18.6**	**17.9**
Student		**36.6**	**32.3**
Work location (of those 18 and older) within the town	**Men**	**32.2**	**47.9**
	Women	**60.3**	**57.1**
Average number of cars in the household		0.82	1.12

RESULTS OF THE ANALYSIS

We first examined the variation in travel behavior by gender of all survey respondents in the two communities who were at least 18 years old. We found a significant variation in travel behavior by gender and by community.

Table 3 summarizes the main differences between men and women in activity participation and in the amount of travel. Men in both countries make more trips and more tours than do women; and Israelis, both men and women, make more trips than do Jordanians. Despite the fact that Jordanians make fewer trips, they spend more time travelling; they also spend more time travelling both by motorized mode and on foot than the Israelis. Furthermore, men and women in Jordan spend more time travelling outside their towns than Israeli Arab women and men.

TABLE 3
Summary Comparisons of Trips Made

Variable	Gender	Jordan	Israel
Per Individual (Daily Mean)		**N=529**	**N=1,043**
Trips	Women	2.4	3.9
	Men	3.1	5.3
Tours	Women	1.2	1.6
	Men	1.3	2.0
Travel time (hours)	Women	01:11	00:53
	Men	01:47	01:31
Time Away from home (hours)	Women	05:23	05:22
	Men	06:40	07:54
Travel time by motorized means (minutes)	Women	55.6	43.1
	Men	97.4	79.3
Travel time on foot (minutes)	Women	16.3	9.8
	Men	11.0	8.4
Trips outside the town (Minutes)	Women	30.9	21.3
	Men	39.4	24.7

Table 4 presents the main daily activity for the sample participants. Six activities are considered: working, shopping, school/study, errands, social activities / leisure, and staying at home. The identification of the main daily activity is based on a combination of the hierarchy of activities (work being the most important) and duration.

The table shows a significant variation in the main activity by gender and community. In both countries, work is the main activity more for men than for women. The percentage of Arab women in Israel who work is twice that of Jordanian women. This means that education level cannot explain the participation of the women in the workforce without taking into consideration additional factors, as Jordanian women are more educated than Arab Israeli women.

It is interesting to see that men in Jordan are more used to going shopping than are women; in Israel, in contrast, women do more shopping than do men. The percentage of men and women in Jordan whose main trip is for study is higher than of women and men in Israel.

Women in Israel make more trips for self-arrangement purposes than do men in Israel and than do women in Jordan. Overall, there are much fewer self-arrangement activities in Jordan, and these are hardly made by women. Participation in social activities is also very much lower for Jordanian women and men than for Israelis.

This lower participation in activities by the Jordanians compared to the Israelis means the former stay at home more. Table 4 shows that more than half of the women in Jordan stay at home and do not participate in any activities, whereas 19.1% of the Jordanian men stay at home. In Israel, more than one fifth of the women stay at home, whereas only 5.4% of the men do.

TABLE 4

Main Daily Activity (over age 17)

Trip Purpose	Men		Women	
	Israel (%)	Jordan (%)	Israel (%)	Jordan (%)
Work	63.9	55.1	38.2	19.4
Shopping	4.7	8.8	6.7	4.2
School/Study	6.4	10.3	7.6	12.5
Self-arrangements	4.9	1.5	7.4	0.4
Social activities / Leisure	14.7	5.2	18.8	8.0
Stay at home	5.4	19.1	21.2	55.5

Mode Shares

Figures 2 and 3 present the mode shares for commuter trips, Figure 2 for men and Figure 3 for women. As can be seen, there are significant differences in mode share between Israeli Arabs and Jordanians and between men and women. The bus is a significant transport mode among Jordanians, men and women, but it is hardly used by Israeli men and only marginally used by Israeli women. Taxis are also much more common in Jordan than in Israel, and they are used more by Israeli women than by Israeli men. On the other hand, Israelis, both men and women, use employer-provided transportation, which is unavailable in Jordan. There are significant gender differences in car use, men being car drivers significantly more so than women; this difference in much stronger in Jordan, as the proportion of car drivers among Jordanian women is very low. On the other hand, Jordanian women travel more as car passengers than Israeli

women do, while women in both countries travel more as car passengers than men do. Women in both countries commute by walking more than men do. A similar analysis for all trips to all activities (not shown here to save space) shows very similar trends.

Various factors account for the foregoing differences that were found. First, of the four groups being compared, women in Jordan have the lowest share of driver- license holding. Car ownership in Jordan is lower than in Israel, which explains the overall lower share of car drivers in Jordan. Public transport in Jordan in general and in Al Husn in particular is well developed compared to that in the Galilee region of Israel; on the other hand, employer-provided transportation is common in Israel but completely lacking in Jordan. In both communities women are more likely to work close to home, and therefore walking is more popular among them than among men. Differences in occupational structure between men and women in both countries make men more dependent on the car for their job.

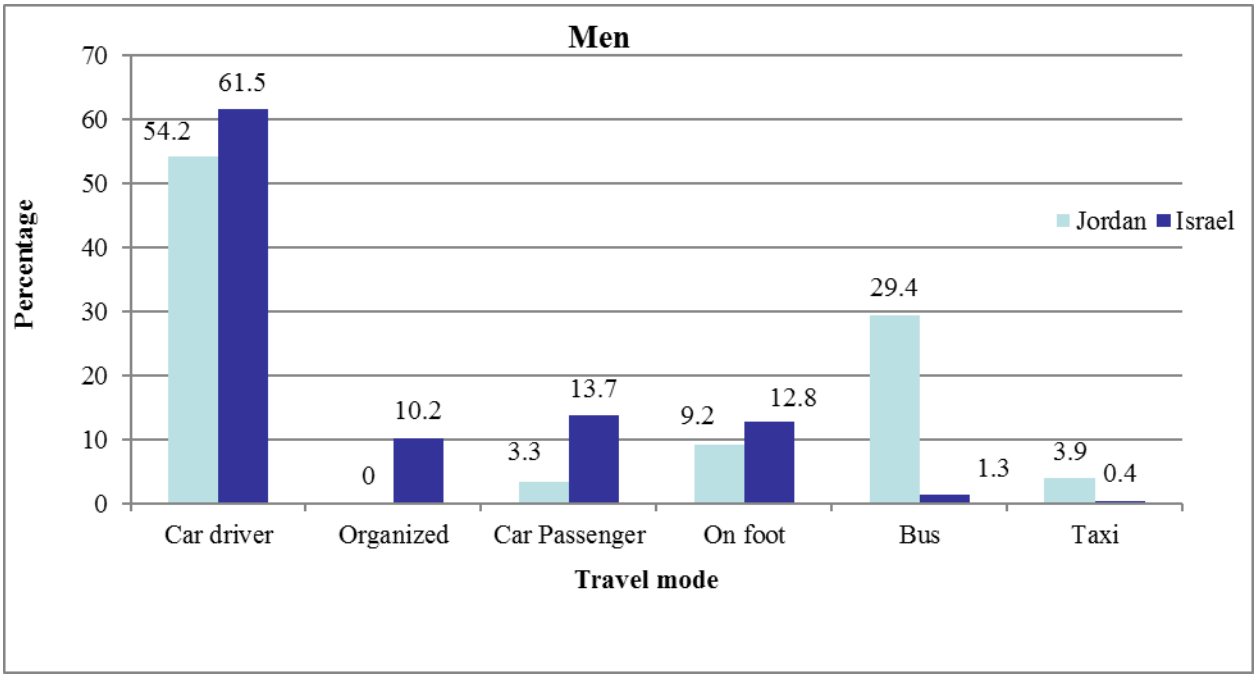

Figure 2 Commuting Mode for Men in Jordan and Israel

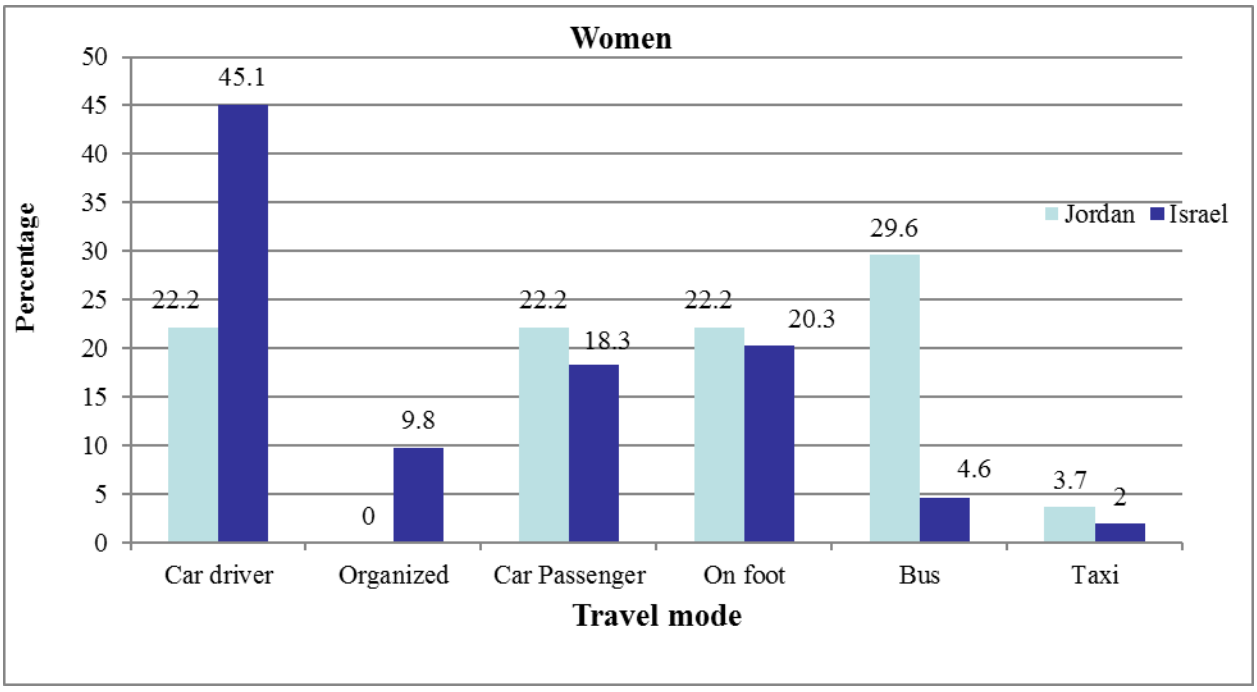

Figure 3 Commuting Mode for Women in Jordan and Israel

Table 5 shows the average number of all activities participation by purpose for Israeli and Jordanian men and women. Although, as mentioned above, men in both countries engage in work outside the home more than women do, the two communities reveal significant differences in regard to the travel behavior of men and women. in Women in Israel are more used to going shopping than are men, whereas shopping is the man's responsibility in Jordan. Differences in the amount of serving activities (Drop Off / Pick Up) between Arab Israelis and Jordanians are explained by the fact that the latter are rarely engaged in this type of activity. In Israel, the amount of serving stops is relatively high and, on average, men make more serving stops than do women, but the difference is not significant. It should be noted that usually men's serving trips are for work-related purposes; e.g., giving an employee a ride, whereas women's serving trips are mostly for dropping off and picking up children.

The findings show that Jordanians participate much less in social activities than do Israelis. In both countries, men's participation in social activities is about 1.5 times that of women. The differences in the various activities may be explained by the differences between Jordan and Israel in socio-economic characteristics, including income level, car ownership, driving licenses, and the household size. These differences may also reflect differences in norms despite the fact that both communities have similar religions and, as a result, a similar culture. It

is possible that the exposure of the Israeli Arabs, especially women, to the Jewish culture has affected the society norms of the Arab community, including their daily activity patterns and travel behavior.

TABLE 5

Differences between Men and Women in Jordan and Israel in the Amount of Daily Activity

Trip Purpose	Gender	Country	
		Jordan	Israel
Commuting to Work	**Men**	0.63	0.91
	Women	0.14	0.35
Shopping	**Men**	0.12	0.14
	Women	0.04	0.18
Drop Off / Pick Up	**Men**	0.05	0.28
	Women	0.01	0.21
School / Study	**Men**	0.07	0.04
	Women	0.07	0.05
Social Activities / Leisure	**Men**	0.13	0.82
	Women	0.09	0.50

There are also gender differences in how people arrange their travel patterns. Figures 4 and 5 present the complexity of the daily activity patterns for women and men, respectively. The daily activity patterns were divided into two categories, the first when the main activity is work, and the second when the main activity is non-work.

In regard to commuter trips, Jordanians make significantly more simple tours from home to work and back compared to Israelis; and Jordanian women make more simple tours than Israeli women do. Finally the rate of simple tours among Israeli men and women is quite similar.

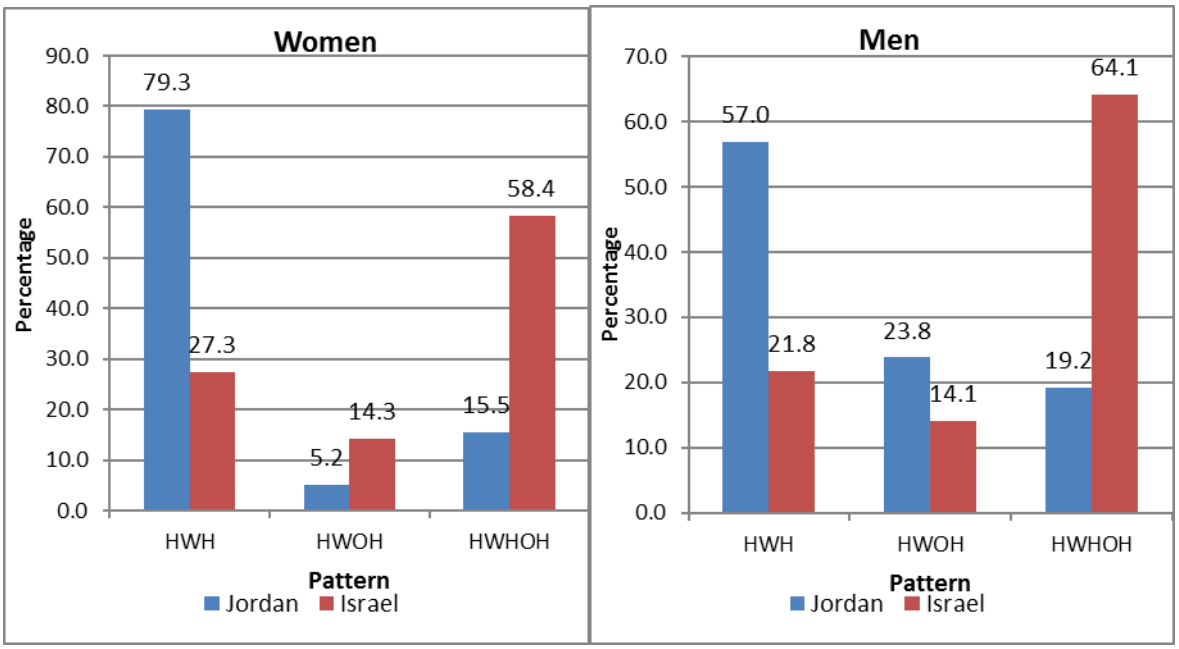

Figure 4 The complexity of the daily activity pattern, by gender and country, when the main purpose is work

In regard to daily activity patterns that do not include work trips, Figure 5 shows that women in both Jordan and Israel make significantly more simple tours from home to non-work purpose and back home, and this is true both by motorized mode HOH and on foot HOH (F), compared to men, who make more complex tours. In sum, the daily activity pattern for men is more complex even when they do not work. Women are more likely to have a simple daily activity pattern that, in many cases, includes a walking trip for a non-work purpose.

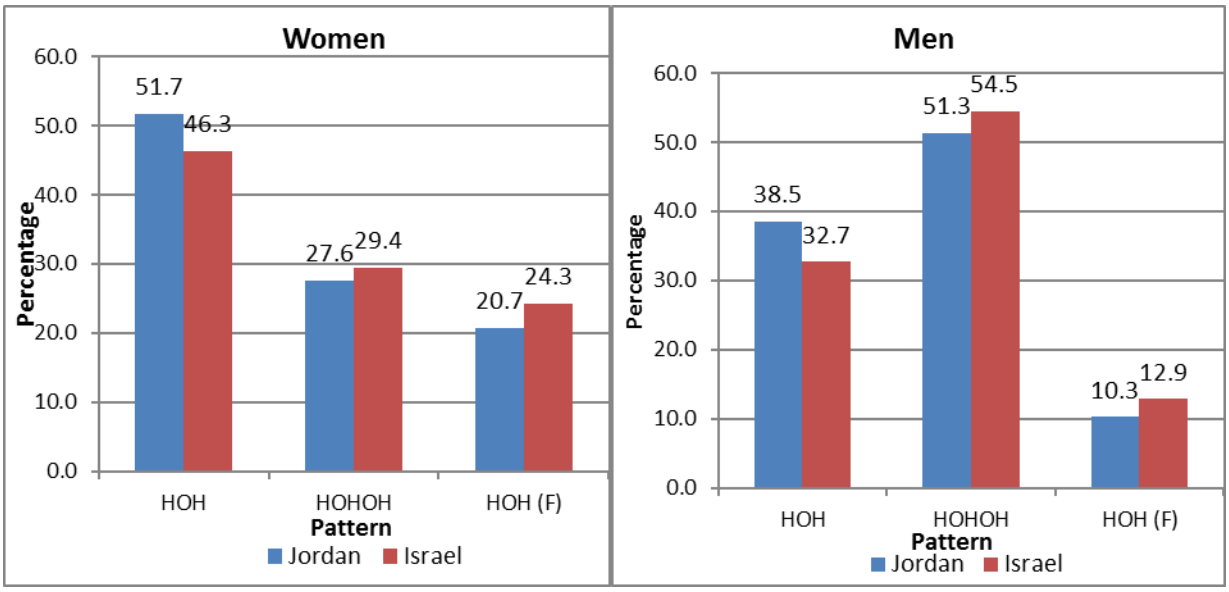

Figure 5 Complexity of the daily activity pattern, by gender and country, when the main purpose is other than work

Estimation Results for the Daily Activity Model

Table 6 shows the estimation results for the main activity model. This model estimates the probabilities of the main activity being one of three: work, education, or other. The work alternative is the reference.

The results show that people older than 65 are less likely to work than are younger people, and that people older than 35 are less likely to study. Men are more likely than women to work, but women are more likely than men to study. Married people are more likely to work and less likely to study. Education is an important factor for work participation, and people with an academic degree are much more likely to work than are people without an academic degree, an effect that is stronger in Jordan. Similarly, holding a driver's license is important, and those who do are more likely to work. Number of cars in the household is an important factor for work participation in Israel, but not in Jordan.

TABLE 6

Estimation Results of the Main Daily Activity Pattern Model

	Other		Study	
Variable description	**β**	**t-statistics**	**β**	**t-statistics**
Constant	**1.933**	**8.05**	**1.149**	**3.18**
Age 36-55, 55-65	**-**	**-**	**-1.994**	**-3.22**
Age 55-65	**2.409**	**7.74**		
Age 66+	**4.101**	**7.35**	**-**	**-**
Gender (male)	**-1.287**	**-8.14**	**-**	**-**
Gender (male), Jordan	**-**	**-**	**-0.750**	**-1.89**
Gender (male), Israel	**-**	**-**	**-0.471**	**-1.36**
Status (married)	**-0.382**	**-1.27**	**-1.819**	**-5.32**
Education (at least a BA), Jordan	**-1.233**	**-4.83**		
Education (at least a BA), Israel	**-1.455**	**-2.79**		
Driver's License	**-1.439**	**-8.46**	**-1.560**	**-5.49**
Number of cars (Jordan)	**-**	**-**		
Number of cars (Israel)	**-0.260**	**-2.0**		
Likelihood with constants only = -1705.155 **Final value of Likelihood = -970.440** **ρ^2=0.505** **N=**				

Table 7 shows the estimation results for the daily activity pattern model when the main activity is work. This model estimates the probabilities of the daily activity being either a complex or a simple pattern. The simple alternative is the reference.

The results show that people age 36 to 55 are more likely to make complex daily activity patterns than are other population groups. Men are more likely to have complex daily activity pattern than are women. People with a driving license are more likely to have a complex daily activity pattern. Working place affects the complexity of the daily pattern, and people who work outside their city of residence are less likely to have a complex daily pattern. This last result can be explained by the occupation type and by the commuting travel time.

Unsurprisingly, the more cars in a household, the more likely its members will have a complex pattern. Income also affects people's daily activity patterns: the higher the income, the more likely it is that the individual will have a complex travel pattern. The results show that Israelis are more likely to have a complex pattern than are Jordanians.

TABLE 7

Estimation Results of the Daily Activity Pattern When the Main Trip Is for Work

	Complex Pattern (HWHOH, HOHOH)	
Variable description	**β**	**t-statistics**
Constant	**2.35**	**6.32**
Age 36-55	**0.79**	**3.57**
Status (married)	**-**	**-**
Gender (male)	**0.57**	**2.45**
Under18 (study)	**-**	**-**
Driver's License	**0.96**	**2.10**
Work place (outside the town)	**-0.7**	**-3.25**
Number of cars in household	**0.54**	**3.20**
Income	**0.149**	**1.86**
Nationality (Israeli Arabs)	**2.27**	**8.88**
Likelihood with constants only = -538.237 **Final value of Likelihood = -364.170** **ρ^2=0.301** **N=**		

CONCLUSION

This research addresses the critical, but understudied issue of gender differences in travel behaviors in developing countries, in general, and in the Arab world, in particular. A rich data set of activity and travel diary surveys from both Israel and Jordan was analyzed by a variety of statistical means to reveal stark gender differences in travel behavior.

On the whole, men in both Israel and Jordan are more mobile than women: they make more trips and travel to work more frequently. Women exhibit a more simple daily activity pattern than men. Men disproportionately travel by private vehicle while women disproportionately travel as car passengers or walk.

The results also show significant differences in travel behavior between Israelis and Jordanians. Israeli Arabs make more trips, spend more time traveling, and spend more time at activities than do Jordanians. Israeli Arab women are more mobile than Jordanian women: they travel to work more frequently, spend more time in shopping, and make more child-serving trips. A considerable percentage of Jordanian women stay at home and do not participate in out-of-home activities. Transit provision in all the Israeli Arab communities is very low and, accordingly, has a low mode share. For Jordanians, in contrast, public transit is one of the major modes.

One of the principal findings of this study is that demographic and socio-economic factors have a significant effect on the diversity of participation in various activities. However, demographic and socio-economic characteristics cannot solely explain gendered disparities. The study results show that despite the fact that women in Jordan are more educated than Arab women in Israel, their participation in the workforce and other social activities is lower.

Therefore, the locational accessibility of employment and the availability of a car, as well, are critical. It may also be that the assimilation of Israeli Arabs within the Jewish population since the establishment of the State of Israel in 1948 has affected the Arab women's lifestyle, activity, and travel behavior, but this is a question requiring further research.

In sum, effective policy interventions must consider these distinctions in order to best address the development needs of the Arab world.

This paper tries to contribute to a better understanding of the various factors affecting differences in activity and travel behavior in the Arab world by investigating differences between

men and women in two populations that share some commonality but are still quite different. Much further research is needed to better understand the weight of different factors: socio economic/demographic characteristics, culture and norms, land-use patterns, and the transportation system. To this end, larger samples from more diverse communities within the Arab world are needed as are more detailed studies of the various communities' characteristics, culture, and norms. More detailed surveys will enable the development of various latent variables representing culture land use, and transportation supply.

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MEN AND WOMEN DRIVERS: A STUDY OF SOCIAL REPRESENTATIONS THROUGH PROTOTYPICAL AND CORRESPONDENCE ANALYSIS

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ABSTRACT

Representations of men and women drivers and their implications are a major societal issue since several years. However, so far, few studies have demonstrated the precise content of these representations among adults. This study is based on the structural approach of social representations. The aim is to analyze the representations of men and women behind the wheel according to sex, age and social status, and to generate hypotheses about the central or peripheral status of the items revealed. According to an intergroup pattern, 414 French participants were asked to answer a questionnaire, using verbal association methodology (N=203 for men drivers, N=211 for women drivers). They were equitably distributed on the basis of sex, age class (from 16 to 50 years-old and over) and social status. The thematic analysis revealed four large topics, including 16 subtopics in both cases. By comparing occurrence frequencies of these associations (salience in the representational field) and average ranks (importance given by subjects), the structural pattern of these representations was explored. Besides, differences and social anchors were analyzed through a correspondence analysis. The results seem to reflect the effect of social positions on the choices made to designate a man or a woman driver. Attitudes also seem to vary according to age: younger people referred more to risk and rules, whereas older individuals referred more to skills and expertise. The results are discussed through gender-related essentialism, in-group/out-group relations, age and socialization impacts in gender stereotypes associated with driving.

1. INTRODUCTION

In most Western countries, men are two to three times more likely to die in a traffic accident than women *(1-3)*. Their chances of being injured in a car accident are 25% higher compared to women *(4)*. Studies show that men are more frequently involved in accidents related to a violation of the rules. In France, at equal mileage, women have 2.5 times fewer points removed from their driving license, and are 6.2 times less convicted for offenses *(5)*. However, despite these objective data about accidentology, it seems that the negative stereotype against women, according to which they would be poor drivers *(6)*, continues. These stereotypes, providing the foundation for strong inductive inferences, can have significant cognitive and behavioral consequences *(7-9)*. In the context of driving, the study of stereotypes appears to be an important aspect of understanding social construction of such content, gender identity, as well as threat phenomena and its implications. Nevertheless, so far, few studies have demonstrated the precise content of these stereotypes among adults. Although some studies are based on a brief review of its characteristics, their study is often restricted to preliminary research *(8)*, and no study has reported this content in terms of social representations. To the best of our knowledge, the specific content of these representations has not been explored in depth among an adult population yet, although we are using it for many other studies. As a consequence, the objective of this study is to analyze the specific contents of the social representations of men and women behind the wheel according to sex and age.

Some social objects can be described as "social representations" *(10)*. These objects, concerning which each individual has a structured definition, are developed through interactions with others, including consensual elements shared by all, as well as minor items on which differences can be observed. On the axis of the work of Moscovici *(10)*, another approach was developed by Abric *(11, 12)* to account for the internal organization of social representations. According to this structural approach, the central core theory aims to demonstrate how are structured the elements constituting a representation. This theory assumes that any representation is organized around a central core. These few elements forming the core (opinions, beliefs, knowledge elements ...) are subject to a consensus among the individuals who share this representation. In this manner, the core has two main functions: a generating meaning function, by conferring meaning to the other elements of the representation, and an organizing function, by characterizing the type of links of the elements constituting this representation. The core has another important property: the stability of the component elements, which are more resistant to change. Other elements related to the representation but are not part of the central core are called "peripheral elements". These elements allow certain flexibility in the representation and reflect the individual appropriation and the context in which they are developed. Thus, unlike the central elements characterized by a consensus, the representation considers many interindividual variations in the peripheral system. The work of Guimelli *(13)* shows in this way that some hunters say that hunting is "a solitary activity", others that it is a "way to meet friends". These individual variations at the peripheral level, however, are not sufficient to reconsider the central element that corresponds to the "territory management". A protective function of the central core (or defense function according Abric) is also involved: the peripheral system operates as "bumper of the representation", according to the expression of Flament *(14, 15)*. Indeed, it allows the integration of new elements in the representation: the transformation of representation first takes place at a peripheral level. Thus, even if the core is the foundation of the representation, peripheral elements play an important role, by operating in a complementary manner with the central system. They are the interface between the core and reality, the concrete situation in which the representation is developed. In the theoretical field of social representation, the aim

of the present study is to analyze the contents of social representations of men and women behind the wheel according to sex, age and social status, and to generate hypotheses about the central or peripheral status of items revealed.

2. METHOD

2.1. Material

The first part of this study is based on the verbal association procedure and the substitution technique. These tools are relevant for the study of specific social groups and for identifying the content of social representations, which is the case of the present research. Many studies used the method of verbal associations to reveal various representational contents *(16-21)*. During a first phase, participants were asked to associate 5 words or expressions to an inductor related to the object of representation. It was thus given the following instruction to the subjects: "Give 5 words or expressions that come immediately to mind to describe a man (vs. a woman) driver". In a second phase, after completing these associations, participants were asked to rank their answers, from the most important to least important to characterize the object. Thus, two indicators are used in the study of associations produced: the frequency of appearance of an item (is the item cited by many participants?) and its importance in the representational field (what is the rank associated with the item by the participants?). Elements that are considered particularly important to characterize the object (and that are potentially the core elements of the representation) are both characterized by a high frequency (consensual aspect) and a high importance. Therefore, a low rank reflects a high importance, because it indicates that the word has been ranked in the first positions. Conversely, a high rank reflects a low importance because it indicates that the word was ranked in the last position (i.e. close to 5).

The median is used to determine the threshold from which a word can be considered to have a low vs. high importance. Given that the importance can be rated from 1 to 5, the associations which importance is evaluated less than 3 are considered to be the most important for the participants. For the frequency criterion, we consider that a word is characterized by a high frequency (vs. low) when cited by more than 10% of the population *(22, 23)*. Given that the population consists of 203 and 211 participants, thresholds are respectively equal to 20 and 21. Concerning elements that can lead to masking strategies, Guimelli and Deschamps *(20)* propose to use a substitution instruction, which consists not directly asking individuals about their personal opinions but what they think the opinions of others are (typically those of the "French in general"). Participants thus give the opinion they think the French have on men or women drivers. The assumption is that this instruction lowers the normative pressure, which allows individuals to express views they would mask in another situation. Therefore, this procedure allows identifying relevant content, including the problematic and non-problematic aspects. This instruction was used as a precaution, assuming that the potential undesirable content (especially against women) would have led to a masking phenomenon, which would have made a whole section of the social representation not accessible. However, the results showed that there were no differences between the two types of instructions.

2.2. Population

The sample consisted of 203 participants for the "man driver" questionnaire and 211 participants for the "woman driver" questionnaire. We divided the population into subgroups based on certain criteria (gender, age, socio-professional category). The socio-economic status (SES) of the participants or of their both parents (for students or high school students) was obtained by referring to the grid of the National Institute of Statistics and Economic Studies, in order to obtain a balanced sample between higher SES (Entrepreneurs, liberal professions, intellectual professions) and lower SES (intermediate professions, employees or workers). As representation could differ according to age, four age groups were differentiated (between 16 and 18 years, between 19 and 29 years, between 30 and 49 years, 50 years and over).

3. RESULTS

3.1. Thematic content analysis

Thematic analysis of the words used by the participants was conducted using four independent judges. The study of the social representation of "the man driver" allowed identifying 16 characteristics (self-confidence, citizenship, practical skills, technical skills, arrogance, impatience, carelessness, inattention, incivility, incompetence, patience, pleasure, caution, transgression of the rules, virility and speed). The study of the representation of the "woman driver" allowed identifying 16 characteristics (lack of practical skills, lack of technical skills, the functional aspect of the conduct, citizenship, skills, compliance with rules, danger, impatience, inattention, incivility, slowness, patience, lack of confidence, caution, transgression of the rules, and vigilance). The categories determined and their frequencies of occurrence in the population are presented in Table 1.

TABLE 1 Categorical analysis of the associations produced

Categories (Men drivers)	Characteristics	Frequency	Categories (Women drivers)	Characteristics	Frequency
Caution	Prudent, security, responsible, attentive, focused, alert	N=34	Caution	Cautious, prudent, reassuring, protective, less risk	N=152
Carelessness	Reckless, dangerous, unconscious, accidents, road hog	N=99	Danger	Reckless, dangerous, imminent death, unconscious, accident	N=133
Inattention	Inattentive, low concentration, distracted	N=18	Vigilance	Attentive, focused, alert	N =46
Speed	Drive fast, speed	N=104	Inattention	Low concentration, distracted, makeup while driving, doing two things at the same time	N =91
Transgression of the rules	Non compliance with the code, irresponsible, alcohol, drug, offenses	N=70	Slowness	Drove slowly, drives like a granny, traffic jam	N=63
Practical skills	Mastery of vehicle, control, reflexes, pilot, performance, facilities, talented, natural talent, abilities.	N=55	Transgression of the rules	Non compliance with the code, irresponsible, alcohol	N=37
Technical skills	Maneuvers, mechanics, sense of direction, technique, good for parking	N=22	Compliance with rules	Compliance with limitations, code compliance, compliance with traffic signals, responsible	N=48
Incompetence	Drive poorly	N=13	Lack of practical skills	Clumsy, lack of mastery, poor reflexes, poor conductor, is not made for it, "another woman at the wheel"	N=85
Citizenship	Gallant, cordial, civic, polite	N=10	Lack of technical skills	Difficulties for maneuvering, understands nothing in mechanics, does not know their way, difficulties to park	N=61
Incivility	Aggressive, angry, rude, vulgar, grumpy, intolerant, disrespectful, discourteous, selfish, individualistic, self-centered	N=193	Skills	Mastery, control, smooth driving, good driver	N=20
Patience	Calm, serenity, patience	N=6	Citizenship	Respectful, courteous, cordial, civic, polite, kind	N=46
Impatience	Impatient, hurry, brutal conduct, nervous, impulsive, stressed, horn	N=130	Incivility	Rude, vulgar, disrespectful, aggressive, hysterical, angry	N=38
Arrogance	Show off, flirt, proud, arrogant, conceited	N=54	Patience	Calm, patient, less impulsive	N=38
Virility	Virility, domination, sense of superiority, power, macho, sexist	N=61	Impatience	Impatient, hurry, nervous, stressed, horn	N=38
Self-confidence	Confidence	N=38	Lack of confidence	Shy, hesitant, unsure of herself, timid, anxious, panic	N=39
Pleasure	Pleasure like driving, freedom, travel, big cars, fast cars, the importance of the car, attached to the vehicle	N=22	Functional aspect of the driving	Daily trips, small cars, cheaper car, sober car, practical c	N=19

3.2. Prototypical analysis

The prototypical analysis of the characteristics was carried out with the "Evoc" program *(24, 25)*. For "men drivers", the most frequently words cited by participants and considered at the same time as the most important to define the object were "speed", "self-confidence", "carelessness", "caution", "impatience" and "transgression of the rules" (table 2). These words were those with the highest probability of belonging to the central system *(22, 23)*. The first periphery (i.e. the frequently mentioned elements but considered as less important) revealed interindividual variations, with terms such as "arrogance" or "incivility". Elements such as "citizenship" and "incompetence" composed the second periphery (i.e. the elements characterized by a low frequency and a low importance). No contrasted element (i.e. not frequently mentioned but very important items) for the representation of the men drivers was found. This area outlines the elements that can be the foundation of diverging or even conflicting conceptions in the representational field.

TABLE 2 Prototypical analysis of the representation of the "men drivers"

Frequency	Rank					
	< 3			> 3		
		N	Rank		N	Rank
> 10 %	Speed	104	2,21	Incivility	193	3,05
	Self-confidence	38	2,57	Virility	61	3,06
	Carelessness	99	2,71	Arrogance	54	3,07
	Practical skills	55	2,72	Technical skills	22	3,40
	Caution	34	2,73	Pleasure	22	3,50
	Impatience	130	2,83			
	Transgression of the rules	70	2,95			
< 10 %				Inattention	18	3,55
				Citizenship	10	4,00
				Patience	6	4,00
				Incompetence	13	4,07

For "women drivers", the most consensual and important terms were "caution", "compliance with rules", "vigilance", "lack of practical skills and confidence" and "danger" (table 3). Concerning the first periphery (i.e. consensual elements but with a low importance), were found elements such as "impatience" and "slowness". Aspects related to "skills" were part of the contrasted elements (i.e. items characterized by a low frequency but high importance). Finally, the functional aspects of the driving, was found in the second periphery (i.e. not frequently mentioned elements and considered as unimportant).

TABLE 3 Prototypical analysis of the representation of the "women drivers"

Frequency	Rank < 3			Rank > 3		
		N	Rank		N	Rank
> 10 %	Caution	152	2,28	Patience	38	3,00
	Compliance with rules	48	2,37	Transgression of the rules	37	3,02
	Vigilance	46	2,56	Lack of technical skills	61	3,21
	Lack of practical skills	85	2,69	Citizenship	46	3,40
	Lack of confidence	39	2,82	Slowness	63	3,23
	Danger	133	2,90	Incivility	38	3,39
				Inattention	91	3,40
				Impatience	38	3,42
< 10 %	Skills	20	2,90	Functional aspect of the driving	19	3,21

3.3. Factorial correspondence analysis

The analysis of the associations produced for each representation was conducted through a Factorial Correspondence Analysis (FCA) *(26)*. This analysis aimed to identify differences in the frequency of the associations, according to the selected variables. This permits to reveal the relationship between associations to define a man or a woman driver and the different variables, i.e. disclose connections between collected items and modalities of variables. Two FCA were performed by focusing the analysis on the variables of sex and age. The two-dimensional graph displays the results of the FCA. Only items with a sufficient contribution per factor were selected. The more an item is located at the intersection of the two axes, the more this item is consensual (no deviation from independence). On the contrary, the more an item is located at the extremity of the graph, the more it is specific of a particular group. In other words, the more an item deviates from the center, the less it indicates a consensus, but rather reflects a specific discourse of a given group. For each axis, were selected the modalities for which the contribution to the formation of an axis exceeded the average (1.666 for the variables and 0.0625 for the observations).

Concerning the first analysis (men drivers), dimension 1 (eigenvalue: 0.030813, 52.59% of inertia) opposes the male respondents to the female respondents. Dimension 2 (eigenvalue: 0.016489, 28.15% of inertia) opposes aged 16 to 18 to those aged 30 and over. Thus, we can see that men associate with their social representation of the "men drivers" characteristics related to practical skills and caution. In contrast, women consider more aspects related to transgression of rules and inattention. Concerning Factor 2, we notice that respondents aged between 16 to 18 years more associated with frequency characteristics such as practical skills to the "men drivers". Conversely, those aged 30 and over rather mentioned characteristics related to technical expertise and the manly aspects of driving.

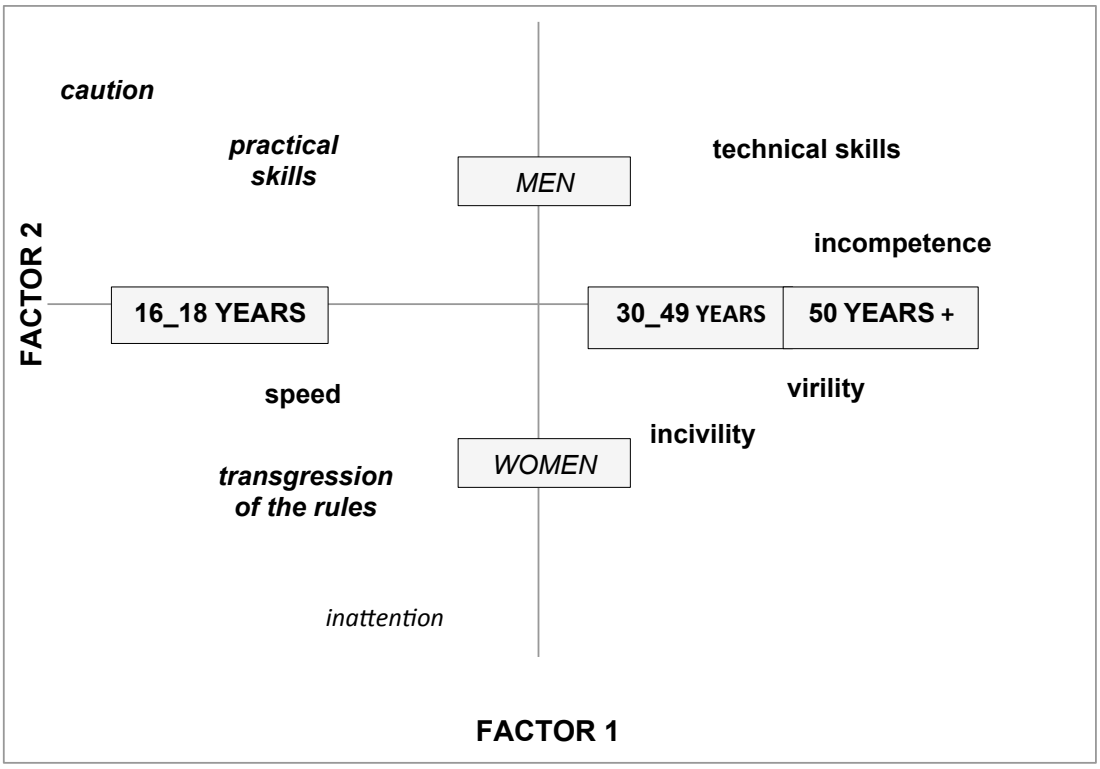

FIGURE 1 Two-dimensional correspondence analysis graph according to sexe and age group (men drivers).

Note: Abbreviations in capital letters inside grey frames represent the terms of independent variables
"**TERM**" means that the independent variables accounts for the construction of Factor 1
"*TERM*" means that the independent variables accounts for the construction of Factor 2
"**Item**" means that the item accounts for the construction of Factor 1
"*Item*" means that the item accounts for the construction of Factor 2
"***Item***" means that the item accounts for the construction of Factor 1 and 2

Concerning the "women drivers", were also identified modalities for which the contribution to the formation of an axis exceeded the average contribution (0.1666 for the variables and 0.0625 for the observations, the number of variables and observations being equivalent as for "the men drivers"). Dimension 1 (eigenvalue: 0.022775, 49.89% of inertia) opposed the male respondents and female respondents. Men associated women drivers with criteria such as slowness, more than women. In contrast, women more frequently mention characteristics related to danger, vigilance and compliance with rules to describe "women drivers". Dimension 2 (eigenvalue: 0.013483, 29.54% of inertia) opposed respondents aged 16 to 18 years to those aged 30 and over. The former refer to vigilance, danger, compliance or transgression with the rules, while the latter focus more on the lack of practical and technical skills.

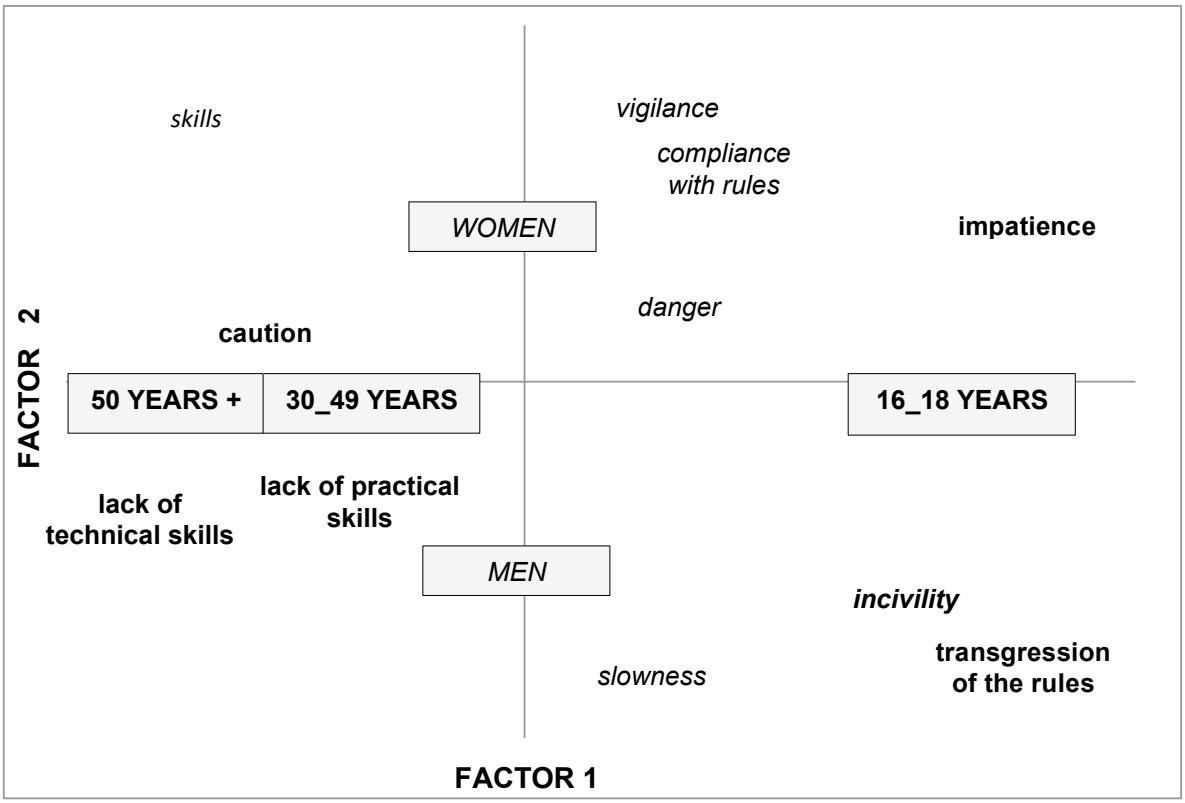

FIGURE 2 Two-dimensional correspondence analysis graph according to sexe and age group (women drivers).

Note: Abbreviations in capital letters inside grey frames represent the terms of independent variables
"**TERM**" means that the independent variables accounts for the construction of Factor 1
"*TERM*" means that the independent variables accounts for the construction of Factor 2
"**Item**" means that the item accounts for the construction of Factor 1
"*Item*" means that the item accounts for the construction of Factor 2
"***Item***" means that the item accounts for the construction of Factor 1 and 2

We see the social construction of these attitudes, depending on the social positions occupied by the individuals. Consequently, we can see that men emphasized on characteristics related to the skills and expertise in their social representation of the "men drivers" characteristics related to the skills and expertise, while women further consider aspects related to the transgression of the rules and inattention, i.e. the dangerous aspects of their driving. To describe the "women drivers", women more frequently mention characteristics related to compliance with rules and vigilance, and highlight a careful driving style. Meanwhile, men associate more criteria for slowness, – which seems to indicate an excess of caution –, lack of confidence or competence in their description of the "women drivers". It seems that the attitudes also differ depending on the age (Dimension 2) where the younger participants suggest more the relation to risk and rules, unlike the older participants, making more references to skills and abilities, in both cases. Thus, for men and women drivers each group emphasized on different skills and behaviors needed to drive safely, men and experimented drivers stressed the technical and practical skills, whereas women and younger drivers

stressed on safety skills and compliance with rules. It seems that social groups highlight and evaluate men and women drivers in relation to the skills they think they possess or that are important to them.

4. DISCUSSION

The objective of this study was to analyze the social representations of men and women behind the wheel according to sex and age. These analyzes allowed to identify some constants. Associations showed shared cognitions, which some are common to the whole group of participants. This is the case of the elements related to self-confidence and impatience (man driver) and lack of confidence (woman driver), ranked first and most frequently cited in the prototypical analysis and not included on the correspondence analysis (which seems to reflect more of a consensual rather than a specific discourse). In the end, it appears that the vision of the "men drivers" seems to be primarily based on their skills. In contrast, the vision of the "women drivers" seems to be primarily based on their incompetence. However, a second aspect appears to come into opposition simultaneously, in both cases. While women seem to be described as very cautious and vigilant, men seem to be seen as driving fast and risky. This could explain the aspects related to the confidence (low confidence for women vs. high confidence for men), which could be seen as a cause or a consequence of the level of competence in driving. These findings are consistent with some studies which have shown that adolescents and preadolescents already differentiate expertise and driving skills according to sex: women have abilities for safety but not for driving, while men have driving skills but neglect security and safety *(27)*. It would be since women are incompetent they must be cautious and because men are competent they can become careless. These results are in line with stereotypes describing men as taking risks, being more aggressive *(28)*, competent *(29-32)* and women more hesitant, less active *(33)*, and considered less competence in driving, even if they have fewer accidents *(34)*. Furthermore, the results of Näätänen and Summala *(35)* showed that even among adolescents, the tendency to drive fast and to overtake is considered as an indicator of competence (one of the most important and frequent characteristic to describe "men drivers"). This suggests that asymmetrical attributions may be made according to the sex of driver: in case of an accident, men would be judged to not have enough take the other users into account while women would be judged to have demonstrated a lack of mastery of the vehicle *(34)*. Conversely, in case of good driving (or accident avoidance), women would have been cautious and vigilant towards other road users (thus avoiding an accident) while men would have expertise and dexterity for driving cars (and this is due to those skills that they avoid an accident). This can be related to Deaux's findings *(36, 37)* according to which performances that are consistent with expectations are attributed to stable and internal causes (such as ability) while performances that are inconsistent with expectations are attributed to more unstable causes (such as effort or luck). Since people usually more expect men to succeed than women (which remains the case for driving), women's successes are more likely to be attributed to luck or effort, and less to ability, contrary to men. Similarly, since people usually more expect women to fail than men, women's failures are more likely to be attributed to a lack of ability, and less to a lack of effort or luck, contrary to men. In this perspective, this indicates that men succeed through internal factors, these factors explaining failure for women. Note that these performance expectations and the reasons attributed to these performances are elaborated by consensus to both sexes *(38)*. This means that women also consider themselves as incompetent and explain it by internal factors, rather than other factors. These results tend to suggest this phenomenon,

since negative terms are used by both sexes for women drivers, such as “danger”, “lack of practical skills” or “lack of confidence”, characterized by a high frequency and high importance. Regarding terms characterized by a high frequency and high importance, no elements indicating any lack of competence are used by both sexes to characterized men drivers. Thus, the representation that the members of the dominant group elaborate toward the members of the subordinate group enables the former to legitimize their dominant position. But at the same time, the representation that subordinate group members elaborate toward dominant group members allow them to justify their position of subordination. Otherwise, according to Fiske *(39)*, the stereotypical judgment is a way of exercising control over others, which reinforces the power of an individual or a group. In other words, stereotypes are used by members of dominant groups to maintain the status quo. This echoes the work of Berger *(6)*, according to which negative stereotypes about women drivers were spread in the early twentieth century due to emancipation that could generate the car. As a result, this threat would have been at the base of a negative stereotype toward women drivers, in order to minimize the impact of the automobile as a perspective of women’s liberation and involvement into social change. Various popular beliefs against their driving style appeared according to which, due to their physical and emotional sensitive constitution, they would be unable to handle stressful situations requiring rapid decision making, which would make them poor drivers.

Beyond these consensual aspects, nevertheless, elements that can give rise to differences within the group are observed. This is the case of “contrasted elements” for women drivers, for example. Aspects related to the “skills” are considered as very important (listed in the first positions), but only through a part of the population, which explains why it is considered to have an overall low frequency. This discrepancy is also found on the analysis of correspondence, where these aspects are more frequently mentioned by women. In fact, women promote more the in-group and denigrate more the out-group than men. Men being members of the dominant group, women tend to defend their position *(40)*. However this phenomenon does not occur for “men drivers” for whom no “contrasted elements” are observed, as if there was no real divergence point among participants.

5. CONCLUSION

This research attempted to analyze the social representations of men and women drivers among young adults and adults. This work allows starting to establish a representational content but does not allow drawing any conclusion yet. The results seem to indicate the effect of social positions to designate a man or a woman driver. Indeed, it seems that the characteristics selected to determine these objects can differ according to social affiliations. We have seen that the vision of the “men drivers” was mainly based on their skills whereas the vision of the “women drivers” was mainly based on their incompetence. Other characteristics also differed by sex or age. However, an accurate diagnosis of these items cannot be established for now, because the methodology used here only allows making assumptions about the central vs. peripheral status of these elements. Indeed, the method of free associations is an effective method to identify a representational content, but does not enable to specify its structural organization. In this perspective, this analysis must be completed by a structural diagnostic test, such as the “Test of Context Independence” (TCI) *(41)* or the technique of “calling into question” *(42)*. This objective will be pursued in further work.

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SUSTAINABILITY TRANSITIONS AND GENDER IN TRANSPORT SECTOR DECISIONS

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ABSTRACT

In this paper we explore the possibilities for climate and sustainability transitions through a focus on transportation issues. We are particularly concerned about gender aspects in the change toward low carbon transportation systems.

Based on Sweden as a case study, data shows that women´s transportation behaviour has lower environmental impact than men´s and also women tend to have stronger preferences for measures improving ´soft´ issues such as e.g. sustainability or safety in the transport sector. The results imply that there are interesting behaviour and attitude characteristics expressed by women that ought to be recognised and applied e.g. through contesting prevailing norms, standards and methods, in order to achieve the climate and sustainability goals for the transport sector. The results altogether suggest that women, beyond democracy reasons, should become more activeas change agents.

There are policy implications of the findings in this study. Measures to improve fair participation of women and men would e.g. make it possible to take advantage of behavioural and attitudinal gender differences. Moreemphasis on the relationships between travel patterns, sustainability and gendering on all levels in transportation planning could also be used as a measure. Gender mainstreaming could be used as an approach to monitoring the impacts that policies and programs have on different groups of men and women. However, today there is a lack of incentives to apply these tools. Since there is a tremendous complexity in the relationship between travel patterns, sustainability and gendering on all levels more research is needed together with improved dissemination of knowledge for the competence level to increase within the transport sector.

1. INTRODUCTION

The overall concern in this paper is how climate and sustainability goals can be achieved together with gender awareness in decisions of the transport sector.Climate problems are a result of human activities over a long time of industrialization and a dependency on fossil fuels such as in the transport sector is a crucial part in actions for change. Research carried out within LETS 2050 in Sweden (*1*) has shown that both technological solutions and behavioural changes are needed in order to reach the stated climate goals for the transport sector. However, LETS 2050 has also shown that measures aiming for reductions in carbondioxid (CO_2) emissions through behavioural changes, contribute to more sustainability goals than technological solutions do. In line with this research, the paper discusses sustainability transitions focusing on reductions in CO_2 emissions.

There is a demand and urgency for action from policy makers at all levels (*2;3; 4*) and there is an imminent need for large scale societal transition toward low-carbon and sustainable societies (*5*). To successfully achieve long-term transformative change in democratic systems is likely to require broad supportof men and women and participation of social groups. Democratic values and norms of justice reasons can be used to argue that women should be included on equal terms in the transition toward sustainability and a decarbonisation of society.

The transport sector is highly implicated in this transition and it is a sector that is gendered (*6*).Transport has a major role in advanced economies in the movement of people and goods, in maintaining standards of living and in improving the quality of life. However, it is also a major consumer of non-renewable sources of energy and is responsible for much of the growth in pollution emissions. The transport systems worldwide are currently not sustainable, and are in many respects moving away from sustainability rather than towards it. The European Environment Agency (EEA) highlights in particular the sector's growing CO2 emissions that threaten the EU meeting its target under the Kyoto protocol (*7*).

Gender relations are reflected in the transport sector because gender is a crucial principle of social organization (*8;9*).Taking a gender perspectives on climate transitions and how they are shaped in the context of the transport sector calls for the recognition of inequities and injustices in the sector but also suggestthat norms can be relevant. Gender concerns the social organization around the difference between men and women, masculinity and femininity (*10*) and is expressed at many levels. Gender scholars speak about a gender power order that structures policymaking and institutions. The gender order can be studied at the level of individual men and women, at the group or organizational level, expressed as material forms of power that distributes resourcesor at a more structural level as norms for behaviour (*11*). The overarching ambition of this paper is to discuss different levels of the gender order of the transport sector, and its possible implications for a transition toward climate and sustainability goals. To do so we use empirical data and examples mainly from the Swedish case.

We have chosen to focus on Scandinavia and we argue that Swedish transport policy is particularly interesting to study because it includes a gender dimension. The overall target of Swedish transport policy has long been to ‘ensure an economically efficient and long-term sustainable transport for citizens and businesses throughout the country’ (*12; 13*). The target is further divided in two parts where the first, ´functional´ target, is to create accessibility with the intention that design, function and use of the transport system should help to give everyone a basic accessibility (availability) of good quality and usability. Unique for Sweden’s policy is that it is said that ‘the transport system should respond equally to women's and men's transport needs’. The second part of the policy, called ´the considerations targets´, state that the targets of increased accessibility should be achieved while road safety and environmental performance improve.The environmental part of the transport policy relates to the national overall generation goal for environment and environmental quality goals by stating that the transport policy should see to that these targets are achieved. The official parliamentary definition stating that ‘the overall goal of environmental policy is to hand over to the next generation a society in which the major environmental problems are solved, without causing increased environmental and

health problems outside of Sweden'. The Swedish Parliament has adopted a vision of zero net emissions of greenhouse gases to the atmosphere in Sweden by 2050.

Transport seems to be gendered in a particularly interesting way when it comes to climate and sustainability goals(*14; 15*). Women´s transportation behaviour has, in general, lower environmental impact (measured as CO_2 emissions) than men´s. More sustainable patterns of transport could be modelled on women's transport choices. Women also tend to have stronger preferences for measures improving ´soft´ issues such as e.g. sustainability or safety in the transport sector and they are also more willing to take action on climate concerns.Results provided in this paper indicate that when transport behaviour is analysed from the perspective of gender, women's transport behaviour in general terms is assumed to be more in line with what is required for a transition that favour climate and sustainability objectives.

This paper starts off with an overview of research results and data showing differences between men and women in travel behaviour and attitudes towards environmental actions, but also related differences in CO_2 emissions in Sweden.

In the following chapter and with the overview as a basis,issues related to sustainability transitions are discussed. There are arguments that women should be included beyond the ambition to increase the democratic quality of policy making and the chapter starts with a mappingof women's and men's representation in a selection of decision making bodies and a discussion on the quality of that representation but also the framing and understanding of gender differences. Questions asked arewhat role women should haveand whether we should be satisfied with gender-balanced representation or does women's transport behaviour also imply that women should become moreactive as change agents in the transport sector.In transition theory (*16*) as well as in gender theory there is an emphasis on the potential that certain actors – who burn for the topic, are willing to think in new ways, have different perspectives and participate in decision making – can disrupt powerful actor constellations and break path dependencies. Experiences, knowledge and ideas emerging from groups that have been outside power can be included in the agenda through these agents.

In the second section the framing and understanding of gender differencesis discussed based on interviews at the national level with civil servants, politicians, interest group representatives and analysis of text documents e.g. impact assessment documents and the Swedish transport policy target regarding gender equality. The investigation pictures the (lack off) knowledge, framing and understanding of gender differences among both planners and decision makers.

The last section discusses the importance of gendered norms to how climate transitions in the transport sector of Sweden are articulated. The gender analysis considers the normative aspects of the gendered transport order. Also in transition theory there is a call to recognize the context for transformation (*17*). Transitions always occur in some broader context of norms, institutionalized over time also gender theory points to this broader context of norms and practices for example that dominant images of men and certain types of masculinity have become the norm for governance (*18*). We may assume that climate governance happens in a transport context in which masculinity is the accepted norm, deeply embedded in transport administrations (*19*). The power of the normative is that it often remains unarticulated and invisible (*20*). When gender is understood as normative, policies and access without a gender perspective simply re-produce the existing normative order.

In the last chapter, final conclusions are made.

2. DIFFERENCES IN TRAVEL BEHAVIOR AND IN ATTITUDES

The report on Gender mainstreaming Europe transport research and policies published by University of Copenhagen and produced through the EU project Transgen state that there are clear and persistent gender differences in travel patterns, (*21*).

In this section we presentin what respects women's travel patterns in Sweden are different from men'sbased on an analysis of the Swedish National Travel Survey. Further we investigate if the differences in travel patterns also result inany differences regarding transport related CO_2 emissions. We also present gendered differences in attitudes to what would be more sustainable transport patterns. What does this imply for the possibility to achieve climate and sustainability goals both within the transport sector but also for the society as a whole?

It is still unusual that statistics on travel behaviours are presented for men and women separately. There are,however, reports presenting statistics on travel behaviour differences between men and women (e.g. 22; 23; 24). Men's and women's travel patterns are different and looking into those differences it is found that men and women make approximately the same amount of trips but men travel further than women. The total mileage travelled differs significantly between men and women in Sweden, seeTABLE 1. Men travel further for all displayed purposes except 'Purchase/service' for which women travel somewhat further. Most part of the differences stems from differences in work-related travel. Men on average make considerably more business trips (almost four times as many kilometres per person per day) and also commute more (see
TABLE 1). On a total men travel as much as 36 percent further per person and day than women.

TABLE 1 Total daily mileage in kilometre presented for different errands and separately for men and women. Source: RES 2005 – 2006 - The Swedish National Travel Survey

	Work/ school	Business travel	Purchase/service	Leisure	Other	Total
Men	11,0	11,8	5,2	19,3	5,7	53,1
Women	7,4	3,0	5,8	18,8	4,2	39,1
All	9,2	7,5	5,5	19,0	4,9	46,1

TABLE 2 Total daily mileage by car in kilometre presented for different errands and separately for men and women. Source: RES 2005 – 2006 - The Swedish National Travel Survey

	Work/ school	Business travel	Purchase/service	Leisure	Other	Total
Men	7,0	6,5	4,3	12,4	2,8	33,1
Women	4,0	1,2	4,7	11,2	2,6	23,7
All	5,5	3,9	4,5	11,8	2,7	28,4

Another explanationfor the differences in total mileage is that men travel more by car than women (see TABLE 2). The mileage travelled by car differs even more than the total mileage and the difference againstems from work-related travel. Differences for other purposes are small. On average men travel 40 percent further by car per person and day compared to women.
The latest assessment of the Swedish national transport policy (25) presents changes between results from the national transport survey RES 2005-2006 and RVU Sweden 2010-2011 and conclude that the differences between men´s and women´s travel behaviour remains. Men still travel further than women and they use car as driver for twice the distance as women do (the figures in TABLE 1 and 2

include car trips both as driver and passenger). A common explanation has beenthat this difference is the result of men and women's differentaccess to the household car. This is not confirmed in thereport. The gendered use of car that we noted remainsthe same in households with more than one car, i.e. men drive the care more. This suggests that there are gender differences in the choice of car related mobility.
Another explanation often used when accounting for the differences, is that men and womens living conditions i.e. household responsibilitiesand employment factors influencing trip lengths. While thereis some truth to it, gender difference in mobility choices is not explained bylevel of income. Interestingly, studies showing that women with good conditions for making free choices (high income, access to a car, etc.) prefer to use public transport more often than men with the same good conditions (26;27).These results correspond also with Räty and Carlsson-Kanyama (28) who show that men use more energy for transport than women. The conclusions are based from their results for single households showing that the average single man spends more on vehicles and fuel than the average single woman all else equal. The difference isequivalenttoapproximately twice as high transport related CO2emissions for single men compared to single women with similar pattern in several countries (28). This indicates a difference in the chosen use rather than a caused use of the transport system in terms of explanations of the differences, beyond socio-economic factors.

To understand what the differences in transport mode and lengths travelled means for sustainability issues we calculated the CO2emissions from all travel for women and men separately. The calculations are based on the mileage per mode and errand from RES 2005 – 2006 (The Swedish National Travel Survey) and the standard Swedish emissions factors for car and public transport, and assuming that walking and cycling do not produce any emissions. The emission factor for cars today is 144 g/km per person assuming an occupancy rate of 1.2 for each journey (29). Since the public transport mode choice is not subdivided into different modes of public transport, the emissions factor for 'public transport' is taken as a weighted average of the emission factors for different public transport modes, based on the mode share of different public transport modes in 2011 from the Swedish National Travel Survey. This gives an emission factor of 33 g/km per person for a public transport journey today.The emission factors for bus, train and tram/metro are 0.002 g/km, 62.1 g/km and 0.002 g/km per person respectively (NTM).

Looking at the transport behaviour translated into daily CO2emissions from transport the pattern of differences presented above remains with women on a total average emitting less than 70 percent compared to men (see TABLE 3).

TABLE 3 Daily CO2emissions from transport presented for different errands and separately for men and women. Calculations based on RES 2005 – 2006 - The Swedish National Travel Survey and national emission factors for different transport modes.

	Work/ school	Business travel	Purchase/ service	Leisure	Other	Total
Men	1 276	1 662	688	2 471	765	6 863
Women	721	403	760	2 317	556	4 757
Difference	-556	-1 259	72	-154	-209	-2 106

Apart from the differences in travel behaviour there are also some systematic differences in attitudes towards different aspects of sustainability issues. Women put higher emphasis on environmental issues and on traffic safety issues than men (e.g. 26; 30). Furthermore, results from attitude surveys e.g. Lindén (31) show that women are more environmentally concerned and express more criticism of automobility than men. A study of the Swedish EPA (32) on climate change showed differences in knowledge and attitudes towards climate change and measures that could improve the situation. Women are consistently more engaged in the issue and to a higher extent think it an important issue.

Women are also more in favour of implementing measures and inclined to changing their own behaviour. Especially questions related to mobility and transport behaviour show differences between men's and women's responses, e.g. the study showed that 80 percent of the women were willing to consider driving less to reduce CO2 emissions compared to 66 percent of the men. 75 percent of the women while only 53 percent of the men stated that they were willing to increase their use of public transport to reduce CO2 emissions. The same pattern shows for ridesharing as well as driving at slower speeds to decrease climate change impact.

Our summarised reflection is thus that the presented research results and the data from Sweden supports the idea that women could be important change agents in the efforts to transform the transport sector more in line with sustainability and climate goals.

3. SUSTAINABILITY TRANSITIONS

3.1 Gender Distribution of Representation

Based on the analysis of women's transport behaviour and women's attitude toward sustainability and climate goals in Sweden in the previous section we concluded that there is ground for expecting that women could be the change agents who by participating in the transport sector decisions could support the sector through a transition.

In this section we will map women's and men's representation in a selection of transition decision making bodies in order to discuss more profoundly also the quality of that representation. Gender equality i.e. when women and men are represented on equal termsin decision making is important for reasons of justice and democracy, it increases the democratic quality of decision making which may be particularly important in situations where societal transitions such as is envisioned for climate and sustainability issues. Gender equality is also assumed to increase the quality of transport policy making because knowledge, attitudes and behaviour of women in relation to transport issues is more in line with climate and sustainability goals. In the following we will look closer at gender equality, representation and norms in the transport sector. The empirical samples are from transport agencies in the Scandinavian countries and from decision-making on infrastructure development in Sweden.

While there is reasonable gender parity in the political arena in Sweden, the private sector and particularly many areas of the transportation and energy sectors are dominated by men (*33*). Men with a background in the engineering profession control decisions on transport infrastructure investments (*34*; *pp. 297–299*) and men dominate the transport and energy sectors both in the labour force, the educational system and in management for Sweden (*35*).

A recent study of gender equality in climate policy making in the Scandinavian countries, Magnusdottir and Kronsell (*34*), concluded that women were well represented in decision making positions in political as well as administrative institutions involved with climate issues. This included environment, energy and transport departments. However, it is noteworthy that the only units among those involved in climate policy making explored in the study, that were not gender-balanced are the Scandinavian transport administrations. The Danish Transport Administration has 66 percent male officials and the Norwegian Transnova, has 70 percent male officials, although the management board would be gender balanced, with 60 percent women and 40 percent men.

The Swedish Transport Administration has 36 percent female officials in total. This is a number that has been constant the last three years for the management level, 38 percent of the management consist of women officials. Although, there has been a decrease of the number of women in leadership positions over the last three years, this is not recognized in the yearly report which simply states that efforts are made to increase the number of women in leadership positions (*36*). Gender is discussed by the Transport Administrationonly in terms of assuring that 'the transportation system should respond to both men's and women's transport needs' in a non-discriminatory way (*36*). That the transport

agencies in the three Scandinavian countries were not gender balanced may be an effect of transport issues being masculine coded (*37*).
The Magnusdottir and Kronsell (*34*) study worked with the assumption that gender equality in decision making would also lead to policy changes that would be visible in climate policy documents. Through a text analysis of selected documents it was revealed that none of the documents made any recognition of gender aspects. The documents from gender balanced institutions compared with those from the more male dominated transport agencies, did not reveal any difference in regards to gender recognition. The identical invisibility of gender and lack of gender awareness in all the documents explored was indeed puzzling and suggested that women's presence in policy making makes little difference on the outcomes. This could be because they do not have a different voice than the men or maybe while women are present they are not listened to.

As a way to probe this further we investigate more closely the institutions and how they are organized in relation to gender equality. Our example is from the long-term infrastructure plans, which have important implications for climate and sustainability as they lock the system into certain transport structures for a long period of time.

Every fourth year the long-term infrastructure plans for the Swedish infrastructure investments are updated. The process takes around two years and involves a multifold of actors and levels of decision making as well as actors preparing the decision-support documents. During 2008-2010, long-term infrastructure plans covering national and regional investments in new roads, railway and navigation infrastructure for the period 2010-2021 were developed by the responsible national transport agencies and regional authorities in Sweden. A study initiated by The Network for Women in Transport Policy (Nätverket för kvinnor i transportpolitiken) investigated whether gender balance was achieved in the development of the above long-term infrastructure plans for 2010-2021 by studying the composition of the various groups involved in the infrastructure planning process (3*8*). The study included a mapping of the physical presence of men and women in working and steering groups through a questionnaire. This material was complemented by interviews with a sample of participants in these groups. The purpose of the interviews was to also get a picture of how men's and women's values and preferences have been heard in the process of producing the plans.

The study concluded that the presence of men and women in the process differ regarding different kinds of tasks. In little less than half of the type of groups studied, those participating in the national as well as regional working and steering groups were dominated by men (8 out of 17). In 8 other types out of the 17 studied types of groups there were a gender balanced distribution of men and women (40-60%) but it is mainly in the groups that can be assumed to have less influence over the outcome. There was one type of group where women were in majority and this was working and advisory groups on environmental assessment. In the steering groups, where also the most important decisions can be assumed to be taken, there is no gender balance.

According to Trivector (*38*), there is a strong preponderance of male participants in the groups responsible for the dialogue between municipalities, businesses, and planners in the transport department or county/regional governments. In these groups, interest organizations and other stakeholders are given opportunities to provide feedback on the suggested plans and investments. This opportunity to influence the content of the plans was mostly given to men. Through the interviews it became evident that in connection with the invitations to these meetings the organizations were encouraged to consider gender aspects when appointing their delegates. This appeal to gender aspects was criticized by municipal officials who were inclined to see this as a questioning of their competence in selecting delegates.

Some of the interviews and questionnaires revealed a tendency that the ones that 'are allowed to be involved and think' in these groups should have many years' experience of infrastructure issues, and that this is a reason why it is often men who are appointed and included in such working groups. The officials explained that men, and often older men, have more experience of previous planning processes and are thus preferred to women delegates. Here we note that the call for competence and

experience becomes a conserving element, which leads to the reproduction of gendered patterns as women are considered 'less competent'.

In the literature on gender equality in decision making it is often argued in favour ofmore women on important posts, and the importance of amounting to a critical mass (*39;40;41*)but it has actually been difficult to point to the evidence of substantive effects on policy making, i.e. there is no clear link between a critical mass and critical acts (*42;43*). This is due in part to limitations of thedata and methodology. The researchersexpected that women who also represent sustainable norms and thus, would in this respect be change agents, but the only evidence of this here was that they clustered their presence in those groups that dealt explicitly with environmental issues. This did not necessarily invest them with more power over the process.

3.2 Framing and Understanding of Gender Differences

In a study on Swedish climate policy making from 2011 we conducted 59 semi-structured elite interviews at the national level with civil servants, politicians, interest group representatives (*44*). One of the questions we asked was if a gender perspective was relevant to climate policies. 39 respondents answered this question and among those 8 came from the transport sector. What was most striking about the results concerning the whole group of respondents, was the 'ignorance' and unawareness of the relevance of a gender perspective, in the sense that a majority of policy makers simply did not know, were unsure or could not really say whether it was relevant or not. For those who were more convinced of the relevance of a gender perspective to climate politics, most did not really know what to do about this knowledge in policy making. Neither were they able to come up with concrete examples of policies implemented related to gender issues. The latter may be considered remarkable as Sweden's policy makers have been asked to gender mainstream policies in accordance with regulation starting in the mid-1990s. In another study we asked climate policy makers also in Norway and Sweden, the same question with a similar result. About 2/3 of Norwegian and Danish officials interviewed did not deny the relevancy of gender but most were very uncertain about what gender in climate change entailed, thus they appeared to lack knowledge or insight rather than the will to include gender as a relevant issuein policy-making. Typical expressions were: 'I don't know if gender is relevant, I don't know enough to speak about it with any credibility' (*33*).

This corresponds to results found in the studyinitiated by *The Network for Women in Transport*wherealso overall impact assessment documents were analysed (*38*). Each of these impact assessment documents presents the assessment of a suggested investment object in the Swedish infrastructure plan with respect to the different objectives in the national transport policy. The study examined the overall impact assessment documents for 284 investment objects with respect to how the contribution to the goal of gender equality was described.

Throughout, the assessments on the contribution to gender equality were very brief and often referred to the lack of, or unclear, understanding of these effects. The majority of formulations of the impact assessments were identical to general instructions from the guidance on effects assessment handed out by the Transport Administration (*45*). Very few assessments were based on any form of report or analysis of specific object's impact on gender equality.

It is noteworthy that the standard wording 'The measure is, however, not expected to have any significant impact on gender equality' has been used in so many cases (approximately 80 percent of the impact assessment documents examined), especially since there is no basis for this conclusion. The repeated used and routine use of formulations from the official Guide reveals a lack of knowledge and understanding of what infrastructure investments result in among those who produce these plans.

It does not appear in the overall impact assessments for individual investment objects how gender has been taken into account in prioritizing and balancing of different options. Nor do the overall efficacy assessment of national and regional plans show how gender equality has been considered and applied in the development of the plan. There is no account of how the target of gender equality has been

factored into the selection of the various investments included in the plan, or any decision support that has been the basis for the assessment of the impact of investment or the prioritization of the investments to be included in the plan.

Studies thus indicate uncertainty regarding how gender differences could be framed. On the other hand there are studies showing that knowledge of gender differences regarding travel pattern seems to be spread among policy makers in general and well-known among those in the transport sector. For instance, according to Magnusdottir and Kronsell(*33*), many of the interviewees knew about the gender differences in the transport behaviour of women and men, e.g. that men travel longer distances and with private cars or airplanes while women more often use public transportation and walk. This 'gender difference' was the most frequently referred to among the respondents. There was also some awareness that women and men have different attitudes towardclimate issues. However, it was very difficult for the respondents to know what to do with this knowledge in the context of policy making. One respondent said: 'should men become women, or behave like women?' suggesting somehow that this would be an impossible even ridiculous call.

Through the analysis of the interviews it became evident how policy makers understood gender. A majority of the informants take gender to mean addressing differences in behaviour and attitudes between women and men. They seem to suggest that women and men 'are' different and this leads to different transport behaviour. Others explainedthat gender per se was not so relevant 'women have to use public transportation for economic reasons', stressing that it has to do with economic status, with class and socio-economic relations rather than gender.However, socio-economic relations and class are gendered and part of a gender power order.

In a discussion with one policy maker in the transport field about how these gendered transport behaviours may change, he suggested that a problem to get more men to travel on public transportation, is that 'men demand that things work to a larger extent, otherwise they will switch to the car or choose the plane to travel' and he goes on to explain 'men tire faster if there are delays'. This statement suggests who has power, men expect that society will deliverto their needs and have more confidence and right to expect it to work. Is it the results of the breadwinner model, men are the most important actors as family providers and thus, their transport needs are prioritized? We could ask if it is a sign that the 'male is norm' for the transportsystem, just as it seems to be in society at large as pointed out by feminist researchers. When 'male is norm' it also becomes ridiculous to ask men to transport behave like women.The failure not to address it, simply reproduces the current (gender) landscape, closes the agenda and narrows the actors and the actions considered possible for climate transition.

The understanding and framing of gender differences can also be analysed based on the wording of the Swedish transport policy target regarding gender. The Swedish transport policy target frames the gender policy as 'the transport system should respond equally to women's and men's transport needs'. This has been criticized since it implies that women have different transport needs than men (*38*). Other researchersLarsson and Jalakas (*46*) frame the differences as being consequential of differences in both situation and role. On the other hand in the latest follow-up report of the transport policy targets(25) the following assessment was made: "*In the functional target it is stated that the transport system should equally respond to women's and men's transportation needs. There is nothing to contradict that by large it is so. However, the existing transportation needs are a consequence of differences in gender roles. But, as research indicates that men and women value traveling about the same all else equal, one can assume that in a more equal society would also men's and women's transport needs to be more equal*."

3.3 Change of Gendered Norms

Gender is also part of a normative order which rests on specific constructions of men and women (*10; 47*). The gendered normative order is deeply structural and creates path-dependencies that impact and set some of the conditions for transitions to sustainability. That male is norm and masculinityis normative means that it becomes perceived as natural, given and remains unquestioned. As Raywyn Connell has argued, the gender order does not require any explicit politics to be maintained, the gender order is simply reproduced through this normalization (*48*). Behavioural standards tend to become normative in this way. If the middle-class man is the norm for transport then this does not require an explicit politics. The norms are simply maintained and reproduced within the relevant institutions through daily routine. Paterson (*49*) explains this in terms of the embedded norms of masculinity, of freedom and autonomy in the ecological and cultural economy of the automobile. In other words, automobility and car use has become part of masculine identity and what it means to be a modern man. Thus, when transport planners are trying to get people to move from cars to buses, trains, bicycles and walking, this is not a simple technical change, nor only a re-shaping of daily habits, it is also about identity, a re-shaping of the identity of people moving from a transport mode to another (*49*). It is about the relationship between what we do and who we are.

Also the norm of ’mobility’ is highly structuring for the transport sector and have implication for sustainability and climate objectives. Mobility holds moving at the centrestage. Mobility seems intertwined with modernity and has, not the least through globalization, become normative and an aspiration for modern life (*50; 51*).Because mobility is normative, it is impossible to question ’mobility’ and it is perceived as something inherently good. For example, we see this in the EU White Paper *Transport 2050* where EU sets the stage for transport in the future, by stating that ’Curbing mobility is not an option’ (*52*). Mobility is tied to modernity, globalization, growth and prosperity.Essebo (*53*) investigates the myth of prosperity through a focus on mobility. She concludes that the prosperity myth permeates regional and local mobility processes including legitimization of both past and future infrastructural developments, institutional praxis and the solutions. Other examples of research questioning the ever increasing mobility and the sustainability of regional expansion though means of stimulating economic growth are e.g. Adolfsson Jörby(*54*) and GilSoláandVilhelmson (*55*). The mobility norm must be challenged in the light of a sustainable transition.

Mobilities are also highly gendered. As we already demonstrated in this article with the data on travel behaviour, feminine and masculine transport mobilities are different, this difference acts to reaffirm and reproduce gendered power relations (*56*).The statistics on transportation patterns based on gender difference are often used in planning and when used, are simply projected into the future through the norm of predict and provide (*57; 58*). This means that rather than questioning transport behaviour as revealed through the statistics, a certain transport behaviour (including different patterns between men and women) are taken as given, they become the norm, and may also be normative for future transport planning (*46*) and create obstacles and impediments to attempts towards sustainability transitions.

In a previous section, we concluded that the difference between men and women regarding their transport choices were such that women’s transport choices were more sustainable and we argued that this difference is partly*chosen* rather than *caused by* for example economic status or some features of the transport system. With the insight of the normative dimensions of gender it is necessary to qualify this statement, while the transport behavior of women and men are chosen, the choices occur within a normative framework, where different transport uses relate to masculine and feminine identities and norms of mobility as something inherently desirable, something which is at odds with sustainability and climate goals.

4. CONCLUSION

This paper discusses how climate and sustainability goals can be achieved together with gender equality in decisions of the transport sector.The review of statistics and other research on travel behaviour suggest that women's travel patterns reveal less need for adjustment for the much needed sustainability transition. Women also have a higher acceptance for actions needed on the path towards a more sustainable transport sector. They, moreover, have shown to be more prone to change behaviour than men. The result imply that there are interesting behaviour and attitude characteristics expressed by women that ought to be recognised and appliede.g. through contesting prevailing norms, standards and methods, in order to achieve the climate and sustainability goals for the transport sector.In a situation in need of a transition toward low-carbon and sustainable societies, actions to more actively involving women can be argued to go beyond the ambition to increase the democratic quality of policy making.The result altogether suggests that women should become more active as change agents.

We can thus find strong arguments that women should be further included in the policy making. Still our investigation into the distribution of decision making power between women and men in the transport sector proves to be unequally distributed with an overweight of men. Also when looking at the quality of the representation women are less represented in important decision making bodies.

Our investigation also shows that there is a lack of knowledge, framing and understanding of gender differences among both planners and decision makers indicating that even if we were satisfied with the gender-balanced policy processes, more knowledge and other ways of planning policies and structures are needed.Even though we argue that gender-balanced policy making could improve transition we do not believe this to suffice. In this study we also argue that the articulation of gendered norms is a key issue for climate transitions in the transport sector. Research discussed in this study indicates that masculinity is the accepted norm, deeply embedded in the transport sector and without a gender perspective it is likely that the existing normative order is re-produced. Based on research we argue that there is a prevailing norm within the transport sector of constantly increasing mobility and with a strong focus on the accessibility of cars which if left undisputed will contribute to the preservation of an unsustainable transport system.

There are a number of policy implicationsof the findings in this study. One implication is that measures should be taken to improvefair participation of women and men to the sector activity in order to take advantage of behavioural and attitudinal gender differences.Efforts should thus be made to at least increase the share/number of women in decision making positions. Today the recruitmentprocess is much focused on the 'people that know the business', (mainly men) and this process has to change in order to ensure that disciplines such as gender studies also are represented.

Another implication is that there should be more emphasis on the relationships between travel patterns, sustainability and gendering on all levels in transportation planning. Gender mainstreaming could be used as an approach to monitoring the impacts that policies and programs have on different groups of men and women (*59*).For instance the City of Malmö in Sweden has decided to gender-mainstream the process of developing the city's system of public transport, integrating gender equality into the broader work to achieve sustainable transportation. Other tools that could be applied are gender budgeting, gender planning, various indicators etc.

There is a need to implement new ways of thinking and framing the problems to be solved. The planning norms should therefore be altered in such a way that the norms support the climate and sustainable goals of the transport sector and the society as a whole. Furthermore, research of environmental psychology using theoretical models like e.g. Theory of Planned Behaviour have shown that we do not need to emphasize attitudinal or perceptual change about sustainability per se, rather we need to prioritize the behavioural component e.g. Bamberg *et al*(*60*). These results suggest that the prevailing norms can be broken through implementation of new planning policies and structures which in turn and over time affects the gendered planning norms.

At the same time one has to acknowledge that there is a tremendous complexity in the relationship between travel patterns, sustainability and gendering on all levels. More research is therefore needed but there is also a need to distribute knowledge (new and exciting) so the competence level generally increases within the transport sector.

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Communicating Transportation Carbon Dioxide Information: Does Gender Impact Behavioral Response?

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ABSTRACT
General concern and knowledge on climate change have been increasingly studied over the past decade. Gender differences have been found for general environmental concern and knowledge, but there are mixed findings with respect to climate change. In transportation, research has examined potential relations between environmental attitudes and transportation behavior, with mixed findings as well. Recently, the use of carbon dioxide (CO_2) emissions information to influence choice has been tested with women being found to be willing to pay more to reduce their personal impacts, suggesting that women are either more willing to change or that their response to information on climate change is stronger. However, those studies used CO_2 mass and studies that examined understanding of CO_2information as a mass have found that people struggle to understand it. If concern and knowledge about climate change differ amongst individuals, then, according to theories such as the Transtheoretical Model, the type of information used to motivate choices is likely important. Using a unique data set (n = 236) it is possible to take a first look at how gender might affect concern, knowledge, and action in terms of transportation and climate change. Further, it is also possible to examine behavioral responses to transportation climate change information. Finally, an empirical analysis is conducted of the effect of *how* the information is presented might differ by gender. Thus, this work aims to investigate whether gender differences might contribute to the explanation of individual behavioral responses (from concern to action) in a transportation climate change context.

INTRODUCTION

Environmental concern, knowledge, and action, and the links between them, have been studied for several decades, while general concern about climate change and knowledge on the subject have been increasingly studied over the past decade. Gender differences were reported in such studies; specifically, findings show that women generally having higher concern of environmental issues and conduct more environmental action, though less activism. However, evidence of gender differences on attitudes towards and knowledge of climate change are mixed.

Studies have examined how environmental attitudes might affect daily travel, but have either found that the environment was not considered (*1*), or that higher education was the defining characteristic for those who did (*2*). Despite the considerable role that transportation plays in anthropogenic greenhouse gas emissions (in particular carbon dioxide (CO_2) that contribute to climate change (*3*)), research in transportation has only recently examined how knowledge (through information) of climate change impacts might affect individual's transportation behavior in choice experiments (e.g. *4-6*). In those studies, women were generally found to be more willing to pay to reduce personal emissions.

One problem that likely exists in the provision of climate change information is whether or not it is useful. Useful can be interpreted as providing the individual with information that they can apply to their choices, or as a means to reduce society's overall impacts. Presumably, improving the first could help with the latter. Previous studies on the use of CO_2 as a mass have found that people struggle to understand the information (*7-9*). In those studies, gender influenced results related to *how* the information was presented.

Using a unique data set from the European Commission Framework 7 project Carbon Aware Travel Choices (CATCH; www.carbonaware.eu), it is possible to take a first look at how gender might explainconcern, knowledge, and action in terms of transportation and climate change. Further, it is also possible to examine behavioral responses to transportation climate change information. Finally, an empirical analysis is conducted to study whetherthe effect on behavioral responses of how the information is presented might be explainedby gender. Thus, this work aims to investigate whether gender differences might contribute to the explanation of individual behavioral responses (from concern to action) in a transportation climate change context. The results will be useful for any program that aims to use information to aid in reducing individual climate change impacts in particular those that apply segmentation.

BACKGROUND

Theoretical Considerations

Knowledge and concern do not translate directly into action. This is often referred to as the attitude-action gap (e.g. *10*), where individuals may know and be

concerned about a problem, but not take action. Anable et al. (*10*) discuss how there are two opposing views on this. One suggeststhat if people had the relevant informationthey would behave appropriately (according to knowledge deficit theory), while the other suggests that information is necessary but not sufficient. Their review found that the latter is emerging as the consensus.

There are many different behavioral models that relate to how information might influence behavior (*11-13*). In this work a dynamic model is used as we focus on the process of change from having no concern about a problem behavior to a behavior that addresses that problem.

Transtheoretical Model: Stages of Change

According to the Transtheoretical Model (TTM; *14*) people pass through different stages on the path to behavioral change and different information will be relevant at each stage(*11*). These stages begin with not being concerned about the problem (*pre-contemplation*), then possibly moving to a point where an individual considers the pros and cons of changing behavior (*contemplation*). Individuals may remain for a long time, or even permanently at this stage where they are concerned about the problem, but are not sufficiently concerned that they truly consider changing. They may think about how they might change, but do not take steps to decide what action they will do.

Following that stage, the individual has now decided to do something and must find what possible behavior changes are relevant and decide which ones they might try (*preparation*). In the *action* stage, the individual has decided on an action and is testing it out. This testing may last for many months until they have found something that works for them. Following that they may work to maintain this new behavior (*maintenance*), and finally if they are successful they will reach a point where they conduct the behavior without allocating much cognitive effort to it, like a habit (*termination*).

The Transtheoretical Model is applied in this research in two ways. The first is to measure the research participants'current level of change with respect to climate change. The second is to measure the level of their reported motivation to reduce car use in response to information. These two applications are detailed in the *Method* section.

Gender-related potential differences in environmental concern, behavior, and response

In this section a review of relevant background literature is given along with the hypotheses (based on previous work and theory) to be tested.

Environmental Concern

Environmental concern is generally defined as "*an individual's insight that humans endanger the natural environment combined with the willingness to protect nature*" (*15*). It is considered to be composed of two primary components: a cognitive one and a conative one (ibid). However, environmental sociology also takes into account an emotional reaction (affective component) (ibid) which has been found in previous research related to climate change (e.g. *16, 17*). The cognitive component relates to knowledge, the conative one to action, and the affective one to emotional connections. Responses to environmental threats "*appear to be largely determined by interactions between people's cognitive and affective psychological mechanisms*"(*18*).

Women are generally found to have more concern than men for environmental problems (*19*) and this concern is stronger at a local level than a national one (*20*). For climate change, women have been found to have slightly more concern than men in the USA (*21*), while in Europe men were found to have higher concern (*22*). In the UK, men have been found to be more likely skeptics of climate change (*23*). Thus it is not clear, from an international perspective, which gender, if any, would have more concern about climate change.

Unlike other environmental problems such as garbage, water pollution, or acid rain, people in western-developed countries have been found to believe that climate change is temporarily and geographically distant (*24*). In general, this reduces concern and action. However, altruistic tendencies might reduce this negative psychological impact. Women have been found to be more altruistic, which is argued to be due to social factors relating to their upbringing (*25* in *19*; *21*). In environmental sociology research from the USA (e.g. *26*), this relates to relevant aspects such as increased attention on impacts on others. According to Stern et al. (*19*), "*women have stronger beliefs than men about consequences for self, others and the biosphere*." If women have greater altruistic tendencies and increased attention on impacts to others and the environment, then this should result in generally higher concern (*H1*). However, a meta-analysis of altruism and gender found inconsistent findings (*27*). With respect to those findings, some research has found that women are more altruistic when the costs are higher, and men when the costs are lower (*28*).

H1: Women, as an aggregate, will report greater concern about climate change, as an environmental problem, than men.

An increase in the level of educational attainment is generally linked to greater environmental concern (if not environmental behavior) (*15; 29*). Internationally, this was found to be true (*15*). However, findings are not consistent. For climate change, Clements (*23*) found lower education to associated with greater skepticism in the UK;Kellstedt et al. (*30*) found no relation between education and concern in the USA;and finally, McCright (*21*) reviewed work that found education to be negatively associated with concern over climate change among the American public.

H2: Higher education will be associated with less concern about climate change.

A country's development stage and GDP are associated with higher levels of environmental concern about climate change. However, they are also associated with higher levels of GHG outputs. Franzen and Vogl (*15*) in a study of 33 countries found that attitudes towards global environmental change differed greatly, with the more affluent countries having higher concern[1]. However, environmental concern is not necessarily related to environmental action, as Canada had the second highest level of concern (behind Switzerland), but is one of the worst per-capita greenhouse gas emitters. One study suggested that although affluence and education were associated with greater concern, they were also associated with increased per-capita CO_2 emissions (*29*).

H3: Residents of developed countries will have higher concern for climate change.

Environmental Knowledge

There are conflicting thoughts on the role of knowledge on concern. The theory of knowledge deficit suggests that having higher knowledge increases concern and this has been found to be true for actual (as opposed to reported) knowledge of climate change (*31*)[2]. Research in the USA has found that men generally have higher knowledge of science, and higher confidence in their knowledge (the latter may be related to the former)(*21*). Due to those general findings, women are expected to have lower knowledge on climate change (as a group). However, recent findings (ibid) in the USA for climate change knowledge suggest that a difference may not exist.

H4: Women, as an aggregate, will demonstrate a lower level of knowledge on climate change as relates to transportation than men.

Environmental Action

As mentioned above, concern and action are distinct, and as the adage goes, "actions speak louder than words" this section will discuss differences between individuals for environmental action.

Research has found that women generally do more local or private environmental behaviors such as recycling, while men are more likely to do more public behaviors such as activism (*32; 33*). However, this may be related to "biographical availability"

[1]It should be noted that individual differences *within* a country will be larger than averages across countries.

[2]However, other findings suggest that there is an inverse relationship between knowledge and concern. The "Environmental Knowledge" hypothesis (*24*,*29*) suggests that knowledge differences in science helps explain differences in environmental concern. Kellstedt et al. (*29*) argue that higher knowledge may relate to a stronger science interest and belief that science will find a solution to climate change. Swim et al. (*23*), who report findings from the American Psychology Association, argue that people with greater knowledge and wealth feel that they can avoid/escape the problems of climate change.

(*32*), where women often retain greater responsibilities at home, limiting their available time to participate in such public behaviors.

H5: Women will demonstrate more environmental behavior than men.

In terms of car use, women typically do not travel as far on average, and often have lower access to a car (e.g. *34; 35*). This would, from an environmental perspective, mean that women's travel patterns are more environmentally friendly (if not environmentally benign in numerous developed countries). Segmentation analyses of various European populations have found mixed differences in driver behavior with respect to environmental concerns and attitudes (*1; 2; 36*).One paper used the term "aspiring environmentalists" to refer to people who wanted to reduce their car use due to environmental concerns (*2*). However, that group's defining socio-demographic characteristic was having higher education. Beirao and Cabal (*1*) found that neither gender was inclined to consider the environment when making transportation decisions. For Anable (*2*), the one group that was dominantly female, was the "reluctant riders" who were also most likely to be retired (and over age 65)[3], here supported by findings by Beirao and Cabal (*1*) which found that men had more positive attitudes towards public transport.

H6: Women, as an aggregate, will not use cars as much as men.

Behavioral Response to Transportation Climate Change Information
The last aspect of this research deals with how individuals might respond to transportation climate change information.

Research on habits suggests that people who have a mixed-use transportation profile are more likely to change behavior (*37*). In general, it would be expected that people who usually use other modes would be more likely to have higher behavioral response (BR) to change car use. Further, in relation to *H6*we expect women would be more likely to change travel behavior in response to climate change information.

H7: People who do not report using a car as their usual mode of travel, will be more likely to report being motivated to change travel behavior.

Women are generally found to be more risk adverse than men in a general, non-transportation context (e.g. meta-analysis (*38*); or 22,000 person study in Germany (*39*)). This suggests that for a problem such as climate change, which poses a risk to people, they mightattempt to reduce such risks. Research on risk and climate change has found that women are more fearful of the risks of climate change (*30, 40, 41*). For environmental concerns, findings have shown that when the information explicitly taps risk perceptions, women express more concern than men (*21*).We therefore expect that women should have a stronger reaction to information that more clearly communicates a risk.

[3]It should be noted that in the UK, elderly people can use public transport without charge.

H8: Women will have stronger responses than men to climate change information that is framed as a risk.

Differences have been found in concern about climate change between developed and other countries with findings generally suggesting that people from developed countries are more concerned (*15*). However, psychological research suggests that people in wealthier nations feel that they are more resilient or could escape the problems of climate change (*23*). Further, climate change impacts are predicted (*42*) to be more damaging to less developed countries (related to location, infrastructure deficiencies, and financial capacity to deal with impacts). Thus, despite having less concern about climate change in general, people from less developed countries may respond to climate change information more strongly as they may feel more vulnerable to the negative impacts. It is not clear what the impact of gender might be with respect to different countries' development levels.

H9: People of each gender in transition countries (despite potentially having lower concern), will have stronger responses to climate change information.

As discussed above, TTM argues that first people need toaccept that there is a problem, and then convince themselves to try a new behavior. People who have already convinced themselves of the need to reduce their climate change impacts should be more likely to respond to climate change information related to their behavior (this would be also supported by the need to reduce the so-called 'cognitive dissonance' (*43*) between two cognitions, in this case people's behavior and their attitudes). Previous research has not considered the level of climate change concern when comparing genders. The impact of climate change concern within each gender is therefore examined.

H10: People of each gender at higher levels of environmentalism should have stronger responses to information on climate change.

Finally, with respect to TTM and the cognitive dissonance theory,and following from environmental concerns and environmental action, we expect that women will have higher BR than men.

H11: Women will have stronger responses to climate change information.

METHOD

Surveys were distributed at work places in five countries associated with the Carbon Aware Travel Choices project (CATCH; www.carbonaware.eu) (n=236; w_{omen}=102; n_{men} = 134). Two of the countries (Brazil and China) can be considered transition countries, while the remaining three (Great Britain, Italy, and Spain) are considered developed countries. Questions tested general knowledge on CO_2emissions related to transport (mix-and-match style), giving a sustainability rating to CO_2information presented in different formats (see below), and behavioral

intention questions related to changing car use[4]. Demographic questions included age, gender, education level, and income level. Transportation questions related to usual mode, and the perceived usual modes of friends, family, community, and city. Respondents were asked whether they performed other daily environmental behaviors: normal (recycling), and less common (composting). Finally, a question asked about the participants' level of environmental stage of change (based on the Transtheoretical Model; ESC) with respect to climate change.

Country development

The three developed countries contained in the data used for this research were included in the Franzen and Vogl study discussed above (*15*), but the two transition countries were not. Spain, Great Britain, and Italy were in the middle of the table, but towards the bottom of the developed countries. Of the transition countries, only Chile had higher concern than those three. We therefore expect that concern should be higher for the developed countries in this study.

Formats: how the information is presented

Four different formats (see Table 1) were used in this experiment: mass, tree-equivalent, earth-equivalent, and carbon-budget. The mass of CO_2 was included as it is the scientific measure and an example of simple information content without either environmental or emotional contextual information. It is the most commonly used format for the results of on-line carbon calculators (*13*). The tree-equivalent format was chosen as a common equivalent that related to the carbon cycle and was associated with environmentalism. It represents a contextualized format that should contain an emotional context, but with less analytical basis (as it lacks a clear limit). The earth-equivalent format was chosen as it was based on a concept of equality, (was believed to) clearly conveyed sustainability and was used by well-known environmental groups such as the 'World Wildlife Funds' Footprint calculator (http://footprint.wwf.org.uk). It represents a contextualized format that is more analytical than the tree-equivalent format as it suggests a limit and has emotional associations. To examine the effect of contextual information void of emotional associations a carbon-budget format based on a fictional limit was included. The limits in the carbon-budget and earth-equivalent formats were the same.

TABLE 1 Formats and information presented in the experiment

Format	**Information presented**
Mass	4 tonnes of CO_2
Tree-equivalent	
Earth-equivalent	
Carbon budget	111% of your carbon budget

[4]The full survey results can be found in (*17*)

Applications of the Transtheoretical Model
To measure the participants' current environmental stage of change (ESC) they were asked to choose a phrase related to concern and action that best described them. These four choices were (TTM relevant levels are given in brackets here, but were not given in the study):

1) 'I don't worry about climate change' (pre-contemplation);
2) 'I worry about climate change, but don't know what to change' (contemplation);
3) 'I worry about climate change and I am planning to reduce my impacts' (preparation);
4) 'I have made changes in the last year to reduce my impacts' (action/maintenance).

Thus it will be possible compare whether there is a difference not only in concern, but also how developed is their behavior change path.

The second application of TTM was for the behavioral responses (BR) to transportation CO_2emissions information. The participants were given these response choices to choose from (again, TTM relevant levels are given in brackets, but were not included in the study):

1) Change nothing (pre-contemplation);
2) Consider a change in the future (contemplation);
3) Change how you got around (check all that apply): reduce trips by car; shorten trips; change vehicle (e.g. better mileage); or stop driving. (preparation/action)

Analyses of hypotheses
For the hypotheses on *concern*, results from the ESC are used where the first level is taken as *not concerned*. For the hypotheses on *knowledge*, the results from the matching exercise are used. With respect to *environmental behavior*, participants' responses to recycling, composting, ESC level, and usual travel mode are used.

For the hypotheses on *behavioral response*, higher-level responses (e.g. change how you get around) will be compared for each format (mass, tree-equivalent, earth-equivalent, and carbon-budget).

RESULTS
The descriptive statistics for the dataset used are shown in Table 2 while the results of the analysis on the hypotheses related to concern and knowledge are shown in Table 3. For non-parametric analysis (e.g. categories and number), a χ^2 test was used. For parametric analysis (e.g. percentages) with categories, analysis of variance (ANOVA) was used. In Table 3, hypotheses that were analyzed intra-gender are shown with the suffix "*.w*" for women and "*.m*" for men. The final table, Table 4, shows the percentage of individuals who responded to the transportation

CO_2emissions information with the highest grouping of behavior change (i.e. change how you get around).

TABLE 2 Select descriptive statistics for the dataset (n=236).

Measure	Female (n=102)	Male (n=134)
Age (years)	37.5 (+/- 12.4)	38.6 (+/- 12.1)
Have higher education	74.5%	78.4%
Usual mode is car	64.7%	62.7%
Environmental Stage of Change		
- No concern	10.6%	11.0%
- Concerned but don't know what to do	28.7%	25.2%
- Will do something soon	22.3%	40.9%
- Have done something in the last year	38.3%	22.8%

TABLE 3 Results for hypotheses related to concern, knowledge, and environmental behavior. Suffix *w* (women) and *m* (men) are used to indicate intra-gender analyses (n=236).

Hypothesis: A/B	Measure	A	B	Interpretation and implications
H1: women/men	Concern	89%	89%	H1 *rejected*◆. Both genders have equal levels of concern (ESC) with respect to climate change.
H2: normal/higher education	Concern	86%	90%	H2*rejected*. People with higher education showed a tendency to be more concerned.
H2.w: normal/higher education	Concern	83%	91%	H2.w *not supported*. However, possibility that a larger sample would be significant.
H2.m: normal/higher education	Concern	89%	89%	H2.m *rejected*. Results were equal.
H3: transition/developed*	Concern	96%	85%	H3*confirmed*. Residents of transition countries were statistically more likely to be concerned.
H3.w: transition/developed	Concern	94%	87%	H3.w *not supported*. Female residents of transition countries were more likely to be concerned, but not statistically so.
H3.m: transition/developed*	Concern	98%	84%	H3.m *confirmed*. Male residents in transition countries were statistically more likely to be concerned.
H4: women/men	Knowledge	46%	46%	H4*rejected*. Men and women both struggle to rank different travel scenarios by their CO_2 emission amounts.
H5.recycle: women/men	Recycle	74%	70%	H5.recycle *rejected*. Women were not statistically more likely to recycle in this sample.
H5.compost: women/men	Compost	30%	27%	H5.compost*rejected*. Women were not statistically more likely to compost in this sample.
H5.ESC_4: women/men*	ESC_4	38%	23%	H5.ESC_4 *confirmed*. Women were more likely to report having done something, implying that they are further along the behavioral change stages (TTM).
H6: women/men	Travel mode	65%	63%	H6*rejected*. Women reported that the car was there usual mode of transport as often as men in this sample. However, distances and frequencies were not requested.

◆*rejected* = Not statistically different and difference was less than 5%; *not supported* = not statistically different, but difference was greater than 5%; *confirmed* = statistically different $p < 0.05$.
* $p < 0.05$

TABLE 4 Percentage of each segment that reported a higher behavioral response (BR; a change in car behavior) across the four format types.

	Gender	Secondary division	n	Mass (g)	Trees	Earths	Carbon-budget
H8, H11	Female		102	64%	78%	76%	82%
	Male		134	66%	82%	72%	80%
H7	Female	Other mode	35	80%*	91%*	85%	91%
		Car	50	52%*	68%*	70%	76%
	Male	Other mode	50	77%*	89%	84%*	84%
		Car	84	58%*	77%	63%*	77%
H9	Female	Transition country	31	77%*	87%	81%	87%
		Developed country	71	56%*	72%	74%	80%
	Male	Transition country	47	85%*	89%	83%*	89%*
		Developed country	87	50%*	76%	63%*	72%*
H10	Female	ESC_low	37	52%	68%	67%	74%
		ESC_high	57	70%	80%	78%	85%
	Male	ESC_low	46	48%*	79%	61%	73%
		ESC_high	81	74%*	85%	77%	85%

* $p < 0.05$

DISCUSSION

Concern, knowledge, and current action

Following previous findings on concern and knowledge of climate change (*21*), sizeable differences between men and women were *not* found. This is in contrast to other findings on general environmental concern (e.g. *15*, *19*). From our sample, education was not found to have a significant impact on concern. It is notable that the only variable to have statistical significance was the country of residence's development stage with residents of transition countries more likely to report at least some concern. Thus, from our findings, it appears that the more difficult task relates to improving concern in the "problem" population where greater emissions per capita occur.

While a deep knowledge of climate change was not tested, a simple matching exercise (five items) was used to determine whether people could match a CO_2 amount to a transportation mode. Men and women had equivalent results, suggesting that they had equal levels of knowledge (both "failed" on average) in this sub-category of climate change concern. Thus, our findings suggest that although people know generally about climate change and are concerned, most do not have sufficient knowledge to make informed decisions about transportation choices to reduce climate change impacts.

The differences between developed and transition countries' residents were mixed and different between the genders. In both genders, residing in a transition country was associated with greater levels of some concern (though not statistically so for women). That finding is contrary to previous findings on differences between countries (*15*). As there was a high percentage of people with higher education in both country types (81% in transition countries, 75% in developed), this may be a

result of the sample group not being representative of the respective countries, but offering a comparison of similar groups across the countries.

Our sample group did not show any difference between the genders in general household environmental behavior (recycling, composting). However, in a larger sample, the tendencies found here could be statistically significant. For transport, women in our sample were not less likely to report usually using cars to travel (we did not measure overall frequency or distances). This result may be related to surveying employed people who generally had finished higher education degrees. The results suggest that recycling behavior is more developed, though arguments could be made that is an "easier" (in terms of infrastructure and time) environmental behavior that occasionally has direct financial reward (e.g. deposit refund for returns).

Women were found to be statistically more likely to report having done something to reduce their climate change impact with nearly 40%. This suggests that although the percentage of concerned individuals was not different between the genders, women in this sample were further along the TTM path of behavior change suggesting that they have accepted the problem, investigated ways to address it, and applied one of those. Considering that most gender studies on environmental behavior are decades old, it may be the case that at the time of previous studies recycling was a less common activity, so the findings at the time reflect those found here for the next environmental behavior paradigm. Thus, our findings suggest that although considerable work remains to reduce climate change impacts, it is men who require additional help to reach the action stage of change.

In summary, for concern, only the country of residence's stage of development resulted in significantly different results. There were no differences found for knowledge between genders. For action, women report having done something to lower their climate change impact.

Behavior responses to how the transportation CO_2 information is presented
No statistical differences were found between the genders for any of the formats, thus rejecting *H11*. Differences in BR for the earth-equivalents format were minor, thus *H8* is rejected as well.

In both genders, individuals residing in transition countries were more likely to have a high BR to the information thus confirming *H9*. Findings were statistically significant for mass (women, men), earth-equivalents (men), and carbon-budget (men). In general, the percentage differences were larger for men, with men from developed countries being the least likely to report high BR to change their car use. Women from developed countries reported the highest BR for the analytical format of carbon-budget, while men from developed countries reported their highest BR for the emotional tree-equivalent format (see Waygood and Avineri (*16*) for an analysis from an analytical-emotional perspective). For both men and women in transition countries, those two formats (tree and carbon-budget) were equally most

effectiveat stimulating high BR. Thus, our findings suggest that the type of format can impact BR, but it is not possible to say from these results that there is a "best" format for improving BR.

People who reported using other modes were more likely to have reported higher BR. This is perhaps not surprising considering that the BR question related to car use. Within in this subset, women's responses were statistically different for mass and tree-equivalent formats. For men it was mass and earth-equivalent formats. For both women and men who reported usually using cars, the carbon-budget format resulted in the highest BR (for men it was tied with the tree format). For women and men who usually use other modes, the tree-equivalent format had the highest BR (for men it was tied with the carbon-budget format). Regardless of their usual mode, all of the formats with some context (tree-equivalent, earth-equivalent, and carbon-budget) resulted in most people reporting high BR. Thus, in terms of the "problem" behavior of usually using cars, the carbon-budget format is the most effective.

For ESC, people reporting higher levels were found to have higher BR, but only statistically so with men for the mass format. For women reporting low ESC, the format had the highest BR, while for men with low ESC the format tree-equivalent was best. For women and men who reported high ESC, the carbon-budget format was the best (though it tied with the tree-equivalent format in men). Surprisingly, the earth-equivalents format only performed better than the contextless mass format. Thus, it appears that as long as some context is given, the impact of being further along an environmental stage of change on BR is negligible.

In summary, a number of important findings are reported here. First, although women and men had similar rates of high BR for each format, differences were evident when intra-gender analyses were conducted suggesting that intra-gender heterogeneity is an important consideration. Second, people from transition countries more frequently reported high BR. Third, even if a person usually used a car to get around, they reported high BR, in particular for the carbon-budget format. Fourth, ESC showed that when people are not already concerned, how poorly the most commonly used format of communicating CO_2 information, mass, was at stimulating a high BR. Finally, considering the results for usual mode and ESC, CO_2information with some context resulted in most people reporting high BR suggesting that if given useful information on climate change people might change their behavior to reduce their impacts.

Recommendations related to findings

1) Provide context-based CO_2 information that relates to a recommended limit to facilitate informed decisions and motivate BR towards less damaging behavior.
2) Focus efforts on changing the behavior of men, particularly in developed countries as they are both the greater problem segment and the less motivated to change.

Limitations

This research examined mostly employed individuals and had a high percentage of participants with higher education, thus it is not a representative sample of the countries. It is however an examination of similar socio-demographic groups across the five countries. This research did not examine actual behavior response, so the potential for socially acceptable responses exists. As well, the ESC was self-reported and it is not clear whether what change the individuals had made and whether it actually reduced their climate change impact. A larger sample size would improve future research.

CONCLUSIONS

A gender analysis was conducted on results from a transportation-related climate change survey containing questions on concern, knowledge, action, and behavioral intention responses to reduce car use. Confirming previous findings related to climate change, differences between men and women on general concern and knowledge were not found. However, looking at action and not just concern, women were more likely to report having done something to reduce their climate change impact, thus suggesting that they are further along the stage of change sequence. The usual mode of travel was found to significantly influence the degree to which transportation climate change information motivated a transportation behavior change. People who live in transition countries showed greater concern, and men in developed countries reported lower intention to change behavior for all information formats; women only reported lower intention for the context-less format of mass. Finally, only for men was an individual's environmental stage of change with respect to climate change concern and behavior significantly related to intentions to change behavior in response to contextless transportation CO_2 emissions information. All results suggest that CO_2 emissions information with some context could lead to personal behavior change to reduce climate change impacts and that men in developed countries require the greatest efforts to reduce their impacts.

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The gendered complexity of daily life: effects of life-course events on changes in activity entropy and tour complexity over time

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The gendered complexity of daily life: effects of life-course events on changes in activity entropy and tour complexity over time

This paper studies changes in the complexity of activity patterns (measured by Shannon entropy) and trip chaining patterns following life course (and accessibility) related key events from a gender specific perspective. It is theoretically informed by the mobility biographies approach and by gender/travel studies. The data used is the German Mobility Panel (GMP) 1994 to 2010 in which households and their members are asked three times in three subsequent years to report the trips they made over a week. Changes made from one year to the next are regressed to key events over the life course, cohort effects and period effects, while sociodemographics, residential and workplace spatial context attributes are controlled. A cluster-robust regression approach is used to account for the non-independent character of panel observations. Significant effects were found for some key events, including the birth of a child, entry into the labour market, and changes in spatial context, accessibility and mobility. Some effects differed distinctly between men and women, suggesting that men and women are differently affected by life course events. However, taken overall the associations found, as well as their gender specifics, are rather limited. Hence, key events over the life course seem to be only loosely associated with the complexity of activity and trip patterns.

Keywords: activity pattern, mobility biography, gender, key event, trip chain complexity, travel behavior change

1 Introduction

It has long been argued that women's daily lives are far more complex than men's. The reasoning behind this claim is that women tend to be committed to multiple duties to a greater extent than men; such duties include employment, housework, and caregiving for children, the elderly or other persons in need (MacDonald, 1999). Hence women juggle a multitude of activities over the course of a day, many of which take place out of the home and are thus linked to trip-making. This has substantial consequences for their travel patterns. Firstly, women travel shorter distances than men on average (Crane, 2007; Scheiner, 2010), which may be due to the spatial ties imposed on them by household work and caregiving duties. Secondly, women tend to organise their trips into more complex trip chains than men to gain efficiency in travel patterns (Strathman/Dueker 1995, Wegmann/Jang 1998, Cao et al. 2008, Paleti et al. 2011). Thirdly, more varied activities suggest that women have more complex activity spaces than men, involving more 'anchor points' such as the home, the workplace, or children's school(s) or nursery. Fourthly, complex activity and associated travel patterns may encourage women to use flexible modes of transport such as the car to juggle all their duties (Dobbs 2005).

On the other hand, this picture is not equally true for all women and men. Couples with children, particularly those with infants, tend to exhibit a strongly traditional division of labour (Grunow et al., 2012), with the husband being the primary wage-earner, while the wife is responsible for the multitude of social and maintenance tasks outlined above. For couples without children the picture is different. They typically show more modern, sometimes close-to-equal patterns of activities (Grunow et al., 2012, Scheiner, 2013). Single households do not exhibit any division of labour at all, but they are nonetheless known to have different activity and trip patterns depending on gender (Taylor and Mauch, 1997).

These considerations suggest that the complexity of activity and travel patterns changes over the life course as an outcome of life course related key events. The most researched example in this respect is the birth of a child which typically goes along with a 're-traditionalisation' of gender roles among couples, even among those who pursued relatively equal work-sharing before (Grunow et al., 2012). The changing travel patterns induced by such key events have been studied in the past decade under the label 'mobility biographies' (Lanzendorf, 2003; Scheiner, 2007).

This paper employs this mobility biography approach from a gender perspective. The focus of interest is changes in complexity of activity and travel patterns as an outcome of key events. Gender is accounted for by using interaction terms. Complexity is measured by two variables: an entropy measure of activity patterns and the number of trips per tour as a measure of trip chaining. Both variables are constructed from trip diaries completed for a whole week by a nationwide sample of respondents from Germany. The data span the period from 1994 to 2010. A companion paper (Scheiner, submitted) focuses on mode choice changes.

The next section introduces the state of the research. This is followed by a description of the data, the modelling approach and the variables used. Subsequently the results are presented, starting with an overview of cross-sectional figures of complexity, moving on to descriptive analysis of change in complexity, and ending with two regression models of activity pattern entropy and tour complexity. The paper closes with some conclusions for further research.

2 State of the research – gendered complexity of daily life

2.1 Activity patterns

Empirical studies of gender differences in activity patterns are so numerous that they cannot be reviewed here in detail. Most of these studies compare mean values and proportions of time allocation to different activities between men and women (McGinnity/Russell 2008, Anxo et al. 2007 in a lifecycle perspective). Many also use regression modelling or other more complex techniques to isolate the impact of gender from other factors. Most often they focus on housework (Bianchi et al. 2000, Treas/Drobnic, 2010; Grunow et al. 2012, Farrell et al., 2012 in a review, Mencarini/Sironi, 2012). Employed work is often considered simultaneously (Gershuny/Kan 2012, McGinnity/Russell 2008, van der Lippe et al. 2011), while leisure is considered in relatively few studies (Anxo et al. 2007, Hilbrecht 2009).

The general finding is that there is little gender inequality in terms of total workload including paid (employed, marketed) and unpaid (non-marketed, household/family) work (Gille and Marbach 2004 for Germany). More distinct differences emerge when paid and unpaid work are considered separately, with men taking on disproportionate shares of paid work and women disproportionate shares of unpaid work.

The number and age of children are consistently identified as key impact factors of worksharing, with mothers' family obligations increasing with the number of children, and decreasing with the age of the youngest child (McGinnity/Russell, 2008; Scheiner, 2013).

Gender differences in activity patterns have been observed to converge over time in various countries (Fisher et al. 2007 for the USA, 1965-2003, Gershuny/Kan 2012 for 12 countries, ca. 1961-2004, Bianchi et al. 2000, for housework in the USA, 1965-1995, Sayer, 2010 for nine countries, ca. 1965-2003). In Germany, time use for unpaid work among men increased over the period 1991/92 to 2001/02, and so did time use for paid work among women (Gille and Marbach 2004). Women's relative overload in terms of unpaid work (odds ratios women/men) consequently declined considerably from factor 1.7 in 1991 to 1.4 in 2001. Nonetheless, gender

specifics in the division of work still exist around the world (Baxter 1997, Sayer 2010). Virtually no changes could be detected among parents in Germany (Gille and Marbach 2004). Mothers make a constantly above-average contribution to unpaid work. There may be some self-selection in this finding in that those women and men who maintain more traditional norms may be more likely than others to found a family.

Gender convergence has also been observed in the distributions of activities over the day and the week. This means that women's temporal distribution of activities over the course of a day is becoming more similar to that of men (Fisher et al. 2007).

Measuring complexity in activity or trip patterns is far from straightforward and involves more than considering just the degree of participation in activities or trips. One possibility is to study multitasking. Bianchi et al. (2007) found that married mothers report more frequent multitasking than married fathers, using multitasking as a strategy of time-management to juggle multiple duties. This result was based on self-report and, hence, may be biased by subjective considerations of multitasking. However, there is similar evidence of this gender gap in time use diaries. Gille and Marbach (2004) construct an indicator of turbulence from the variety of activities undertaken during a day, the number of transitions between different activities, and multitasking (activities undertaken simultaneously). They find that women's daily lives are considerably more turbulent than men's. Additionally, Offer and Schneider (2011) find that fathers multitask about 35% of their time (sleeping time excluded), compared to 43% for mothers, and the types of multitasking mothers typically perform appear to be more strongly associated with negative affects and stress than those of fathers.

Another way to study complexity would be to focus on fragmentation of activity patterns. Fragmentation means "the disintegration of activities into smaller sets of acts that can then be performed at different times, differents locations, or both" (Alexander 2011, 678), which may make activity patterns more burdensome and/or more difficult to schedule. Lenz and Nobis (2007) cluster a sample of German respondents according to their travel, work schedule and use of mobile devices to find out about the level of fragmentation of activities. They find the highest proportion of women in a cluster of 'conventional part-time workers' with little fragmentation. Alexander et al. (2011) study a number of different spatial and temporal measures of fragmentation in the Netherlands. The few significant gender differences they find suggest somewhat more fragmentation among men than women.

Spatial and temporal fixity of activities may also contribute to complexity in scheduling. Based on a time-geographic approach in the tradition of Cullen and Godson (1975), Schwanen et al. (2008) find that women coordinate and negotiate more space-time fixity constraints than men. This is not because women consider childcare or maintenance work to be more binding than men, but because they engage in such activities more than men. From trip chain analysis, one may derive similar conclusions (see below).

There are a number of theoretical explanations for such gender differences in complexity. Probably the most important single factor is the increasing female labour force participation that can be observed in various countries (Dustmann 2005). This shift from the male-breadwinner-and-female-housewife-model to more modern arrangements (Farrell et al., 2012) does not necessarily result in more equal gender relations. As long as men continue to pursue their careers without contributing to filling the gap in caregiving and housework, it rather leads to women's 'double burden' or 'second shift' (Hochschild/Machung 1989).

Gender norms and preferences are also likely to play a substantial role. Taylor and Mauch (1997) show that even in single households women shop more often than men, and trace this finding back to socialisation effects. Alternatively, it may be subject to preferences for certain goods (such as healthy food which has to be purchased freshly). The somewhat leisure-like character of

shopping may also play a role, although not for grocery shopping (which was the focus of this study). Fortin (2005) finds evidence in a cross-national study of 25 OECD countries that women's participation in the labour market and their earnings depend strongly on gender norms which in turn are shaped by socialisation. These norms include perceptions of women's homemaker role, attitudes towards gender equity, and inner conflicts between family values and egalitarian views ('mother's guilt').

Another explanation is more biological in nature. Mäntylä (2013) studies gender differences in the capability to multitask in an experimental study. He traces these differences back to biologically determined cognitive spatial abilities.

2.2 Trip chaining

Individuals organise their daily trips in tours, i.e. sequences of trips starting and ending at home. Tours involving an outbound plus an inbound trip are typically conceived as simple tours, while tours involving more than two trips (or more than one stop) are considered complex (see Section 3.3 for a discussion of definitions).

Trip chaining has been a topic of inquiry for decades in transport studies (see Hanson 1979, Damm 1979, Thill/Thomas 1987 for early reviews). Organising trips in complex chains is typically considered to serve efficiency in travel or, to put it another way, to minimise the disutility of travel (Chen 1996, Spissu et al. 2007). For instance, people who have more than one job tend to link non-employment activities in their work-to-home tour (Castro et al. 2011). By reducing total travel time, trip chaining contributes to increased accessibility (Chen 1996). Over time, trip chaining has increased considerably (Levinson/Kumar 1995 for the period 1968-1988; review in Currie/Delbosc 2011).

Several variables have been found to impact people's propensity to chain trips, including social circumstances, the spatial environment, and the transport system. Trip chaining is linked to mode choice, but the direction of causality is not clear (see discussion in Ellison/Greaves 2010). It is typically assumed that the complexity of trip chains impacts mode choice (Hensher/Reyes 2000; Krygsman et al. 2007). Complex chains are considered less suitable for public transport use due to its limited flexibility (Currie/Delbosc 2011, Mousavi et al. 2012, Bhat/Sardesai 2006, Hensher/Reyes 2000, Strathman/Dueker 1995, Krygsman et al. 2007). However, Mohammadian/Frignani/Auld (2011, 59-60) find that public transport is more prevalent in complex than in simple trip chains (likewise: Primerano et al. 2008).

There is consistent evidence that women are more likely to make complex trip chains than men (Paleti et al. 2011) both with respect to job tours and non-job tours[1] (Strathman/Dueker 1995; in data from Switzerland Ye et al. 2007 find no gender effect on complexity in non-job tours). As people typically link different types of activities in a chain, a large part of research attention is devoted specifically to the links between employment and non-job trips. Studies show that female employees are more likely than their male counterparts to use a complex job trip pattern, i.e. they are more likely to stop on the commute (Wegmann/Jang 1998, Bhat 1999, Cao et al. 2008).

Men and women also differ in terms of the types of trip chains undertaken. Men undertake more simple employment or education trip chains and more complex chains involving employment, while women undertake more simple shopping and escort trip chains, and more complex chains involving shopping and/or leisure purposes, but not employment (Primerano et al. 2008).

[1] These two types are mostly named work and non-work trip chains in the literature. However, the term 'non-work' masks that this type of trip chains includes much unpaid work, such as shopping, errands, and escort trips.

Krygsman et al. (2007) point out that women are much more likely than men to take responsibility for social functions such as serving passengers on their commute. As such purposes are highly constrained (e.g. by school or daycare start and end times), one may suspect that women are less flexible than men in their travel patterns (McGuckin/Nakamoto 2005). Mohammadian/Frignani/Auld (2011) add that working-age women make more complex chains than their male counterparts, but within complex chains men make more stops than women.

Distinguishing age categories, Mohammadian/Frignani/Auld (2011) find that elderly women are just as likely as elderly men to perform complex trip chains. Conversely, Schmöcker et al. (2010) find the expected gender gap in complexity among the elderly in London.

In a SEM study Golob/McNally (1997) show gender-specific interactions between two partners in a household in terms of participating in certain activities, thus affecting the gendered complexity of patterns. They also corroborate the finding that women make more complex trip chains than men (likewise: Kuppam/Pendyala 2001 with a focus on in-home v. out-of-home activities).

Perhaps their more complex patterns are the reason why women "tend to be more structured in terms of how the week is planned" (Lee/McNally 2006, 553). However, comparing activity scheduling with realised activity behaviour reveals that many trip chains are formed 'as opportunity knocks' while being out of the home (Lee/McNally 2006).

The general explanation for women's more complex trip chaining is their stronger responsibility for various activities. "Gender differences in side trip making [complex chain] arise mainly from gender differences in household division of labor" (Sarmiento 1996, 44). Consequently, trip chain complexity refers to mothers more than to women in general (McGuckin/Murakami 1999). Mothers also encounter higher levels of fixity constraints (Kwan 1999) and, hence, may be more likely to seek efficiency. This may not be true for women in general, as Schwanen et al. (2008) did not find a significant gender effect in fixity constraints, other variables held constant. The need for efficiency in travelling is further fuelled by mothers' above-average complexity in activity patterns.

2.3 Gendered changes in complexity over the life course

As both the complexity of activity patterns and trip patterns is linked to specific life situations (most notably employment, caregiving duties and household structures), changes in life situation may be expected to result in changes in pattern complexity. For instance, retiring may result in reduced complexity due to the loss of job trips. The birth of a child is likely to result in enhanced complexity for parents due to their more varied obligations.

The birth of a first child versus that of a further child in a family may exhibit different effects on household organisation and travel patterns (Schulze, 2009 and Lanzendorf, 2010 for Germany), particularly on activity pattern and tour complexity. The birth of a first child normally induces marked changes in household organisation and the gender division of labour. The birth of a further child involves a similar need for care for the youngest. However, this need meets ongoing needs for care, escort and activity among the elder sibling(s). Thus, parents may opt to split their obligations, inducing even more complex patterns on the household level, or else they may opt to further shift their division of employed and household/family work towards a more traditional pattern, which could result in extremely complex patterns for one partner (typically the wife) while the other (male) partner would be responsible for breadwinning. In any case, making a distinction between the birth of a first child versus that of a further child in a family is clearly of interest.

As outlined, such changes in complexity may be gender specific as the changes in life situation are linked to gender. Due to the lack of life course-oriented studies in a gender context there is little direct evidence for gendered effects of key events (but see Rönka et al. 2003 for various key

events; Wall et al. 2013 for residential moves). However, from cross-sectional data there is much evidence that "the presence of children continues to affect women's travel patterns more than men's", as McGuckin/Nakamoto (2005, 54) put it in a study on trip chaining.

Perhaps women generally tend to react more distinctly to context changes. For instance, Mokhtarian et al. (2010) study gendered reactions to the temporary closure of a US highway. They find that women more than men change their behaviour in terms of temporal shifts in travelling, route choice, public transport use or carpooling. A German study supports this notion by finding that women use their cars in a less habitualised manner than men (Matthies et al. 2002).

3 Methods

3.1 Data

In the following, changes in complexity are studied empirically from a gender perspective. The data used is the German Mobility Panel (GMP) 1994 to 2010[2]. The GMP is a household survey with the sample organised in overlapping waves. Every household is surveyed three times over a period of three consecutive years (Chlond and Kuhnimhof, 2005), e.g. from 1994-1996, before being excluded from the survey. A trip diary is used to collect information on trips over a whole week from all household members aged ten years or over. Sociodemographic attributes for the household and its members are collected as well as spatial context attributes at the residence and at the household members' places of work or education.

An important limitation is that household income has only been recorded since 2002. Income is thus excluded from the analysis, rendering it impossible to directly investigate the effects of income changes. Education level and employment status are used as rough proxies for income. Coding multiple life course events results in missing values in many cases (see Scheiner, 2011 for details). As life course events are relatively rare events in an individual's life, no event in cases of uncertainty is assumed. The coefficients estimated are thus based on changes among those for whom an event occurred, while some of those for whom no event is assumed may in fact have experienced one.

The data include a total of 26,918 individual weeks of report. 12,868 weeks are 'last-time-reports' for which no change to the next year can be detected. For 12,349 weeks complete information (other than that discussed above) is available, and these are used in regression modelling. This sample is composed of 7,555 individuals, for 4,794 of whom two observations of change are available (from the first to the second and from the second to the third year of report).

3.2 Analysis approach

This paper uses regression modelling to detect the effects of a comprehensive set of life course events, access and mobility changes, cohort and period effects on activity pattern and tour complexity. Descriptive analysis of selected life course events that turned out significant is presented as well. Descriptive analysis is undertaken using weighted data. Unweighted data are used for regression modelling and any tests of significance.

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[2] The GMP is conducted by the University of Karlsruhe on behalf of the Federal Ministry of Transport, Building and Urban Development (BMVBS). The data are provided for research use by the Clearingstelle Verkehr (www.clearingstelle-verkehr.de).

To take the gender specifics of life courses into account, interaction terms between any variable and gender are used. This procedure resulted in exorbitant multicollinearity in some cases, most pronouncedly between the variables cohort and cohort squared, and their respective gender interactions, with variance inflation factors (VIF) exceeding VIF=100. In an extended, stepwise modelling process VIF values could be reduced dramatically (see Section 3.3 on variables).

The panel nature of the data results in non-independent (clustered) observations, thus violating a most basic assumption of statistical analysis. The use of OLS regression with such data may result in the underestimation of standard errors because the amount of independent information available is inflated. The significance of parameters may therefore be overestimated (Hedeker et al., 1994).

There are two basic ways of treating panel data in regression. Either one employs a random effects model or a cluster-robust estimation based on pooled data. The former has the disadvantage that it assumes constant correlation between successive observations of the same unit. In contrast, clustered regression with pooled data allows for arbitrary correlation. The estimates are less efficient and, similar to OLS, the standard errors may be too small when the number of clusters is finite (Wooldridge, 2003; Nichols and Schaffer, 2007). However, the cluster-robust standard error estimator converges to the true standard error as the number of clusters (not the number of observations) approaches infinity (Kézdi, 2004; Nichols and Schaffer, 2007). Given the relatively large sample and cluster number, neither of these issues should raise serious concern.

Hence, a pooled data approach is used that accounts for clustering by using a robust estimation method controlling for autocorrelation within subjects emerging from the temporal order (sequence) of records. This means that the correlation matrix of within-subject dependencies is estimated as part of the model. The SPSS procedure GEE (generalised estimating equations) is used for the analysis.

Concerning model specification (see Garson, 2010 for details), the autoregressive correlation type is used due to the temporal order of within-subject measurements. This means that values at a given point in time are a function of prior values plus error term. The dependent variables used are continuous in nature, and normal distribution is assumed. A graphical inspection reveals that this assumption holds true, which is not surprising as behavioural change from one year to the next is scattered around zero.

Unlike OLS regression, there is no determination coefficient available for cluster-robust regression. SPSS reports a quasi likelihood under independence criterion (QIC) which is an extension of the Akaike Information Criterion (AIC) for repeated measures (Garson, 2010). It is available in a corrected form (QICC) that penalises model complexity and small sample size. QICC works in a 'the smaller the better' form. It is reported for the final models as well as for the intercept models. However, there is no formal test of significance in model improvement available.

For comparison, OLS regressions with a random subsample of one observation per individual are estimated. The results are available upon request from the author. OLS regressions are known to be relatively robust against mild violations of assumptions. A comparison of the cluster-robust regressions with the OLS regressions shows different levels of significance and effect magnitudes in some cases. However, generally the two modelling approaches yield similar results for the magnitudes and, more importantly, the signs of the coefficient estimations, supporting the robustness of the findings. There are no instances of significant effects changing signs. The R^2 values from the OLS regressions are reported in the results table for readers' convenience.

3.3 Variable definitions

Target variables

People organise their trips in trip chains that form tours. There are various definitions of trip chains in the literature. Firstly, some authors use the terms tour and trip chain interchangeably (Frank et al. 2008, 39). However, a tour is typically defined as a sequence of trips that starts and ends at a person's home (Paleti et al. 2011) or workplace (see Schmöcker et al. 2010 for discussion), while some authors consider trip chains to be parts of tours that link two 'anchors' (typically home and workplace). Seen this way, the morning commute between home and work may be considered a complex chain in itself, if it involves an in-between stop, and tours may be composed of more than one trip chain (Sarmiento 1996, 42, McGuckin/Nakamoto 2005, 50, Vande Walle/Steenberghen 2006).

Secondly, the criterion by which trip chains are separated from each other does not need to be a specific start and end point as defined by activity. A trip chain may well be defined as a sequence of trips that are interrupted by dwell times of not more than 30 minutes (Schmöcker et al. 2010, McGuckin/Nakamoto 2005). It could, e.g., start at the workplace and end at a shopping centre.

The complexity of a tour refers to the number of trips (Timmermans et al. 2003) or stops (Paleti et al. 2011) involved, with the number of trips being one more than the number of intermediate stops. Typically, multiple stop tours involving at least three trips are considered complex tours, while tours including two trips (outbound plus inbound trip) are considered simple tours. For trip chains, the same definition of complex versus simple is typically used (Schmöcker et al. 2010, Paleti et al. 2011, 5, Frank et al. 2008, Strathman/Dueker 1995).

For the purpose of this paper, tour complexity is defined as the mean number of trips per tour from home to home a person makes over a whole week. Hence, the analysis is at the level of the individual, and the target variable is the change in a person's mean tour complexity from one year to the next.

Likewise, the analysis of activity pattern complexity is on the individual level as well. Activity is a nominal-scaled variable and measuring complexity in its patterns requires a qualitative measure of variance. There are various such measures (Coulter 1989). From a detailed discussion of three key measures (variation ratio, index of diversity, Shannon's entropy) in Wagner and Franzmann (2000), it is concluded that Shannon entropy fits the purpose of this paper particularly well. The variation ratio measures the share of cases (here: duration of activity) that do not fall into the modal category of the distribution. Hence, it is not a true measure of diversity as it does not address the distribution of cases over other categories. The index of diversity differs from Shannon's entropy in that it emphasises strong categories (as it is based on squared values), whereas the entropy emphasises weakly represented categories as it is based on logarithm. One may assume that side activities 'in-between' considerably affect the overall complexity of daily patterns and, hence, such side activities should rather be over- than underrepresented in a measure of complexity.

Hence, activity pattern complexity is measured using Shannon's entropy. Entropy is a measure of qualitative variance used in physics and information science, but in social sciences as well. It describes the amount of heterogeneity in the distribution of certain categories (here: activities). Heterogeneity is minimal when only one activity is performed, and reaches its maximum when the total amount of activity time is distributed equally over all categories. Hence, entropy simultaneously considers the number of different activities and the relative amount of time devoted to each activity, which resembles the merging of two measures of activity fragmentation used by Alexander et al. (2011): the number of fragments and the distribution of fragment sizes. The reasoning behind the latter measure is that "a plate broken into 10 pieces of equal size is

more fragmented than a plate broken into 10 pieces, one of which is 90% of the original plate" (Rutledge 2003, quoted from Alexander et al. 2011, 682).

Mathematically, entropy is defined as $-\sum (p_i * \log_2(p_i))$ (Coulter 1989). In this study the p_i are the shares of time spent for an activity plus associated trips in the week of report. Six activity classes are available for analysis plus 'housing', which remains unconsidered here. The activities included are employment, business, education, shopping/private errands, escort, and leisure. Trip times are added to the activity at the destination. Zero entropy means that a person conducts only one type of activity over the week of report, while the maximum value (here: 1.79) means that the time spent out of home is equally distributed over all activity types.

The use of tour complexity and activity pattern entropy is not meant to indicate that these two measures reflect the same dimension of daily life. In fact, there is hardly any correlation between the two ($r=0.03$) even if the correlation is significant ($p=0.01$). Rather, tour complexity reflects the attempt of an individual to efficiently organise his or her trips. On the other hand, activity pattern entropy reflects a complex daily life in terms of the requirement to juggle multiple activities with a similar level of importance (in terms of time spent for any activity), while a low level of entropy means that an individual's daily life tends to be devoted to only one activity.

Explanatory variables

Various state and change variables including sociodemographics and spatial context at the residence and at the place of work or education (for the sake of brevity: workplace) are considered as explanatory variables. Change variables reflect life course events or changes in spatial/access context or mobility. State variables reflect the baseline value observed in the year prior to change. Some of the variables used are explained in the following, as required (see Table 1 and Table 2 for the full set along with descriptive statistics).

With respect to cohort effects, cohort plus cohort squared divided by 100 are considered simultaneously in order to capture non-linear effects. Those born in 1900 are coded as cohort zero while those born in 1901 are coded as cohort one and so forth[3]. To capture period effects, the year of survey (1994 equals zero) is considered. An interaction term between year of survey and a dummy taking the value one for years from 2000 and zero for years to 1999 was included because travel behaviour trends in the aggregate tended to change from this year.

To account for the interaction between travel/activity pattern complexity and mode choice, a variable capturing the change in driving (the share of trips made as a car driver in the report week) is included. It is acknowledged that the change in mode use is not necessarily a cause of change in complexity; it may well be the other way round.

Finally, the respective baseline value of the dependent variable under study in the year prior to change is included, as those with a high level of complexity may be expected to reduce complexity more than those who exhibit very simple patterns (Krizek, 2003).

The analysis started with a set of 116 variables, including 58 baseline and 58 change variables. 59 of 116 variables were retained in the final analysis (22 baseline and 37 change variables). The following baseline variables that did not pass a very moderate significance level of $p=0.10$ in any

[3] Models including age plus age squared, but excluding cohort, were run for comparison. These models turned out as virtually identical to those including cohort. However, one may assume age effects to be captured to a large extent by using life course changes (such as founding a family, starting a job, retiring etc.). Thus, cohort is used for further analysis. It should be noted that cohort does not perfectly correlate with age here, as cohort depends exclusively on year of birth, while age also depends on year of observation.

model were excluded in a stepwise process, except for categories logically related to other categories:

- Living with partner versus not living with partner
- Possession of driving license
- Various spatial / access variables: city size category, central versus remote location of residence (subjective report), urbanity (calculated from self-reported walking access in the neighbourhood to various facilities), parking situation at the workplace (subjective report), walking distance from PT stop to workplace, PT connection to work (from various categories, as reported by respondents), PT quality in neighbourhood (calculated from the number of different systems accessible on foot)
- Interaction terms between gender and (a) employment, (b) education level, (c) cohort, (d) period.

Following the same reasoning, some change variables were excluded as well.

- Change in PT quality in neighbourhood
- Change in workplace
- Change in residential location (upward versus downward in the central place hierarchy).

Furthermore, some variable categories were lumped together for the sake of parsimony due to lack of significance and effect signs pointing in the same direction, respectively:

- The distinction between the birth of a first child versus that of a further child in a family is limited to descriptive analysis; it was abandoned in the regression modelling due to lack of significance. All effects had the same signs for the first and for further children.
- Parking situation at the workplace and PT connection to work: the categories 'gets worse / much worse' are merged into one category, as are those 'gets better / much better', respectively. These variables are based on the self-reporting of respondents; the quality of the PT connection is calculated from various categories (see Scheiner, 2011, for details).

Other variables, although not significant in any case, were retained in the analysis. These variables may be expected to strongly affect activity and travel patterns from a theoretical perspective:

- Household foundation with partner
- Separation from partner
- Finishing school or apprenticeship
- Start of apprenticeship.

Last, but not least, period effects were tested in two alternative, yet finally abandoned, model specifications. Firstly, a quadratic function and, secondly, a linear function was used. Both these variants performed slightly worse than the version presented here in terms of improvement in QICC. The quadratic function was not significant; the linear function was significant and positive in the entropy model.

As noted above, the modelling process started with excessive multicollinearity problems. Due to the exclusion of a large number of variables, this problem was reduced substantially. In the resulting models, all VIF are < 4 except for gender (5.2), which is well below the usual threshold of acceptance (VIF<10, Schendera, 2008, p. 105). Exceptions are cohort (VIF=64.5) and cohort squared (VIF=72.9) which are naturally correlated but retained in the model due to the recent debate on gender specific trends in travel behaviour among young adults (Kuhnimhof et al.,

2012). As recent trends observed in travel behaviour suggest a break around the year 2000, year of survey and an interaction term between year of survey and 'year of survey = 2000 or later' are both used in the models despite high VIF levels (VIF=15.9 and VIF=15.7, respectively).

	Type*	Min	Max	Mean	SD
Change in no. of trips per tour	C	-27.3	40.4	0.01	1.36
Change in entropy	C	-1.39	1.46	-0.02	0.32
No. of children in household (< 10 yrs)	B	0	4	0.27	0.62
No. of children in household (10-13 yrs)	B	0	3	0.16	0.44
No. of children in household (14-17 yrs)	B	0	3	0.17	0.44
No. of children in household (< 10 yrs) * female	B	0	4	0.13	0.46
No. of children in household (10-13 yrs) * female	B	0	3	0.08	0.32
No. of children in household (14-17 yrs) * female	B	0	3	0.09	0.32
Change in urbanity	C	-5	5	-0.02	1.12
Change in urbanity * female	C	-5	5	-0.01	0.80
Cohort (born in 1900 = 0)	B	5	98	54.87	18.41
Cohort, squared, div. by 100	B	0.25	96.04	33.50	21.18
Year of survey (1994 = 0)	B	0	14	7.32	3.79
Year of survey (1994 = 0) * 2000 or later	B	0	14	6.27	4.97
Change in driving (share of driving in all trips)	C	-1	1	0.002	0.216
No. of trips per tour in baseline year	B	1	41	2.55	1.02
Entropy in baseline year	B	0	1.67	0.73	0.30

Table 1: Continuous variables used in regression: descriptive statistics

* B = baseline variable; C = change variable.

	Type*	N	Per cent 'yes'
Gender female	B	6,267	50.7%
Birth of child	C	257	2.1%
Birth of child * female	C	126	1.0%
Child leaving home	C	250	2.0%
Child leaving home * female	C	130	1.1%
Household foundation with partner	C	244	2.0%
Separation from partner	C	178	1.4%
Household foundation with partner * female	C	113	0.9%
Separation from partner * female	C	92	0.7%
Full-time employed (reference)	B	4,278	34.6%
Part-time employed	B	1,667	13.5%
Apprenticeship, trainee, education	B	1,732	14.0%
Not employed	B	4,675	37.8%
University entrance qualification or higher (reference)	B	3,950	32.0%
Elementary school qualification without apprenticeship or no qualification	B	1,787	14.5%
Elementary school qualification plus apprenticeship	B	3,124	25.3%
Secondary school qualification level I	B	3,491	28.3%
Finished school or apprenticeship	C	756	6.1%
Finished school or apprenticeship * female	C	370	3.0%
Start of apprenticeship	C	84	0.7%
Start of apprenticeship * female	C	33	0.3%
Entry into labour market	C	445	3.6%
Entry into labour market * female	C	258	2.1%
Leaving labour market (no retirement)	C	262	2.1%
Leaving labour market (no retirement) * female	C	169	1.4%
Retirement	C	350	2.8%

Retirement * female	C	208	1.7%
PT connection to place of work or education gets...			
... worse / much worse	C	1,208	9.8%
... better / much better	C	1,195	9.7%
... worse / much worse * female	C	600	4.9%
... better / much better * female	C	559	4.5%
Parking situation at place of work or education gets...			
... worse / much worse	C	974	7.9%
... better / much better	C	951	7.7%
... worse / much worse * female	C	437	3.5%
... better / much better * female	C	443	3.6%
Gaining driving license	C	273	2.2%
Loss of driving license	C	149	1.2%
Gaining driving license * female	C	145	1.2%
Loss of driving license * female	C	81	0.7%
Car not available (reference)	B	3,706	30.0%
Car occasionally available / after agreement	B	1,428	11.6%
Car regularly available	B	7,218	58.4%
Car occasionally available / after agreement * female	B	827	6.7%
Car regularly available * female	B	3,243	26.3%
Decrease in car availability	C	654	5.3%
Increase in car availability	C	726	5.9%
Decrease in car availability * female	C	340	2.8%
Increase in car availability * female	C	391	3.2%
n		12,352	100.0%

Table 2: Dummy variables used in regression: descriptive statistics

All variables are coded as yes=1, no=0.
* B = baseline variable; C = change variable.

4 Results

4.1 Mean state value comparisons

We begin by looking at state values of entropy and tour complexity in typical life situations, categorised by gender. The life situations are constructed in a straightforward manner from household type and employment. For households without children (couples and singles), young households are distinguished from mid-aged adults and the elderly.

Table 3 shows that in some life situations women exhibit higher entropy levels in activity patterns than men. This refers particularly to employed singles, employed (or non-employed, but the difference is not significant) individuals living in a couple with smaller or adolescent children, employees in 'other' (non-family) households with three or more adults, and lone parents no matter whether they are employed or not. The differences in magnitude are particularly striking among employed couples with children and among lone parents whether employed or not. This finding supports the familiar notion that mothers rather than women overall are particularly affected by above-average complexity in daily life due to their multiple duties. Conversely, men exhibit a slightly, but significantly, higher level of entropy than women among elderly couples without children.

These gender differences are only partially reflected in tour complexity. In only one of the life situations studied does a significant gender difference appear both in entropy and tour complexity: employed lone mothers make more complex tours and experience more entropy than employed lone fathers.

Otherwise, there is little significance in gender differences in tour complexity. Firstly, non-employed women living in a couple with adult children make considerably more complex tours than their male

counterparts. However, this finding is based on small numbers, and it is not supported by differences pointing in the same direction among couples with younger children. Among those with small children, non-employed women make more complex tours than their male counterparts, but among those with older children it is the other way round (differences are not significant).

Secondly, women make more complex tours among non-employed individuals living in a couple without children, where at least one partner is younger than 60 years of age. This probably reflects gender-specific circumstances in that such situations include more housewives than househusbands, but more unemployed men than women. Such men may consider themselves jobless rather than housekeepers and hence may be less inclined to seek efficiency in trip-making.

Thirdly, gender differences are significant, albeit with minor magnitude, for all household types taken together. Interestingly, the direction is contrary to expectations for employed individuals, i.e. employed men exhibit more complex tours than employed women.

Compared to gender differences, the differences between life situations, as defined by employment status and household type, are far more striking. Employed individuals exhibit considerably higher levels of entropy than those who are not employed. This is true for all life situations identified, least so for households with children where even those not employed experience relatively high levels of entropy. Again, this pattern is different for tour complexity. One may assume that employed individuals with children have more reason to pursue efficiency in trip-making than those without a job and/or without children because they have to cope with multiple duties. Indeed, those employed make more complex tours than those who are not employed, and this is true for almost all sub-groups. However, there is no systematically higher level of tour complexity in households with children compared to those without.

Age also seems to play a certain role, even if it has been categorised here on a very rough level. Comparing young-to-mid-aged with elderly singles reveals that the elderly exhibit both lower levels of activity entropy and tour complexity. This pattern is repeated among couples without children.

Employed	Sex	Entropy	Trips per tour	N	Employed	Sex	Entropy	Trips per tour	N
	Single, 18-59 years					Couple with children, youngest child 10-17 yrs			
Yes	M	**0.78**	2.77	937	Yes	M	**0.73**	2.45	1,563
	F	**0.82**	2.77	896		F	**0.79**	2.43	1,501
	All	0.80	2.77	1,833		All	0.76	2.44	3,064
No	M	0.62	2.55	192	No	M	0.71	2.43	104
	F	0.62	2.52	193		F	0.70	2.36	217
	All	0.62	2.54	385		All	0.70	2.39	321
All	M	**0.75**	2.73	1,129	All	M	**0.73**	2.44	1,667
	F	**0.79**	2.72	1,089		F	**0.78**	2.42	1,718
	All	0.77	2.73	2,218		All	0.76	2.43	3,385
	Single, 60+ years					Couple with children, youngest child 18+ yrs			
Yes	M	0.73	2.67	77	Yes	M	0.75	2.67	888
	F	0.77	2.43	149		F	0.76	2.60	717
	All	0.76	2.50	226		All	0.76	2.64	1,605
No	M	0.56	2.42	615	No	M	0.65	**2.34**	129
	F	0.56	2.36	1,273		F	0.61	**2.88**	167
	All	0.56	2.37	1,888		All	0.63	2.63	296
All	M	0.57	2.45	692	All	M	0.74	2.64	1,017
	F	0.57	2.36	1,422		F	0.74	2.65	884
	All	0.57	2.38	2,114		All	0.74	2.64	1,901
	Couple, no children, younger partner < 60 yrs					Other household with 3+ adults			
Yes	M	0.80	2.74	1,276	Yes	M	**0.74**	2.54	623
	F	0.79	2.70	1,300		F	**0.80**	2.57	631

	All	0.79	2.73	2,576		All	0.77	2.56	1,254
No	M	0.59	**2.45**	528	No	M	0.63	2.41	231
	F	0.57	**2.74**	557		F	0.58	2.37	298
	All	0.58	2.60	1,085		All	0.60	2.39	529
All	M	0.74	2.67	1,804	All	M	0.72	2.51	854
	F	0.72	2.71	1,857		F	0.73	2.50	929
	All	0.73	2.69	3,661		All	0.72	2.51	1,783
Couple, no children, both partners 60+ yrs					Lone parent				
Yes	M	0.76	2.62	139	Yes	M	**0.72**	**2.41**	766
	F	0.74	2.60	134		F	**0.84**	**2.52**	1,109
	All	0.75	2.61	273		All	0.79	2.47	1,875
No	M	**0.53**	2.44	1,601	No	M	**0.63**	2.39	31
	F	**0.51**	2.41	1,606		F	**0.75**	2.46	201
	All	0.52	2.42	3,207		All	0.74	2.45	232
All	M	**0.55**	2.45	1,740	All	M	**0.72**	**2.41**	797
	F	**0.52**	2.42	1,740		F	**0.82**	**2.51**	1,310
	All	0.54	2.44	3,480		All	0.78	2.47	2,107
Couple with children, youngest child < 10 yrs					All household types				
Yes	M	**0.76**	2.61	1,979	Yes	M	**0.76**	**2.61**	8,248
	F	**0.91**	2.59	1,348		F	**0.82**	**2.59**	7,785
	All	0.81	2.60	3,327		All	0.78	2.60	16,033
No	M	0.70	2.35	74	No	M	**0.57**	**2.437**	3,505
	F	0.74	2.47	729		F	**0.58**	**2.439**	5,241
	All	0.73	2.46	803		All	0.58	2.44	8,746
All	M	**0.75**	2.60	2,053	All	M	**0.706**	2.56	11,753
	F	**0.85**	2.55	2,077		F	**0.714**	2.52	13,026
	All	0.80	2.58	4,130		All	0.71	2.54	24,779

Table 3: Mean entropy and tour complexity in various life situations, categorised by gender

M: Male, F: Female
Employed respondents include students and those in apprenticeship
Bold: gender difference significant (p=0.05, two-tailed t-test)

4.2 Mean value comparisons of change

Activity and trip patterns may change according to life course events. We now present descriptive analysis of changes in entropy and tour complexity (Table 4).

It meets expectations that no significant change can be detected for respondents who did not experience any life event in the year prior to the survey. Concerning the effects of life events, the birth of a child leads to a reduction in entropy, possibly because of reduced employment hours. The difference between the birth of the first versus a further child is only minor. However, only the birth of the first child markedly reduces mothers', but not fathers', entropy. Even if the gender difference is not significant, it supports the idea of reduced employment affecting mothers much more than fathers. There is also a marked, albeit not significant difference in changes in tour complexity, depending on the position of the child born. After the birth of the first child trip patterns tend to become more complex, which favours the idea of young parents aiming for more efficiency. However, following the birth of a further child, tour complexity tends to decrease, particularly among mothers. As it is unlikely that mothers of babies with elder siblings do not seek efficient trip patterns, the decrease in mothers' tour complexity may reflect the difficulties of organising complex tours that include visits to more than one destination when more than one child is present. Yet, the observations are too few to draw definite conclusions.

A child moving out of the parental household also affects parents' activity and travel behaviour. Entropy in parents' activity patterns decreases, and tour complexity increases, but only for

mothers. The change in entropy may perhaps be due to the lapsing of shared family activities, while mothers' increased tour complexity may be a result of less dependency in trip patterns.

Entering or leaving the labour market is also associated with changes in activity and travel behaviour. While entry into the labour market leads to more complex activity patterns and trip-making, leaving the labour market reduces entropy. Interestingly, the latter result only refers to the transition into unemployment, but not the transition into retirement. Retiring even significantly increases entropy, albeit only very slightly. Perhaps retiring is associated with somewhat more varied out-of-home activities including leisure, maintenance and shopping, while this is not true for becoming unemployed.

There are some significant gender differences in the effects of labour market-related events on behaviour. Entering the labour market increases entropy among women, but not men, which may reflect the familiar idea of a female 'second shift'. On the other hand, men, but not women, show a marked increase in tour complexity when they enter the labour market, thus coupling various activities in their tours.

Leaving the labour market shows opposed gender differences: while men tend to increase entropy and decrease tour complexity, it is the other way round for women. The changes in entropy may reflect that employed men have relatively simple activity patterns focusing on their jobs, while employed women combine multiple duties and, hence, their daily lives become less complex when they leave the labour market. Similarly to transition into unemployment, retirement produces less complex tours for men. It seems that men tend to organise their tours into chains only if time is seriously constrained.

Finally, there are two significant accessibility variables: the PT connection to and the parking situation at the workplace are significantly associated with entropy. As both the improvement and worsening of the PT connection or parking situation seem to affect entropy in the same (negative) direction, these effects are difficult to interpret. As these findings were not reproduced in the regression model presented below, one may suspect that unobserved background variables are at play here. Hence, this result should not be overstated.

Taken overall, the descriptive findings suggest that a number of life course events affect the complexity of activity and travel patterns. These events are related to the family cycle and to labour market changes or, to put it in 'mobility biography terms', in household biography and employment biography. However, given that a substantial number of other events have been tested without any significant effects being found, it seems that such changes in complexity are limited to only few key events in the life course.

		Change in...		
		entropy	trips per tour	n
Birth of first child	M	-0.03	0.21	49
	F	-0.16	0.14	52
	All	**-0.09**	0.18	101
Birth of further child	M	-0.09	**-0.22**	85
	F	-0.04	**0.03**	88
	All	**-0.07**	-0.10	173
Child leaving home	M	-0.08	**0.00**	124
	F	-0.06	**0.11**	144
	All	**-0.07**	0.06	268
Entry into labour market	M	**-0.02**	**0.40**	210
	F	**0.09**	**-0.05**	303
	All	**0.04**	**0.15**	513

Leaving labour market (no retirement)	M	**0.06**	-0.17	101
	F	**-0.12**	0.18	196
	All	**-0.05**	0.04	297
Entry into retirement	M	-0.04	**-0.22**	149
	F	0.03	**0.01**	241
	All	**0.01**	-0.07	390
PT connection to place of work or education...				
... gets worse / much worse	M	-0.02	-0.05	654
	F	-0.03	0.02	688
	All	**-0.02**	-0.01	1,342
... gets better / much better	M	-0.04	-0.06	684
	F	-0.02	-0.06	652
	All	**-0.03**	-0.06	1,336
Parking situation at place of work or education...				
... gets much worse / worse	M	-0.03	-0.01	574
	F	-0.02	0.07	529
	All	**-0.03**	0.03	1,103
... gets much better / better	M	-0.04	-0.09	553
	F	-0.04	-0.06	533
	All	**-0.04**	-0.08	1,086
No life event experienced	M	0.01	0.04	1,115
	F	-0.01	0.00	1,275
	All	0.00	0.02	2,390
Total sample	M	-0.02	0.00	6,635
	F	-0.01	0.02	7,380
	All	-0.01	0.01	14,015

Table 4: Changes in mean entropy and tour complexity after experiencing various life course events, categorised by gender

M: Male, F: Female
Rows M+F bold: gender difference significant (5%, two-tailed t-test)
Row 'all' bold: effect of life course event significantly different from zero (5%, two-tailed t-test)

4.3 Multiple regression analysis

Before getting into the details of the regression results, a key result confirming the descriptive analysis above is that only relatively few life course events are significant, and even fewer have distinct gender specific effects (note the elaborations above about events that have been excluded from analysis in the course of the modelling process).

Effects of baseline variables

We start by briefly looking at the significant effects of state variables that capture the respondents' life situations in the year prior to change in entropy or tour complexity, respectively (Table 5).

Part-time employees increase their entropy more than full-time employees (reference category), while for unemployed individuals the opposite is true. Individuals with different education levels also exhibit different trends in entropy and tour complexity. Both entropy and tour complexity by and large seem to increase with education level. Academics increase both their entropy and tour complexity most strongly from one year to the next. Respondents with permanent car availability increase entropy as well as tour complexity more than those without access to a car. These results taken together seem to suggest that increases in complexity may be related to having a relatively high social status and strong resources, with part-time v. full-time employment being an exception.

The effects of cohort and cohort squared taken together suggest that changes in entropy as well as in tour complexity become stronger from one cohort to the next, but in a curvilinear function that reaches its maximum among those born in 1979 (for entropy) and in 1967 (for tour complexity). These cohorts include adolescents to mid-aged adults over the study period. One may suspect that the period of observation is relatively short for a cohort study. Hence the cohort variables may mask age effects to some extent. Thus, the maxima found appear to be reasonable.

Period effects are significant as well. They suggest that entropy decreases relatively quickly over time until the turn of the millennium, and continues to decrease more slowly afterwards. Tour complexity tends to increase initially, but decreases slowly after the turn of the millennium.

The only significant gender interaction in baseline effects is that the number of small children in the household increases mothers' but not fathers' entropy over time. This may reflect children's increasingly diversified needs as they grow older, and it suggests that mothers bear the prime responsibility of meeting these needs.

Finally, baseline behaviour in the year prior to change yields by far the strongest effects in both models, suggesting considerable path dependency in behaviour. Those experiencing the highest levels in entropy or tour complexity are most likely to reduce their levels.

Effects of change variables – life course events and access changes

Few life course events and changes in the transport system significantly affect entropy or tour complexity.

A child moving out of the family household results in fewer trips per tour for his or her father, but for mothers the effect is in the opposite direction. The reduction in fathers' tour complexity may be because the need to take the adolescent to school, sports or other activities, or pick her up afterwards, lapses when she moves out. On the other hand, the increase in mothers' tour complexity may be because of their increased out-of-home activity levels which again would be the result of fewer domestic obligations.

Entry into the labour market results in increased entropy, for women even more than for men, which suggests that the simple cliché of male activity patterns, 'just work, nothing else' is not true, at least not for the time after someone has entered the labour force. At the same time, tour complexity increases for men but not for women, but both effects just fail to achieve significance.

Conversely, leaving the labour market reduces entropy, but only for women, suggesting that men who leave the labour force fill the 'void' with other out-of-home activities. Entry into retirement induces somewhat different changes than leaving the labour force for other reasons. Retiring means that entropy decreases for both men and women. Tour complexity also decreases, but only for men (assuming that the interaction term with gender is true, even if it just fails to reach significance).

A number of other associations related to access and mobility are found. Firstly, increased car use (measured in terms of the share of driving in all trips) is associated with increased entropy and reduced tour complexity. The latter result may be a direct impact of car use, as the car is a flexible and fast mode of transport that may reduce the need for efficiency in the way trips are organised. The positive association between driving and entropy is not as straightforward. The need to drive may be induced by increased entropy and the associated requirement to juggle more varied commitments. Conversely, the time saved by using the car may allow people to juggle more activities. The association between mode choice and entropy is also reflected in a significant effect of the PT connection to the workplace. A decrease in the quality of the PT connection is associated with increased entropy.

Similarly, the connection between mode choice and tour complexity may help explain the significant effect of the parking situation at the workplace. More parking space results in reduced tour complexity (but only for men). This association may be mediated by an increased propensity to use the car for the commute.

		Change in entropy			Change in no. of trips per tour		
		B	Exp (B)	Sig.	B	Exp (B)	Sig.
Intercept		0.312	1.366	0.000	1.516	4.555	0.000
Gender, household, family biography							
Gender female	B	-0.005	0.995	0.599	0.058	1.059	0.150
No. of children in household (< 10 yrs)	B	0.010	1.010	0.096	0.011	1.011	0.673
No. of children in household (10-13 yrs)	B	-0.002	0.998	0.794	-0.048	0.953	0.283
No. of children in household (14-17 yrs)	B	0.011	1.011	0.177	0.055	1.057	0.310
No. of children in household (< 10 yrs) * female	B	0.032	1.033	0.000	-0.022	0.978	0.508
No. of children in household (10-13 yrs) * female	B	0.012	1.012	0.253	0.009	1.009	0.866
No. of children in household (14-17 yrs) * female	B	0.004	1.004	0.723	-0.062	0.940	0.330
Birth of child	C	-0.035	0.966	0.168	0.016	1.016	0.864
Birth of child * female	C	-0.031	0.970	0.396	0.088	1.092	0.407
Child leaving home	C	-0.018	0.982	0.516	-0.163	0.849	0.010
Child leaving home * female	C	-0.007	0.993	0.838	0.272	1.312	0.032
Household foundation with partner	C	0.000	1.000	0.997	-0.090	0.914	0.145
Separation from partner	C	-0.015	0.985	0.632	-0.104	0.902	0.157
Household foundation with partner * female	C	0.015	1.016	0.646	0.008	1.008	0.920
Separation from partner * female	C	0.054	1.056	0.181	0.008	1.008	0.930
Social status, employment and educational biography							
Employment (reference: full-time)							
Part-time employed	B	0.064	1.066	0.000	-0.060	0.942	0.068
Apprenticeship, trainee, education	B	-0.026	0.974	0.061	0.062	1.064	0.263
Not employed	B	-0.052	0.949	0.000	-0.050	0.951	0.139
Education level (reference: university entrance qualification or higher)							
Elementary school qualification without apprenticeship or no qualification	B	-0.040	0.961	0.000	-0.204	0.815	0.000
Elementary school qualification plus apprenticeship	B	-0.047	0.954	0.000	-0.202	0.817	0.000
Secondary school qualification level I	B	-0.028	0.972	0.000	-0.114	0.892	0.000
Finished school or apprenticeship	C	0.005	1.005	0.745	0.074	1.077	0.292
Finished school or apprenticeship * female	C	0.024	1.025	0.238	-0.047	0.955	0.563
Start of apprenticeship	C	-0.047	0.954	0.186	-0.131	0.878	0.141
Start of apprenticeship * female	C	0.077	1.080	0.277	0.096	1.100	0.473
Entry into labour market	C	0.062	1.063	0.006	0.339	1.404	0.074
Entry into labour market * female	C	0.057	1.058	0.049	-0.372	0.689	0.057
Leaving labour market (no retirement)	C	0.018	1.018	0.561	-0.107	0.898	0.251
Leaving labour market (no retirement) * female	C	-0.111	0.895	0.005	0.036	1.037	0.742
Retirement	C	-0.071	0.932	0.007	-0.156	0.855	0.001
Retirement * female	C	0.049	1.050	0.133	0.151	1.163	0.058
Change in access to place of work or education							
PT connection to place of work or education gets...							
... worse / much worse	C	0.025	1.025	0.033	-0.047	0.955	0.218
... better / much better	C	-0.004	0.996	0.751	-0.053	0.948	0.302
... worse / much worse * female	C	-0.022	0.978	0.180	0.052	1.054	0.330
... better / much better * female	C	0.026	1.027	0.101	0.007	1.007	0.907
Parking situation at place of work or education gets...							
... worse / much worse	C	0.007	1.007	0.595	0.008	1.008	0.847

... better / much better	C	-0.006	0.994	0.640	-0.093	0.912	0.047
... worse / much worse * female	C	0.003	1.003	0.871	0.006	1.006	0.929
... better / much better * female	C	0.005	1.005	0.759	0.121	1.129	0.043
Mobility and associated changes							
Gaining driving license	C	0.045	1.046	0.076	-0.067	0.935	0.240
Loss of driving license	C	-0.032	0.969	0.318	-0.067	0.935	0.374
Gaining driving license * female	C	-0.034	0.966	0.328	0.044	1.045	0.591
Loss of driving license * female	C	0.034	1.035	0.402	-0.046	0.955	0.658
Car availability (reference: no)							
Occasionally / after agreement	B	0.004	1.004	0.779	-0.004	0.996	0.928
Regularly	B	0.030	1.030	0.001	0.122	1.130	0.001
Occasionally / after agreement * female	B	0.019	1.020	0.281	0.093	1.097	0.243
Regularly * female	B	0.005	1.005	0.663	-0.070	0.932	0.146
Loss in car availability	C	-0.010	0.990	0.540	-0.041	0.960	0.442
Increase in car availability	C	0.023	1.023	0.209	0.072	1.074	0.135
Loss in car availability * female	C	-0.019	0.981	0.388	-0.047	0.954	0.494
Increase in car availability * female	C	-0.024	0.976	0.297	-0.108	0.898	0.123
Change in driving (share of driving in all trips)	C	0.078	1.081	0.000	-0.213	0.808	0.001
Change in spatial context at residence							
Change in urbanity	C	0.000	1.000	0.969	0.017	1.017	0.113
Change in urbanity * female	C	0.004	1.004	0.317	-0.011	0.989	0.436
Cohort, period and baseline value of behaviour							
Cohort (born in 1900 = 0)	B	0.005	1.005	0.000	0.011	1.011	0.000
Cohort, squared, div. by 100	B	-0.003	0.997	0.000	-0.008	0.992	0.007
Year of survey (1994 = 0)	B	-0.006	0.994	0.013	0.041	1.042	0.000
Year of survey (1994 = 0) * 2000 or later	B	0.003	1.003	0.061	-0.030	0.971	0.000
Baseline entropy / trips per tour	B	-0.643	0.525	0.000	-0.745	0.475	0.000
(Scale)		0.069			1.260		
QICC		964.3			15609		
QICC (intercept model)		1279.8			22933		
R^2 adj (from OLS regressions)		0.327			0.272		
n (observations)		12,349			12,349		
n (individuals)		7,555			7,555		

Table 5: Cluster-robust regression models of changes in entropy and tour complexity

B = baseline variable; C = change variable.

5 Conclusions

This paper has studied changes in complexity in activity and trip patterns over time from a gendered life course perspective. Activity pattern complexity was captured by Shannon's entropy, i.e. the 'qualitative mix' of out-of-home activities an individual performs. Trip pattern complexity was captured by the mean number of trips per tour over a week. An attempt was made to trace back the changes in complexity to life course-related key events and changes in accessibility, transport and spatial context.

The results suggest, firstly, that changes in complexity are affected by some state variables that capture the respondents' life situations in the year prior to change. This may sound somewhat surprising as there is no obvious reason to expect changes in activity and trip pattern when circumstances remain stable. One reason may be that some changes in circumstances are not adequately represented in the data. Another reason may be that people continuously adjust their behaviour even without obvious and massive changes in circumstances. This has been reported similarly in a companion paper on mode choice (Scheiner and Holz-Rau, 2013).

Secondly, some life course events and changes in the transport system significantly affect entropy or tour complexity. The only household-related key event that was significant in the

regression models was a child moving out of the family household, which reduced tour complexity for men but not for women. In a descriptive analysis childbirth has been found to significantly and negatively affect entropy in activity patterns, but this finding could not be reproduced in regression modelling. Other, if non-significant, descriptive results suggested a difference between the birth of the first or a further child in a family. A detailed look at the family cycle and its consequences for travel would seem to be well worth further inquiry.

Other significant key events refer to employment. Entry into the labour market results in increased entropy, for women even more so than for men. At the same time, tour complexity increases for men but not for women, although both effects just fail to achieve significance. Conversely, leaving the labour market reduces entropy only for women, suggesting that men who leave the labour force fill the 'void' with other out-of-home activities. Entry into retirement decreases entropy for both men and women. Tour complexity also decreases, particularly for men.

Thirdly, increased car use is associated with increased entropy and reduced tour complexity. It has to be noted that these associations do not impose a clear-cut cause-impact relationship between mode choice and complexity in activity or trip patterns.

Fourthly, it has to be noted that only relatively few life course events are significant. Most events under study have been excluded from analysis in the course of modelling for reasons of parsimony. This is particularly noteworthy because activity patterns are directly related to life situations and, hence, the effects of key events were expected to be relatively strong. Even fewer events exhibit distinct gender specifics. This suggests that, in general, key events seem to be relatively loosely associated with changes in complexity, and only few events appear to be strongly gendered.

Three reasons may be offered for interpretation. Firstly, the period of observation of any household is relatively short, and changes in complexity may be delayed. Secondly, travel behaviour is known to involve strongly habitual elements (e.g. Bamberg et al., 2003), and the structure of an individual's activity pattern may depend more on what she or he simply has to do than on external circumstances. Thirdly, the measures used may not capture complexity as accurately as necessary. Even if, say, activity pattern entropy remains on a stable level, much change may go on under the surface, e.g. in terms of the sequencing of activities, the destinations visited, or the actual activities performed within a broad category such as 'leisure'.

This paper suggests various directions for future research. Firstly, the relatively minor life course related effects found do not imply that life course perspectives in travel studies are not a worthwhile field of inquiry. The idea of mobility biographies includes a broad spectrum of topics and methodological approaches, and it may serve as a framework for other fields in transport research such as the debate on residential self-selection (Scheiner, forthcoming).

Secondly, extending the approach used to other measures of activity and travel behaviour could be worthwhile. A companion paper on mode choice also yielded relatively loose associations with life course-related events (Scheiner and Holz-Rau, 2013). Still, the framework could be used to study the sequencing of activities, activity spaces and destinations visited, actual activities rather than broad activity categories, or composite measures of activity/travel.

Thirdly, it would be valuable to extend the analysis of change to longer periods to capture delayed effects (e.g. Dargay, 2001). People may react to changing circumstances slowly, and they may react in very different ways, because changes in some respects are superimposed on the steady habits of daily life in other respects.

Finally, an important issue is to tackle interpretation of such empirical results in terms of sustainability, particularly with respect to its gender equity dimension. Gender specific travel behaviour changes over the life course may suggest gendered worksharing in childraising,

housework or employment, they may show gendered adaptions to spatial context, or they may be the outcome of powered negotiations between two partners over getting access to the car (Scheiner and Holz-Rau, 2012). However, they may also be the outcome of gender specific preferences deliberately developed by individuals rather than of power relations. If this were ascertained, then there would be no point in complaining about inequality just because there is difference. Thus, more research is needed on the emergence of gender differences or similarities, rather than just on the behavioural outcome, and a focus should be on the extent to which unequal power relations are at play. Only thus will it be possible to ascertain whether there is reason to criticise a deficit in sustainability in terms of gender inequality.

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TRAVEL BEHAVIOR OF WORKING MOTHERS IN TOKYO METROPOLITAN AREA, PARTICULARLY ADRESSING THOSE WITH SMALL CHILDREN AND THEIR RESIDENTIAL AREAS

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ABSTRACT

In Japan, although the women's employment rate has improved, child-rearing mothers' burdens remain heavy. A preschooler would have to be attended by an adult, whose physical burden would certainly increase. Those physical burdens might be reduced through policy measures to improve transportation systems or the built environment. This study was undertaken to ascertain how different the travel behaviors of working mothers of nuclear families in Tokyo metropolitan area are from other attributes, especially the actual conditions of taking their children to day-care on the way to work. The characteristics were clarified by comparing 20–39-year-old employed women with preschooler and women with different household compositions and resident area attributes. The study uses results of the Tokyo Metropolitan Area Person-Trip Survey, conducted in 2008. Analyses particularly addressing the transport of children to day-care and others while commuting revealed that the women in households with children aged under five years old had 3–4 times as many trips for dropping-off during 8:00 to 9:00 in the morning as women in households without children under five years old. The time difference of 10–20 minutes was confirmed between the presence of day-care related travel and absence. Particularly, results show that women living in the suburbs and working in central Tokyo, took a train for commuting after taking their children to day-care by bike or on foot. Therefore, they spent as many as 70–80 min, on average, going from home to work.

INTRODUCTION

Japan's population, which peaked in 2008 with 128 million, has been declining (*1*). The birth rate was 1.39 in 2010 (*2*). Moreover, the birth rate has been changing at a globally low rate. Estimates of future population by National Institute of Population and Social Security Research suggest that the total population in 2030 will be around 117 million (around 10% less than in 2008), including around 12 million juveniles under 14 (around 30% less than in 2008) and around 37 million elderly people over 65 (about 30% more than in 2008) (*3*). The median household size has decreased from 2.99 in 1990 to 2.42 in 2010 (*4*), and the number of households has increased. Population decline and societal aging will advance rapidly with fewer children in the future. Increasingly, Japanese people will live in single-person households and nuclear families.

Against the background of such a demographic change, the labor force population also tends to decrease year-by-year. According to a survey conducted by the Ministry of Health, Labour and Welfare, the labor force population has been gradually declining from 68 million in 2000 to around 66 million in 2012 (5). From the viewpoint of supplementing the declining labor force population because of the low birth rate and longevity, Japan's important policy issues are to raise the young women's employment rate and to improve the work and social environment, making it easy for women to work during child-rearing years, thereby forestalling an even lower birth rate. The employment rate of 30–34-year-old women increased from 50% in 1990 to 64% in 2010 (*5*). However, 25% of employed women aged 30–34 are non-regularly employed (*5*). The women's employment rate has increased during the past twenty years not only because an increased percentage of unmarried women engenders increased working women but mainly because the percentage of employed married women has also increased.

Although the women's employment rate has improved, child-rearing mothers' burdens remain heavy. The burden of mothers with children under six (preschooler) is specifically regarded as a problem. The increasing pattern of residing in nuclear families has made it difficult for mothers to return to work after child-rearing leave. Day-care centers for children (includes preschool and kindergarten) are invariably too few, so households have difficulty arranging for their children to attend day-care. Even if they can, they must transport their children to day-care in addition to work, housekeeping, and child rearing responsibilities. Transporting children to day-care might be a heavy burden because it must be done in busy commuting times and within a tight time constraint. However, no quantitative research has been done to assess it.

Different from cases in which children attending elementary or junior high schools, it is difficult to reduce the time necessary for transporting children to day-care. Without lower crime rates and public transportation improved to the degree that children can travel by themselves, it is difficult to have preschoolers act unattended. A preschooler would have to be attended by an adult, whose physical burden would certainly increase. Although it is almost impossible to stop transporting their children to day-care completely, physical burdens might be reduced through policy measures to improve transportation systems or the built environment. However, travel behaviors depend strongly on conditions of public transport and vehicle ownership, so working mothers' travel behaviors and burdens of transporting their children to day-care might vary depending

on whether they live in urban areas or in the suburbs and whether they live near railways or not. Consequently, to improve the environment so they can work easily while rearing their children, it might be important to clarify quantitatively the actual traveling conditions and the level of burdens attributable to child rearing of mothers with preschooler according to the characteristics of residential areas.

Therefore, this study was undertaken to ascertain how different the travel behaviors of working mothers of nuclear families in Tokyo metropolitan area are from other attributes, especially the actual conditions of taking their children to day-care on the way to work. The characteristics were clarified by comparing 20–39-year-old employed women with preschooler and women with different household compositions and resident area attributes. Devoting particular attention on their taking their children to day-care on the way to work every morning, which is presumably a burden especially for traveling, the differences in transportation mode and commuting time were clarified between those of mothers transporting their children to day-care and those of mothers who do not. The Tokyo metropolitan area was targeted because its population scale is the largest. It has the largest number of working mothers.

PREVIOUS STUDIES

This chapter presents a review of studies examining the difference of women's travel behaviors according to the built environment, especially mothers' burdens attributable to transporting their children.

Although the idea that travel behaviors are affected by the built environment is an old one, it has been studied increasingly since the 1990s, when new urbanism attracted greater attention (*6*). Regarding the relation between women's travel behaviors and the built environment, studies were conducted by Handy (*7*) and Clifton and Dill (*8*). According to Handy, previous studies revealed obvious differences in travel behaviors between sexes but not their correlation to sufficient community designs. Additionally, that study analyzed travel behaviors according to gender, presence or absence of children, and by area, to demonstrate that women residing in the suburbs tended to commute by car more than in areas where communities had been formed before WWII. Clifton and Dill also pointed out that women tended to walk more under conditions in which they could walk more easily.

Recent studies particularly address the putative relation between the difference of built environment and children's travel behaviors (*9-12*). They are based on the ideas that the more easily children can travel alone, the lower the burden of parents in transporting their children. Using the National Household Travel Survey (NHTS), McDonald (9) sought to verify in his hypothesis that because children can travel alone in highly populated urban areas, their mothers' burden of transporting children should be reduced, which could not be confirmed. Children turned out to be able to travel alone in both conditions: in highly populated urban areas, they were able to travel alone on foot; they were able to use school buses or drive vehicles themselves in thinly populated suburban areas. In 2001, Weston (10) analyzed the travel behaviors of 13–15-year-old children by gender with NHTS, suggesting that their travel behaviors differed between sexes. They were affected by the built environment. He pointed out that young women, who are subjected to greater danger of

being kidnapped, avoided commuting by walk, by cycle, and by bus without being attended by their parents, which might explain gender differences of travel by young people. Waygood et al. (11)(12) compared the travel behaviors of 10–11-year-old children in the Kyoto–Osaka–Kobe area in Japan to those of children in the United States based on their hypothesis that children can transport themselves in more advanced transit oriented development (TOD) and that the burden of parents' to transporting their children should be reduced. Results show that the percentage of Japanese parents transporting their children was 15%, which was very low compared with 65% in the United States. Other results suggest that Japanese children should be remarkably more independent of their parents and commute more by themselves.

This research also specifically assessed the relation between the built environment and reduction of mothers' burdens attributable to transporting their children. However, unlike most previous studies, targeting elementary and junior high school students sufficiently old to commute independently, i.e., "children's self-reliant travel," this research specifically assessed "the burden of mothers with preschooler", who have practical difficulties going out alone. Additionally, previous studies have compared built environments using indexes including urban/suburban environments, level of TOD, urban density, and ease of walking. Considering mothers' travel behaviors and burdens of transporting their children should be affected by whether they live near the railway or not, the present study categorized built environments into three: central Tokyo, suburbs along railways and suburbs distant from railways. The method of classification was unique to this research and different from those of previous studies.

ANALYTICAL METHODS

Data

Analyzing built environments and quantitatively clarifying the characteristics of working mothers with children under five years old in terms of travel behaviors and behaviors of transporting their children to day-care, this study compared the travel behavior of 20–39-year-old working women according to residential area and by household composition. The study uses results of the Tokyo Metropolitan Area Person-Trip Survey, conducted in 2008. The sample survey assessed actual conditions of a person's daily travel and helped elicit transportation plans in urban areas in particular. The examinees were selected randomly from households who live in Tokyo metropolitan area. The questionnaires were sent to the target households where they were completed and returned by mail or via the internet. It was a large-scale survey with a sampling rate of 2.12% and the sample number of 730,000. The survey consisted of two types: individual and household questionnaires. With the former, destination, time, purpose, and transportation were revealed; with the latter, sex, age, vocation, and possession situations of driver license and car of all the members of a household. It showed a person's individual travel behavior by composition of the household in which he or she resided.

The Tokyo Metropolitan Transportation Planning Conference, conducting this survey, expansively processed the samples of the Person-Trip data so that they correspond to the population by sex, age, and

residential area; then it made them public. The widely available, expansively processed data were used to analyze them. Although statistical tests are usually necessary to evaluate the significance of a difference, data of individual samples could not be used, so a comparison was made using aggregated values.

Area Types

The Tokyo metropolitan area has an urban structure in which workplaces are highly integrated in the city center. Residential areas are spread in the suburbs and are connected by railways. The railways are multiply networked in both radiating and circular directions in a highly complex network that is rare even when regarded on a world scale. The Tokyo metropolitan area Person-Trip survey(2008) showed that the Tokyo metropolitan area's modal share of railways and cars were 30% and 29%, respectively, with railways being used more than cars for the first time.

To conduct travel behavior analyses considering different areal features as indexes of built environments as described in former chapter, this study categorized the circle area with radius of 50 km from the center of city into three parts: central Tokyo, suburbs along railways and suburbs distant from railways. Business functions concentrate on central Tokyo, with a high level of railway service. Suburbs along railways have a high level of railway service and integrated city functions near train stations. The suburbs that are distant from railways are mainly residential zones that are distant from any train station. Their bus service level is low. The concrete classification method is presented in Table 1.

TABLE 1 Area Types and Area Features

Area types	Area range	Mean population density	Service level of public transportation
Central Tokyo	8 wards in central Tokyo (about km from the center)	137 people /ha	Both the station density and travel frequency are extremely high.
Suburbs along railways	area from 1.5km from the station (50 km from the center)	80 people /ha	Station density and travel frequency are high.
Suburbs distant from railways	other areas (50 km from the center)	21 people /ha	With long distance from a railway station.

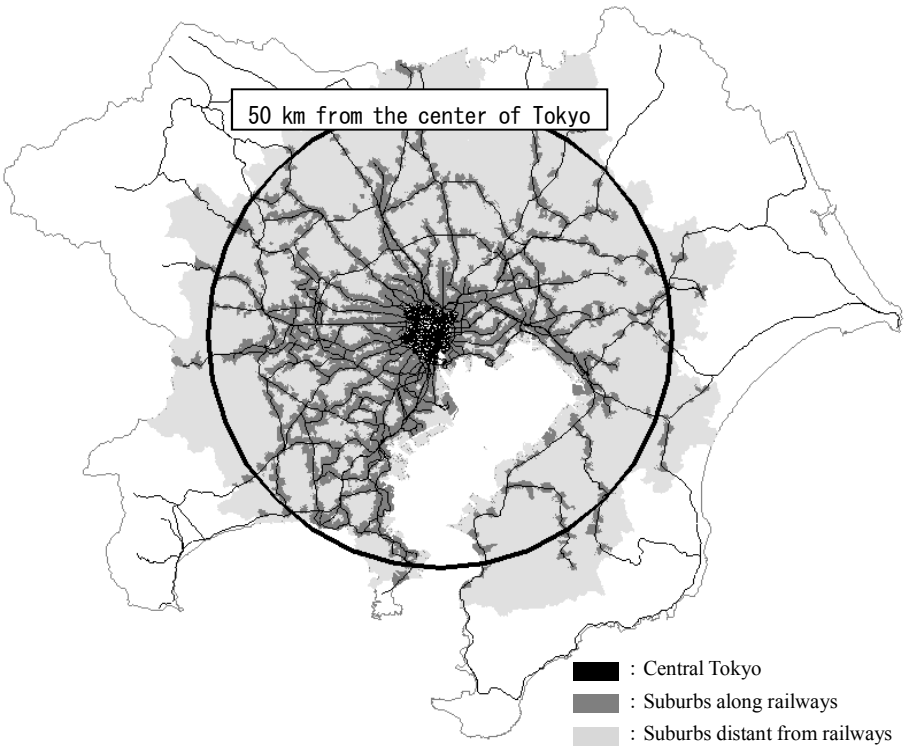


FIGURE 1 Area Types

Household Types

Because the Tokyo metropolitan Person-Trip survey shows no within-household relationships, respective family compositions cannot be strictly identified. This study used substitute rules to define the household composition.

First, households with employed women aged 20–39 were selected. In a household, a man with age difference within 20 years was regarded as the woman's husband. Boys and girls under 16 with age difference of greater than 20 years were regarded as children of the woman residing in the household. Under these conditions, the household types shown by Table 2 were defined. Whereas this study targeted households with preschoolers younger than 6, the person trip survey showed data for every five years. Therefore, here the households with children were divided into households with children under five years old and households without children under five years old.

To see the composition ratio of 20–39-year-old employed women according to household type, single-person households and households with men and women accounted for about 30%. Households with children under five years old and households without children under five years old or younger respectively accounted for 8% and 6% of the total. Others accounted for about 50%, most of whom were women living with their parents.

TABLE 2 Household Types (source: Tokyo metropolitan Person-Trip survey, 2008)

Household types		Population (thousands)				
		Central Tokyo	Suburbs along railways	Suburbs distant from railways	total	ratio
I	Single-person households	77	480	101	658	22%
II	Men and women households	28	294	107	429	14%
IIIA	Men, women and children (under five) households	11	147	75	234	8%
IIIB	Men, women and children (five and older) households	5	99	74	177	6%
IV	Others	539	864	638	1,554	51%
	Total	**173**	**1,884**	**994**	**3,052**	100%

FEATURES OF YOUNG WORKING WOMEN'S TRAVEL BEHAVIOR

As described above, to elucidate working mothers' travel behavior, addressing "presence or absence of children under five years old" and "differences of area types," this study used only aggregate results for groups I–III among the household types presented in Table 2.

Car Ownership

Car ownership by household type is shown as a premise for comparison. Household types IIIA and type IIIB had generally higher car ownership than others did. The car ownership rates in suburbs distant from railways were 80–90 percent. Even in central Tokyo, with its convenient public transportation, about half of the households owned cars. These results were remarkably higher than those for household type I and also 10–20% higher than for household type II, suggesting a tendency by which the car ownership rate of households with children is high.

Analyzing them by residential area, the car ownership rate for all household types became higher concomitantly with distance from the city center: The rate in suburbs that were distant from railways was highest, followed by suburbs along railways and central Tokyo. When the public transportation service level is low, people must depend on their own cars. Therefore, the car ownership rate in remoter areas was suggested to be higher.

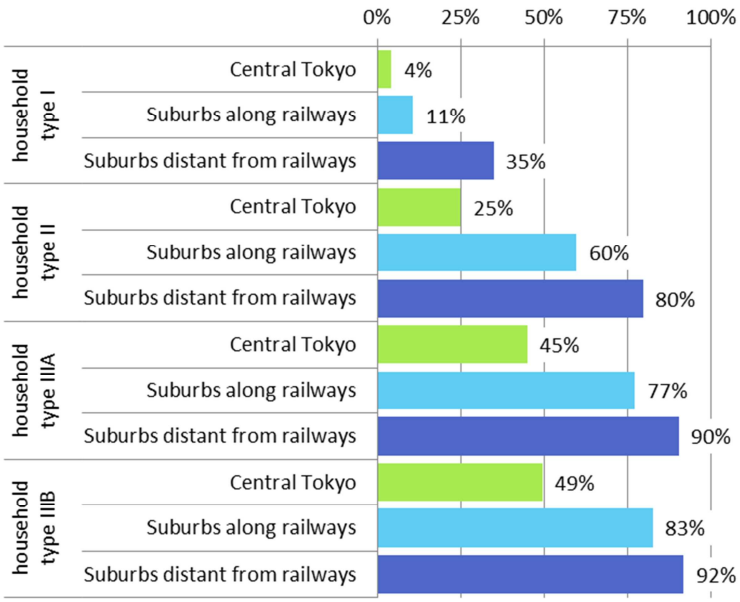


FIGURE 2 Percentage of Car Ownership by Household and by Residential Area (source: Tokyo metropolitan Person-Trip survey, 2008)

Average Daily Trips

The number of average daily trips of women of household type III was larger than that of household type I or type II. The difference among residential areas was not large. The difference was attributable to the trips related to dropping off and picking up. The average daily trips attributable to dropping off and picking up of household type IIIA was higher than that of household type IIIB. Although some trips were dedicated to the dropping off and picking up even in household type IIIB, they traveled more for commuting. Results suggest that when children are younger, the number of daily trips for picking up and dropping off should be larger and that when they become more independent, their mothers should return to work, and the number of times commuting should become larger.

The number of trips for dropping off and picking up included all the trips for women taking their husbands to railway stations, their fathers or mothers living in their neighborhood to hospitals, and their children to day-care, elementary schools or cram schools. However, because households without children had few trips for dropping off and picking up, it might be inferred that most such trips are for transporting their children to or from someplace.

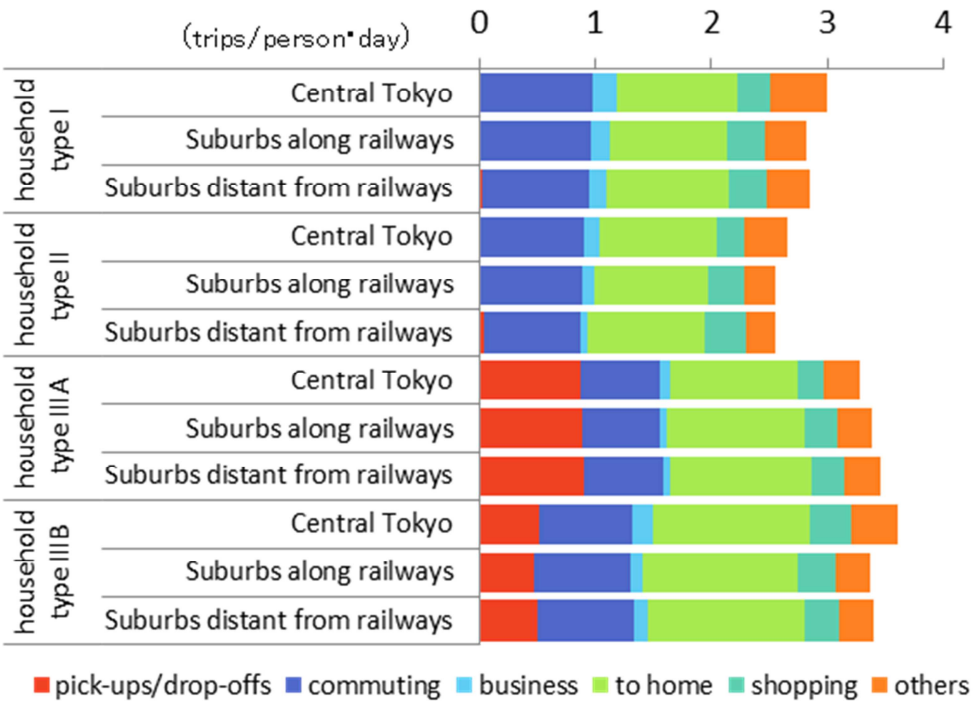


FIGURE 3 Average Daily Trips Made by Women by Household and by Residential Area (source: Tokyo metropolitan Person-Trip survey, 2008)

Average Daily Travel Time

The average daily travel time of women in household type III was shorter than in other household types. The total travel time of the women under less time pressure in household types I and II was longer. The women in household type III who were compelled to devote their time to child-rearing activities including picking up and dropping off at day-care might make efforts to reduce travel time by doing necessary tasks in their neighborhood. Based on the result that the number of daily trip and daily travel time of the women in household type III were larger but shorter, respectively, than in household types I and II, women in household type III are inferred to spend a shorter time traveling for their various purposes.

Analyzing them by residential area revealed that, for women of household types I and II, the closer they lived to the city center, the shorter their travel time became. In the urban central areas on which various functions focus, it was suggested that they should be able to save their travel time. For the women in household type III, however, the total travel time in suburbs distant from railways was the shortest. Results suggest that the women in household type III, with a high rate of car ownership, should try to reduce their travel time by using their cars more effectively.

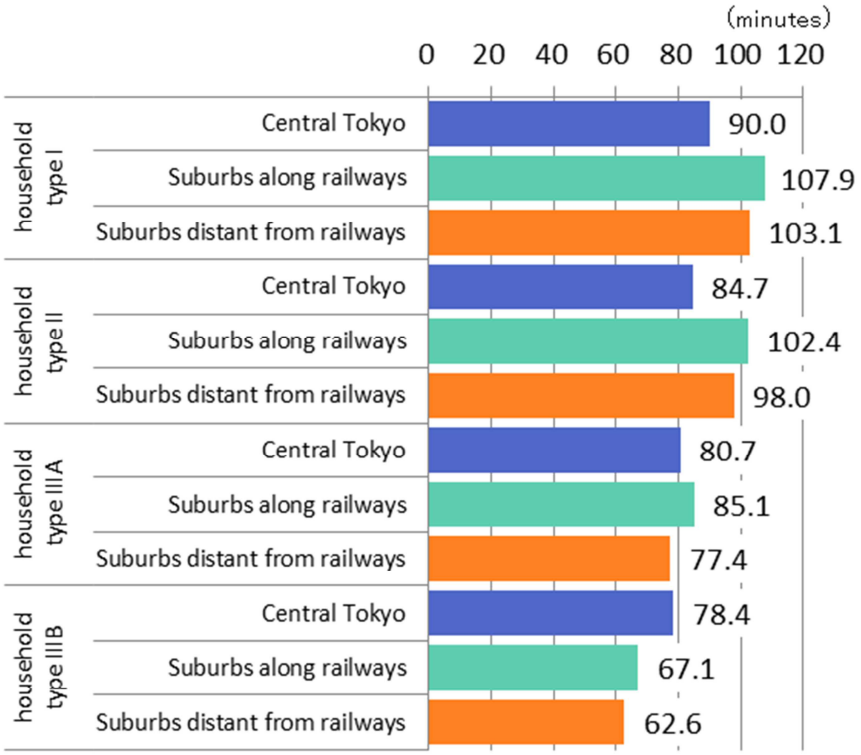


FIGURE 4 Women's Total Travel Time per Day by Household and by Residential Area (source: Tokyo metropolitan Person-Trip survey, 2008)

Modal Split

Although the percentages of trips by rail of the women in household types I and II were high, the percentages of trips by car, bicycle, and walk were high in household type III. Analyzing them by residential areas, for women living in the suburbs (distant from railways), the percentage of trips by car was higher in general.

Comparison of household types IIIA and IIIB reveals that the percentage of trips by rail and walk was higher in the former and the percentage of trips by bicycle, in the latter. When they traveled with their young children who are unable to move alone, they tended to use public transportation or walking. As their children became somewhat older, the bicycle uses increase. Certainly, mothers often carry their children in a stroller or with a front baby carrier, as demonstrated by these figures.

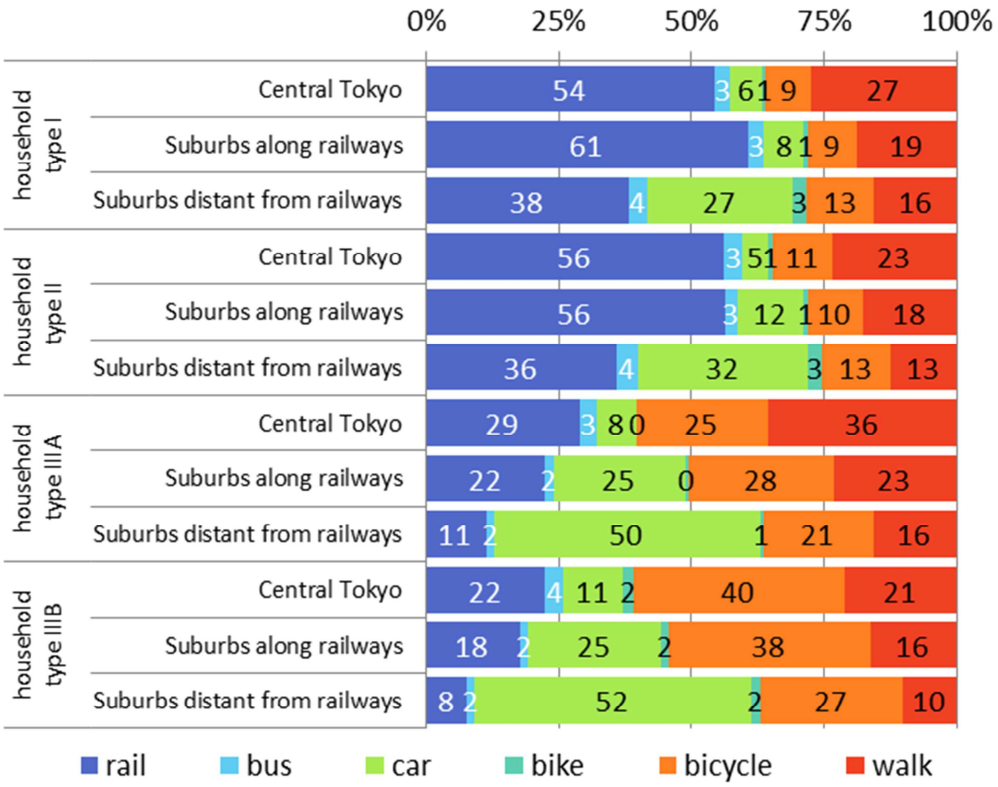


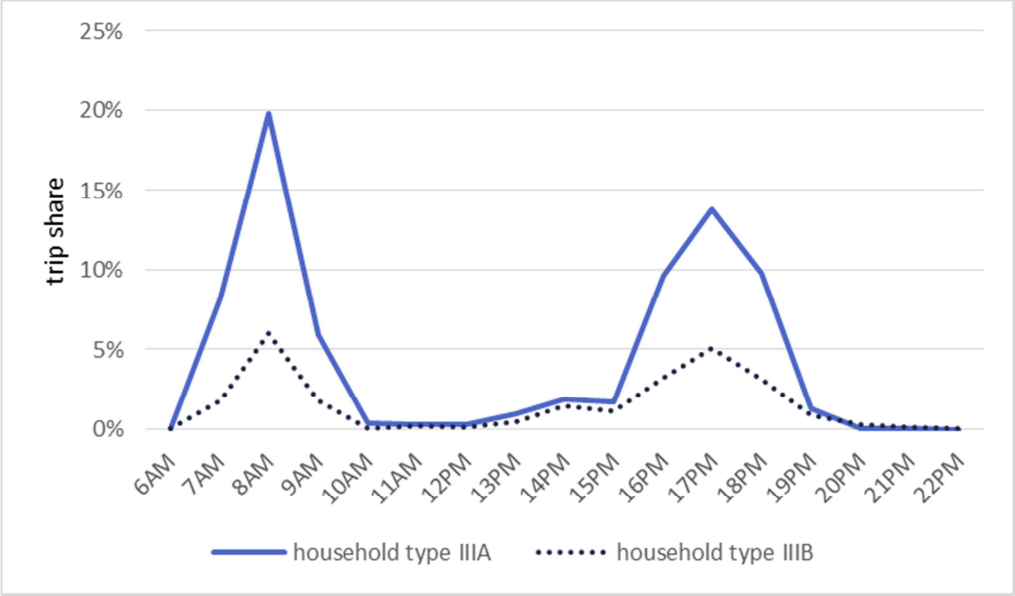
FIGURE 5 Modal Split of Women by Household and by Residential Area (source: Tokyo metropolitan Person-Trip survey, 2008)

ANALYSES PARTICULARLY ADRESSING PICKING UP AND DROPPING OFF AT DAY-CARE

As the results of analyses above suggest, it was remarkable that women in households with children under five years old traveled more frequently for dropping off and picking up compared with women from households with other compositions. Consequently, we targeted working women in household types IIIA and IIIB to analyze the actual situations of trips for picking up and dropping off at day-care exclusively, with attention to the trips which destination facilities are school, educational facilities, kindergarten, and preschool.

Time Zone Distribution of Picking up and Dropping off Trips

There were more trips for picking up and dropping off at day-care in household type IIIA than in household type IIIB. In both types, the trips peaked twice, at 8:00 in and at 17:00. During each time period, the women in household type IIIA made 3–4 times as many trips as those in household type IIIB. The trips in the morning were concentrated during 8:00 to 9:00 because mothers had to arrive at the office before opening time. In the evening, they were somewhat more dispersed: from 16:00 to 18:00.



*the sum of day-care related travel of household; IIIA and IIIB is regarded as 100 percent.

FIGURE 6 Trip Shares of Day-care Related Travel by Household and by Time (source: Tokyo metropolitan Person-Trip survey, 2008)

Actual Conditions of Transporting Children to Day-care on the Way to Work

These analyses revealed that working women in households with children younger than five had trips for day-care related travel at high frequency. Moreover, the picking up and dropping off trips were concentrated in the time period of 8:00 to 9:00. Most burdens for working women in households with children under five years old can be attributed to day-care related travel while commuting.

Then, particularly addressing women's trips for day-care related travel while commuting by residential area, analyses were made to ascertain the level of the burden caused by it. Concretely, targeting trips for picking up children from schools, educational facilities, kindergartens and day-care facilities on the way to work and those women without them in household type III A, comparisons were made of transportation modes used to travel to the pick-up destination to the workplace and the required time spent for travel from home to the workplace. Results depended on the relation between residential places and workplaces. Therefore, residential places were divided into two categories: suburbs along railways and suburbs distant from railways. Workplaces were divided into three categories for comparison: central Tokyo, suburbs along railways, and suburbs distant from railways. The residential places were categorized into two categories because very few women living in the central city transported their children to day-care while commuting.

Modal Split

Women who live in the suburbs along railways and work in central Tokyo or the suburbs along railways used bicycles or walk for day-care related travel and used railways and bicycles for commuting, in general. More than half of the women with workplaces in the suburbs distant from railways used bicycles for day-care related travel and cars for commuting. With their workplaces in the suburbs distant from railways, even if living in the suburbs along railways, the women generally used cars. Women living in the suburbs distant from railways and commuting to central Tokyo used bicycles for day-care related travel and railways for commuting. For women working in the suburbs along or distant from railways, the percentages of trips by cars were the highest for women transporting children to day-care, and commuting.

These showed the following: when they worked in central Tokyo, the women used bicycles or walked for transporting children to day-care and used railways to work; working in the suburbs distant from railways, they used cars both for day-care and day-care related travel and commuting. Working in the suburbs along railways, the ways they used cars depended on whether they lived along or distant from railways.

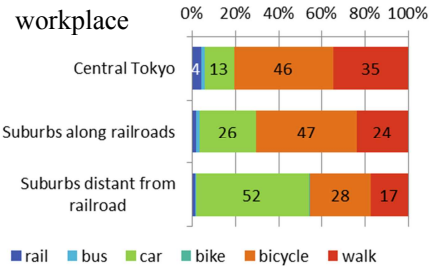
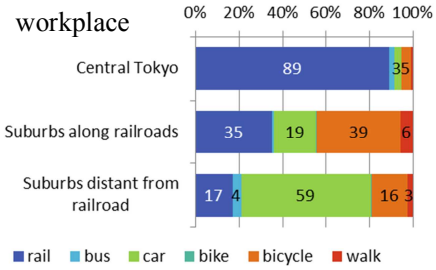
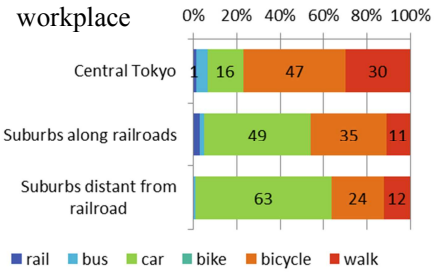
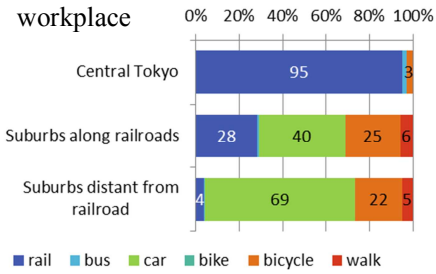
residence	dropping off children	to work
Suburbs Along Railways		
Suburbs Away from Railways		

FIGURE 7 Modal Split (for Transporting Children to Day-care and Commuting) of Women by Household, Residential area, and Workplace (source: Tokyo metropolitan Person-Trip survey, 2008)

Time Required from Home to Workplace

In all cases, there was a time difference of about 10–20 min depending on whether there was day-care related travel while commuting from home to the workplace. The difference of 10–20 min was the physical burden on working women, which seemed to make little difference when compared by area.

The point to examine specifically was the total time necessary for commuting. When women living in the suburbs and working in central Tokyo had day-care related travel, it took 70–80 min on average to travel to the workplace. In the Tokyo metropolitan area, multiple and advanced business functions are integrated in central Tokyo. Women who hope to work in such businesses must look for their workplace there. However, when they choose to live in the suburbs and work in central Tokyo, they must spend as many as 70–80 min twice a day, every day, on traveling to and from workplace in the morning and evening. Furthermore, the main transportation mode to central Tokyo is rail. Therefore, they must take a crowded train at peak rush hour. For this reason, physical burdens are imposed particularly on working women.

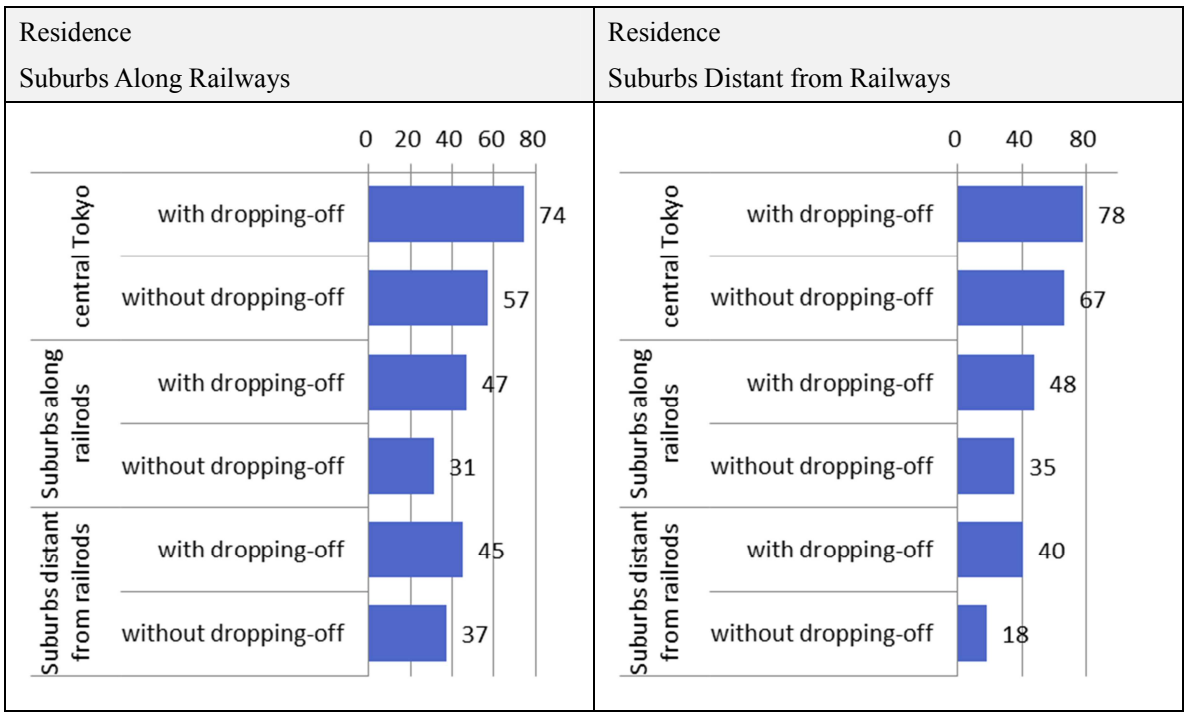


FIGURE 8 Women's Travel Time for Commuting (with and without Day-care-Related Travel) by Household (source: Tokyo metropolitan Person-Trip survey, 2008)

CONCLUSION

Results

With the 2008 Tokyo Metropolitan Area Person-Trip Survey, this study analyzed the travel behaviors of working mothers in nuclear households with day-care children and their day-care related travel and to work.

Compared to households without children, the car ownership rate of the households with children under 5 was higher. The tendency was remarkable especially in the suburbs that were distant from railways. Additionally, although their total number of trip was large because of their high frequency of trips for picking up and dropping off, their total travel time was generally shorter, which showed that they did what they need to do by traveling among various destinations for a short time. Regarding the mode of transportation, the percentages of trips by railways and walking turned out to be high.

Analyses particularly addressing the dropping off children at day-care and others while commuting revealed that the women in households with children aged under five years old had 3–4 times as many trips for dropping off during 8:00 to 9:00 in the morning as women in households without children under five years old. The time difference of 10–20 min was confirmed between the presence of day-care related travel and absence. Particularly, results show that women living in the suburbs and working in central Tokyo, took a train for commuting after taking their children to day-care by bike or on foot. Therefore, they spent as many as 70–80 min, on average, going from home to work. In this way, the results of this study show the characteristics of working mothers with children under five years old in a quantitative manner by area.

Discussion and Future problems

The results of analyses conducted in this research showed that, in terms of the travel behaviors of working women with children under five years old, the number of trips was larger than those by other women. Additionally, transportation modes and travel time varied depending on the area type.

The quality of life (QOL) of working mothers might be affected by various factors including the presence and absence of children and the mothers' day-care related travel, and residential environments, to which might be added "quality of work." That point might be true because the city center often has integrated populations and city functions and provides various and high-quality jobs for which more people live in the suburbs and work in the city center. When women look for challenging jobs, their wish can often and actually be fulfilled in the city center, so they might choose to work in the city center even if the commuting time is somewhat longer. Nevertheless, it is physically impossible for all people working in city center to live there in any city of the same scale as Tokyo. Furthermore, the city center is not necessarily appropriate as an environment in which to rear children. Consequently, it is reasonable to choose living in the suburbs after weighing and evaluating several factors. Which factor might improve the QOL for working women among living and working in the city center, living in the suburbs and working in city center, and living and working in the suburbs depends on which stage of life they are now at and how important they consider their work to be. Certainly, households with children under five years old might have greater physical burdens but more of a

sense of spiritual happiness by which they care for their children. The results of analyses presented herein might constitute objective assessments to consider when choosing among various lifestyles.

For the future, it will be desirable to design cities presenting various options so that the residents can enjoy a variety of jobs and balance work satisfaction, commute time, and day-care related travel. Concretely, political measures to advance the return of residents to the city center and to create hubs with integrated business functions along railways in the suburbs to prevent overconcentration in the city. To realize this, long-term and consistent political measures will be necessary. Ties and collaboration with private companies will also be necessary.

Analyses for this study used only travel behavior data. To evaluate the relationship between travel behavior and QOL of all people as well as working women in the future, it will be necessary to make more qualitative valuations and analyses, say, by introducing the QOL index as a policy variable into the Person-Trip survey.

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GENDER DIFFERENCES IN ESCORTING CHILDREN AMONG DUAL-EARNER FAMILIES IN THE PARIS REGION

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ABSTRACT

The present article looks to pinpoint explanatory factors for the sharing of escorting of children in dual-earner families. It proposes a detailed analysis of inequalities and interactions in dual-earner families when it comes to escorting children by taking into account the characteristics of trips to and from school for children, the characteristics of the parents' occupations, and the characteristics of the household. Compared with earlier research, the model considers more detailed data about the escorts' jobs, such as specific working hours, which provide a better understanding of the constraints on parents and insight into the choices made when both parents are in a position to escort their children. The findings depart somewhat from those of earlier work on the question because more specific data are considered. They show a marked gender inequality in escorting because mothers in dual-earner families do more than two-thirds of the escorting. But the factors explaining the sharing of escorting act almost symmetrically for both parents, with the effect of work starting and finishing times being preponderant. These models confirm that the inequality kicks in ahead of this: mothers in dual-earner households are more often than fathers in jobs with shorter working hours and which are more compatible with escorting.

KEY WORDS

Escorting; Chauffeuring Trips; Dual-earner Families; Parenting; Household Interactions; Household Travel Survey

INTRODUCTION

Much research has been conducted in recent years into parents' escorting of children especially between home and school. This phenomenon lies at the junction of three areas of research into transport and mobility. The first these areas relates to gender differences in mobility (Hanson and Pratt, 1995). It reveals that escorting is shared unequally between mothers and fathers (Gershuny, 1993). Even when both parents are earners, women do more of the chauffering(Schwanen, 2007) because they are considered to be the primary care-givers for the children (Rosenbloom and Burns, 1993). The second, more recent and very active area of research relates to factors prompting active modes of transport for children traveling to school and back. The challenge in this research, much of which has been published in medical journals, is the fight against overweight and obesity (McDonald, 2007; Saelens and Handy, 2008). The effects of the built environment have been investigated and the findings show that accessibility or proximity, mixed land use, density, aesthetics, sidewalks, street connectivity and safety are decisive factors in the choice about children's travel between active modes (walking, cycling) and, implicitly, being chauffeured by parents. But while these factors related to local planning are important, escorting remains primarily a question of the age of the children and the availability of parents, and especially mothers (McDonald, 2008). The third area of research that has been developing in recent years concerns interactions among members of the same household and their effects upon demand for transport (Bhat and Pendyala, 2005). Unlike the research in the other two fields, interaction models point to a difference in factors prompting parents to take their children to school in the mornings or to bring them home in the afternoons (Vovsha and Petersen, 2005; Yarlagadda and Srinivasan, 2008). In these studies, whether the mother works and her working hours are particularly decisive for morning trips. Schwanen et al. (2007) go further by constructing an interaction model combining several reasons for making trips. Apart from whether or not the parents work and their working hours, escorting may vary with the sharing of other activities between the parents, such as shopping.

The present article is part of this third area of research and looks to pinpoint explanatory factors for the sharing of escorting of children in dual-earner families. It proposes a detailed analysis of inequalities and interactions in dual-earner families when it comes to escorting children by taking into account the characteristics of trips to and from school for children, the characteristics of the parents' occupations, and the characteristics of the household, much as in the models proposed by Vovsha and Petersen (2005) or Yarlagadda and Srinivasan(2008). Compared with earlier research, the model considers more detailed data about the escorts' jobs, such as specific working hours, which provide a better understanding of the constraints on parents and insight into the choices made when both parents are in a position to escort their children.

The findings depart somewhat from those of earlier work on the question because more specific data are considered. They clearly show a marked gender inequality in escorting because mothers in dual-earner families do more than two-thirds of the escorting. But the factors explaining the sharing of escorting act almost symmetrically for both parents, with the effect of work starting and finishing times being preponderant. These models confirm that the inequality kicks in ahead of this: mothers in dual-earner households are more often than fathers in jobs with shorting working hours and which are more compatible with escorting, as described by England (1993). Conversely, 'split-shift' practices remain rare in dual-earner families in Ile-de-France, the dominant practice being for the same parent to accompany the children morning and evening.

PREVIOUS RESULTS

Dual earners but not dual carers, women are the primary care-givers and chaperones

Within couples, gender differences have been the subject of much research into the distribution and sharing of household activities, both domestic and parental. These activities are said to catalyse the continuation and re-production of considerable gender inequality (Pfefferkorn 2011). And yet, the growing participation of women in the labour market is indicative of a decline in the supposedly dominant model of the male breadwinner, where the man is the earner and the woman the homemaker

and carer for the children (Crompton 1999; Lewis 2001). This model would seem to have given way to a new more equal ideal of sharing: the dual-earner/dual-carer model in which both men and women participate equally in household activities. However, in point of fact, the dominant model in western countries is rather that of dual-earner but not dual carer because many inequalities remain. Apart from differences in earnings, careers or access to employment, the distribution of jobs related to the home remains a stumbling block. In France the division of both domestic and parental labour has changed little (Ricroch 2012). Even within dual-earner families, the woman is often forced to take on a second service (Hochschild and Machung 1989) doing both her job and domestic chores. Women then find it increasingly difficult to reconcile work and private life (Garner et al. 2005).

Although women do most of the escorting of children, men do contribute too. In the Netherlands, based on an ad hoc survey in Utrecht, Schwanen(2007) reports that men undertake 38.4% of school runs by dual-earner families. In the United States, men are less involved in escorting children according to the National Household Travel Survey (NHTS) making 30.5% of school trips whether the mother is in work or not (McDonald, 2008). On the basis of the Atlanta household activity–travel survey, Vovsha and Petersen (2005) report a similar level of participation by men in taking children school (29.8%) and even lower participation in collecting them from school (23.3%). Analysis of the Household Travel Survey (EGT) for Ile-de-France set out below shows that men do 32% of the escorting.

The unequal contribution of parents to escorting children is not merely the reflection of occupational inequality (level of activity, job characteristics, etc.). While more women work part time and close to home, all else being equal, female household members do more escorting than males (Vovsha and Petersen, 2005). However, the findings by Vovsha and Petersen are based on analyses that take account in part of the characteristics of employment and of the working day of the parents. Yet the sector of activity, type of employment, and precise number of hours worked are all factors that affect the likelihood of escorting the children, as shown by Schwanen (2007). Ignoring the interaction with child commuting, Schwanen reports that, while women maintain a high level of escorting even when they have long working and commuting times, men seldom escort their children when the working and commuting time is above average. Short of a fair share-out of chores, fathers are more involved in escorting children when the mother works. Yarlagadda and Srinivasan(2008) report that men in dual-earner families are more likely to do some of the escorting.

Interactions between partners in escorting practices

Although the characteristics of each of the parents are decisive, some research underscores the crucial role of interactions among household members over escorting the children. But the emphasis falls primarily on the crossed effects between parents and children (McDonald, 2008; Vovsha and Petersen, 2005; Yarlagadda and Srinivasan, 2008) and not between the parents themselves. It is difficult to take account of interactions between parents insofar as the research primarily models children's travel to and from school and not escorting practices by either parent. In addition, two-parent and single-parent families are analysed indiscriminately. At best, the research confirms the fact that women do more chaperoning than men, all else being equal.

Schwanen (2007) proposes a closer analysis of the interactions between parents by considering dual-earner households and modelling the escorting practices of parents rather than children's commutes. The outcome is that women adapt their level of escorting to their partners' time constraints, and the partners offset to some small degree the woman's long working day by moderately increasing their participation in escorting. Moreover, Schwanen et al. (2007) paint a picture of partners who interact intensely but in different ways. They may share traveling by taking advantage of their complementarity (Ettema et al. 2007). For example, faced with very busy schedules, one partner may take care of the shopping while the other escorts the children. This specialisation in domestic activities would seem then to explain why it is predominantly women who do the escorting. However, by comparing the activity schedules of men and women and via analysis of their comments, some couples seem to have an escorting strategy. The father takes the children in the morning before going to work and the mother picks them up in the evening after work (Schwanen 2007). In this case, escorting is shared equally between the parents.

Characteristics of children and of the area determining escorting practices

Besides the characteristics of the parents and their interactions in terms of escorting, other factors related more directly to the children are reported to influence the parents escorting practices. The motivations and the levels of escorting vary greatly with the age of the children. While children under the age of six are almost systematically accompanied to school, the proportion declines rapidly with increasing age (McDonald and Aalborg, 2009; Yarlagadda and Srinivasan, 2008). The number and age of siblings also affects the likelihood that parents will accompany them (Schwanen, 2007). Older siblings can accompany younger ones and parents are less concerned about safety when children go to school in groups (McDonald and Aalborg, 2009; McMillan, 2007).

Insofar as children are seldom escorted by an active mode of transport but essentially by a motorised mode (McDonald, 2008) for reasons of convenience and compatibility with the parents' own commute (Faulkner et al., 2010; McMillan, 2007), the built environment of the home and school is reported to influence the likelihood of parents escorting their children. Several studies have shown that the choice between active and motorized modes is related to the built environment (Saelens and Handy, 2008), especially for children (McMillan, 2005). For many researchers, the aim is to show that public policies can act against problems of overweight and obesity in the population and notably in children by encouraging them to use active modes of transport. Among the characteristics of the built environment, the main factors investigated include accessibility or proximity, mixed land use, density, aesthetics, sidewalks, street connectivity and safety. Although these factors are not to be considered in isolation but must be associated with other factors like the transport options available to parents and children, social/cultural norms, and socio-demographic characteristics, they have some effect on the mode of transport of children and indirectly on the probability of them being accompanied. All told, these factors mean that the locations of the home and children's school or parents' work and their characteristics affect the escorting of children.

HYPOTHESIS AND RESEARCH DESIGN

With regard to the bibliographic framework set out and the factors highlighted, we shall examine the inequalities between parents of dual-earner households in escorting their children on the basis of data from the Household Travel Survey (HTS) of the Paris Region. The survey was not designed specifically for this research but it does contain a fairly precise description of mobility for escorting and for commuting. It was conducted by face-to-face interviews at the respondents' homes and captures information on all trips undertaken by household members aged six and over on a designated survey day as well as socio-demographic information (for complete details of survey design see DREIF (2004)). In all, 10 478 households were surveyed between October 2001 and April 2002. Of those households, about 1 400 were dual-earner families with at least one child. The work analysed escorting (or its absence) by parents of these households. Given the relatively moderate sample size, we capture here only dual-earner couples of different sexes.

We posit three working hypotheses. The first is that escorting practices are shared unequally between men and women, all else being equal. For a working day of equal length, with the same starting and finishing times, it is more likely women will do the escorting. The second hypothesis is that interaction occurs between parents and that despite male/female inequality, the escorting practices of one partner depend on their own occupational constraints and those of their partner and on the partner's escorting practices. Thus the probability that the father will escort the children home in the afternoon will be greater if the mother works late and takes the children to school in the morning. The third hypothesis postulates a spatial dimension to escorting. Schwanen (2007) reports that, for families living in the city centre, fathers escort their children more often than when families live on the outskirts, especially for the morning trips. This work confirms this.

To answer these questions and test the three hypotheses, we perform multivariate analysis based on HTS data for the Paris Region. The results set out here are based on multinomial logit models. The first two predict the likelihood of escorting in the morning, the afternoon or both, one for men and one for women. The next two look exclusively at households which escort their children. They predict the likelihood of it being the father or the mother who do the escorting, one for the

morning and one for the afternoon. We try to capture differences in explanatory factors and different strategies in father/mother and morning/afternoon escorting.

Child escorting in the HTS

The trips studied in this research are the escorting of children by their parents. Parents must live as couples and have jobs. The Paris Region HTS indicates whether the person escorted is part of the household and if so whether it is a child of the couple. In this way, we can circumvent the restriction of the survey—which does not enquire into the mobility of children under six years old—by inferring it from the parents' escorting mobility. This study therefore covers the escorting of all children and not just those aged over six, as in recent research on children's travel. Moreover, all trips were taken into account and not just school runs. It is assumed here that interactions between parents over escorting are not confined to school and that escorting should be taken into account comprehensively so as to better analyse it.

Even so, school remains the main reason and probably the one that structures escorting by parents. Vovsha and Petersen (2005) show that if taking the child involves a detour on the way to work this will have a negative effect on the likelihood that parents will escort the child. For this reason, it is necessary to identify more specifically trips relating to school so as to deduce its location, especially for children under six years old. The HTS from the Paris Region indicates the reasons for the trip made by the person escorted. Yet, only 70% of children under six were escorted to school. To offset this, the detour for parents for other children in the family was applied to children under six for which the detour could not be determined. For children over six who were not escorted to school, information about the location of the school was obtained from analysing the mobility of the children themselves. The school location was included in the models notably by calculating a level of effort, that is, the detour in terms of time involved in escorting to or from school on the commute to and from work.

Characteristics of the partners' working days to understand parents' escorting practices

Information on the mother and fathers' work status, occupation, education, transport mode and distance to work is recorded in the HTS for the Paris Region: these characteristics are known for all of the dual-earner households surveyed. It is also possible to infer the number of hours worked by each parent from the departure and arrival times for commutes, which is a variable used in many models about escorting or children's school journeys. But we also used the starting and finishing times at work to determine whether they were compatible with their children's school times and to check whether parents are in a position to take their children to and from school. In the French school system, which is very largely state-run, school times up to the age of 10 are fixed, starting at about 8.30 am (depending on the local area and schools) and ending at around 4.30 pm. Moreover, in most schools, there are after-school arrangements for children to remain up to 6.00 pm. This time extension means parents can more easily collect their children from school. Two variables indicating the compatibility of parents' working hours with morning and afternoon school times were used in the models presented. Above the age of 10[1], school starting and finishing times may be more variable. However, up to the age of 15 at least, the school day from 8.30 am to 4.30 pm remains the dominant model.

Interactions between partners examined in two models with instrumental variables

In order to introduce interactions into log models between escorting trips, a problem of endogeneity has to be overcome. If one tries to explain the likelihood that one of the parents escorts the children in the morning by the fact that they did or did not escort the children in the afternoon, it is obvious that

[1] Children above 10 usually start to go to secondary school (UK) or middle school (USA) or college (in French). In french secondary schools, each subject is teach by different teachers and pupils may have more complex time schedule.

the cause and effect may work in both directions. A parent who collects the children in the afternoon will be less likely to take them in the morning; but a parent who takes them in the morning will also be less likely to collect them in the afternoon.

We therefore construct four models with instrumental variables to predict the likelihood of escorting in the morning and the afternoon for each of the parents. These are standard logistic regression models. The instruments used are a set of socio-demographic variables similar to those presented below in the final models. These probabilities of escorting the children are then used as explanatory variables in the models to capture any interaction between escorting trips.

RESULTS

Factors affecting escorting for dual-earner families: few differences between men and women

Among the dual-earner households studied, 55% of parents escorted their children at least once on the survey day. This figure ranges from more than 70% for households with at least one child under the age of 6 to 31% when the household has at least one grown-up child. Escorting is usually done by women since almost half of mothers escort their children versus less than one-third of fathers (Table 1). Far more mothers than fathers escort both mornings and afternoons, and a few more mothers than fathers escort just in the mornings, which is consistent with observations in other countries. A relative balance is found between fathers and mothers for escorting in the afternoons alone. However, it can be observed at this point that some characteristics of women's employment may be related to these gender differences. More women begin work after 8.30 am, giving them the opportunity to escort their children in that time slot.

TABLE 1 Descriptive variables of dual-earner households with one or more children

Variables		Men		Women	
		N	%	N	%
Escorting	None	922	72.0	709	55.4
	am and pm	46	3.6	202	15.8
	Am	156	12.2	208	16.2
	Pm	157	12.3	162	12.6
Employment	Public sector	316	24.7	456	35.6
	Private sector	827	64.6	746	58.2
	Liberal profession	138	10.8	79	6.2
Work starting time	> 08:30	676	52.8	479	37.4
	< 08:30	605	47.2	802	62.6
Work finishing time	> 18:00	657	51.3	490	38.2
	< 18:00	624	48.7	791	61.8
08:30 > working day > 18:00		233	18.2	109	8.5
08:30 < working day > 18:00		424	33.1	381	29.7
08:30 > working day < 18:00		443	34.6	370	28.9
08:30 < working day < 18:00		181	14.1	421	32.9
Urban commuting distance		11.5 km		8.1 km	
Outer suburban commuting distance		12.4 km		10.5 km	
Rural commuting distance		21.6 km		17.7 km	
		Household			
		N	%		
Number of children	1	580	45.3		
	2	554	43.3		
	3 and more	147	11.4		
Children aged under six	None	670	52.3		
	1 or more	611	47.7		
Adult children (over 18)	None	1074	83.8		
	1 or more	207	16.2		
Number of cars	None	83	6.5		
	1	530	41.3		

	2 or more	668	52.1
Area of residence	Urban	1051	82.0
	Outer suburbs	135	10.5
	Rural	95	7.4

TABLE 2 Logistic Model: Probability the father escorts both mornings and afternoons, mornings only or afternoons only

		Estimate	Std. Error	t-value	Pr(>|t|)	
am and pm		-5.7	1.3	-4.525	6E-06	***
Am		-5.8	0.97	-5.831	5E-09	***
Pm		-3.7	0.73	-5.039	5E-07	***
am and pm	Mother escorts am	-0.44	0.3	-1.445	0.148	
Am	Mother escorts am	-0.56	0.18	-2.930	0.003	**
Pm	Mother escorts am	0.51	0.2	2.530	0.011	*
am and pm	Mother escorts pm	-0.32	0.21	-1.522	0.128	
Am	Mother escorts pm	0.16	0.13	1.264	0.206	
Pm	Mother escorts pm	-0.45	0.12	-3.562	0.000	***
am and pm	Private sector employment	-0.18	0.35	-0.530	0.596	
Am	Private sector employment	0.066	0.23	0.284	0.776	
Pm	Private sector employment	-0.59	0.21	-2.850	0.004	**
am and pm	Liberal profession	-1.5	0.81	-1.857	0.063	.
Am	Liberal profession	-0.3	0.36	-0.838	0.401	
Pm	Liberal profession	-1.3	0.45	-2.921	0.003	**
am and pm	Start work > 08:30	0.1	0.34	2.960	0.003	**
Am	Start work > 08:30	1.7	0.23	7.177	7E-13	***
Pm	Start work > 08:30	-0.15	0.22	-0.701	0.483	
am and pm	Finish work < 18:00	1.2	0.36	3.381	0.001	***
Am	Finish work < 18:00	-0.72	0.22	-3.213	0.001	**
Pm	Finish work < 18:00	1.9	0.26	7.730	1E-14	***
am and pm	Commute (m)	-5.0E-05	1.8E-05	-2.677	0.007	**
Am	Commute (m)	-4.9E-06	8.7E-06	-0.567	0.570	
Pm	Commute (m)	-1.2E-05	8.5E-06	-1.365	0.172	
am and pm	2 children	0.38	0.37	1.029	0.303	
Am	2 children	0.61	0.23	2.571	0.010	*
Pm	2 children	-0.19	0.23	-0.829	0.407	
am and pm	3 or more children	0.045	0.51	0.087	0.930	
Am	3 or more children	0.74	0.29	2.595	0.009	**
Pm	3 or more children	7.3E-03	0.32	0.023	0.981	
am and pm	1 or more children under 6	0.98	0.44	2.228	0.026	*
Am	1 or more children under 6	0.86	0.26	3.302	0.001	***
Pm	1 or more children under 6	0.93	0.28	3.393	0.001	***
am and pm	1 or more adult children	-2.0	0.81	-2.448	0.013	*
Am	1 or more adult children	-0.59	0.41	-1.449	0.147	
Pm	1 or more adult children	-0.44	0.44	-0.989	0.323	
am and pm	1 car	0.99	0.95	1.053	0.292	
Am	1 car	1.9	0.82	2.317	0.020	*
Pm	1 car	0.68	0.51	1.346	0.178	
am and pm	2 or more cars	0.95	0.97	0.979	0.328	
Am	2 or more cars	2.3	0.83	2.779	0.005	**
Pm	2 or more cars	0.84	0.52	1.615	0.106	
am and pm	Home in outer suburbs	0.99	0.43	2.310	0.021	*
Am	Home in outer suburbs	0.066	0.32	0.208	0.835	
Pm	Home in outer suburbs	0.19	0.29	0.654	0.513	
am and pm	Home in rural area	1.1	0.55	2.030	0.042	*
Am	Home in rural area	-0.13	0.37	-0.342	0.732	
Pm	Home in rural area	0.45	0.34	1.314	0.189	

TABLE 3 Logistic Model: Probability the mother escorts both mornings and afternoons, mornings only or afternoons only

		Estimate	Std. Error	t-value	Pr(>|t|)	
am and pm		-5.2	0.86	-6.053	1E-09	***
Am		-3.7	0.85	-4.359	1E-05	***
Pm		-3.2	0.92	-3.480	0.000	***
am and pm	Father escorts am	-0.22	1.1	-2.002	0.045	*
Am	Father escorts am	-0.29	0.11	-2.653	0.008	**
Pm	Father escorts am	0.27	0.12	2.363	0.018	*
am and pm	Father escorts pm	-0.29	0.10	-2.915	0.003	**
Am	Father escorts pm	0.21	0.099	2.086	0.037	*
Pm	Father escorts pm	-0.37	0.1.1	-3.506	0.000	***
am and pm	Private sector employment	-0.15	0.19	-0.789	0.430	
Am	Private sector employment	0.43	0.20	2.153	0.031	*
Pm	Private sector employment	-0.25	0.20	-1.250	0.211	
am and pm	Liberal profession	-1.0	0.47	-2.215	0.027	*
Am	Liberal profession	0.10	0.38	0.274	0.784	
Pm	Liberal profession	0.082	0.39	0.208	0.835	
am and pm	Start work > 08:30	0.83	0.19	4.240	2E-05	***
Am	Start work > 08:30	1.2	0.22	5.757	9E-09	***
Pm	Start work > 08:30	-0.48	0.19	-2.488	0.013	*
am and pm	Finish work < 18:00	1.3	0.21	6.439	1E-10	***
Am	Finish work < 18:00	-0.16	0.18	-0.897	0.369	
Pm	Finish work < 18:00	1.7	0.26	6.545	6E-11	***
am and pm	Commute (m)	-4.6E-05	1.2E-05	-3.946	8E-05	***
Am	Commute (m)	-3.4E-05	1.1E-05	-3.139	0.002	**
Pm	Commute (m)	4.5E-06	9.7E-06	0.470	0.638	
am and pm	2 children	0.49	0.19	2.642	0.009	**
Am	2 children	0.39	0.18	2.152	0.031	*
Pm	2 children	-0.065	0.21	-0.314	0.753	
am and pm	3 or more children	0.18	0.31	0.581	0.560	
Am	3 or more children	-0.022	0.31	-0.071	0.943	
Pm	3 or more children	0.26	0.29	0.903	0.367	
am and pm	1 or more children under 6	1.5	0.22	6.646	3E-11	***
Am	1 or more children under 6	0.72	0.22	3.272	0.001	**
Pm	1 or more children under 6	1.0	0.23	4.494	7E-06	***
am and pm	1 or more adult children	-1.7	0.40	-4.255	2E-05	***
Am	1 or more adult children	-1.2	0.32	-3.714	0.000	***
Pm	1 or more adult children	-0.29	0.32	-0.904	0.366	
am and pm	1 car	0.77	0.53	1.468	0.142	
Am	1 car	0.89	0.51	1.757	0.078	.
Pm	1 car	0.066	0.61	0.108	0.913	
am and pm	2 or more cars	1.4	0.53	2.625	0.009	**
Am	2 or more cars	1.3	0.52	2.554	0.010	*
Pm	2 or more cars	0.21	0.62	0.334	0.738	
am and pm	Home in outer suburbs	0.24	0.30	0.806	0.420	
Am	Home in outer suburbs	5.5E-03	0.28	0.018	0.984	
Pm	Home in outer suburbs	0.17	0.30	0.574	0.566	
am and pm	Home in rural area	0.94	0.31	3.070	0.002	**
Am	Home in rural area	-0.077	0.36	-0.213	0.831	
Pm	Home in rural area	0.23	0.34	0.687	0.492	

The first model (Table 2) predicts the likelihood that fathers will escort the children in the mornings or in the afternoons, or that they will escort them mornings and afternoons. The second model (Table 3) predicts the same probabilities for mothers. The main explanatory variables of the two models work in similar ways: the start and finish times of work for the parents and the presence of children under the age of 6 in the household. The presence of young children has a very positive effect

on the probability of escorting in the mornings and/or afternoons for fathers and mothers. For working hours, a late start increases the probability of escorting in the mornings only or mornings and afternoons. Conversely, an early finish increases the likelihood of children being escorted in the afternoons only or mornings and afternoons. Apart from the main explanatory variables, two other factors have significant effects on the probability of parents escorting children. The likelihood of escorting in the mornings increases for parents in households with several children and for those with one or more cars. The likelihood of escorting mornings and afternoons is also greater for mothers in households with two children and/or two or more cars.

Concerning the three hypotheses posited in this article, the factors of gender inequality seem somewhat reduced in these first two models. The first relates to the type of occupation, the second to the presence of a third adult in the household. Thus men who are private sector employees or in the professions are less likely to escort children in the afternoons than are men who are public sector employees. For women in similar occupations, there is no significant reduction in the likelihood of them escorting their children according to type of occupation except for escorting them in the mornings for private sector workers and for double escorts (mornings and afternoons) for those in the professions. Conversely, the presence of an adult child (over 18 which is legal age of majority in France) significantly reduces the likelihood the mother will escort the children in the mornings or mornings and afternoons. For the partner, the presence of a third adult reduces only the probability of morning and afternoon escorts and barely significantly. For afternoon escorts, the presence of a third adult has no significant effect, even for mothers. It can be postulated that afternoon escorts are those which weigh somewhat less heavily on mothers (cf. Table 3), even if they still perform them more often than fathers. The second hypothesis relates to forms of interaction between parents. In the first series of models, there are two types of interaction. First, if one parent escorts the children in the mornings or afternoons, the likelihood that the other parent escorts the children in the same time slot is very low. Just one parent seems to escort in a given time slot. Secondly, if one parent escorts in the mornings, it is much more likely that the other parent will escort the children in the afternoons. Parents are complementary between mornings and afternoons. The final hypothesis relates to the existence of a spatial dimension of escorting. Such an effect is not very frequent in models. Only living in a rural area significantly increases the likelihood of escorting both mornings and afternoons. The same is true for the outer suburbs, but for fathers only. This result is presumably because parents are more likely to escort children when they live in the outer suburbs and in low density areas where schools (nursery, pre-school, primary) are often furthest from home. Less directly, the models below tend to show that the commuting distance (in metres) reduces the propensity to escort both mornings and afternoons for fathers and for mothers, and to escort children in the mornings for mothers. Thus the distance between home and work might have a negative overall effect on the likelihood of escorting children in dual-earner households in the outer suburbs and rural areas, given that these distances generally increase as one moves away from the city centre (Table 2)

In which cases do fathers do more escorting than mothers?

For parents who escort their children in the mornings only, in more than two-thirds of instances it is the mother who does this (Table 4). Yet in nearly half of households (49.1%), fathers have working hours that are compatible with taking children to school in the mornings. In our sample, more women use public transport which is less amenable to escorting practices (Prédali 2005), especially in the mornings.

TABLE 4 Descriptive variables of households escorting in the mornings

Variables		N	%
Escorting	Mother	372	69.5
	Father	164	30.5
Start work > 08:30	None	85	15.8
	Mother	188	35.0
	Father	77	14.3
	Both	187	34.8

Father's transport mode	Public transport	137	25.6
	Car	345	64.4
	Foot	53	9.9
Mother's transport mode	Public transport	192	35.9
	Car	301	56.2
	Foot	42	7.9
Adult child	None	498	92.9
	1 or more	38	7.1
Home area	Urban	437	81.4
	Outer suburbs	55	10.3
	Rural	44	8.3

The model below (Table 5) predicts the probability of fathers escorting more than mothers in the mornings. The main explanatory variable relates to the work starting times. Unsurprisingly, the likelihood that fathers will do the escorting is greater when their working hours are compatible with those of the school and when the mothers' working hours are incompatible. Conversely, the probability fathers will escort children is far lower when their work starting times are not compatible with school times and mothers' working hours are. Where both parents' working hours are compatible, no trend stands out. Intuitively, in such a situation, it would be expected that mothers would do more of the escorting. For all the other variables in the model, symmetry of effects between fathers and mothers can be observed. For example, having just one car increases the likelihood that the parent using that means of transport for going to work will also escort the children. Similarly, making a big detour on the journey to work to drop off the children (materialised here by the level of effort to deviate from one's route) reduces the likelihood of escorting for fathers and mothers alike. There is therefore no amplification of the asymmetry between men and women with respect to the factors that prompt them to escort the children, at least for those parents who do escort their children. That women do most of the escorting in the mornings seems therefore to be related to a structure effect: more women than men apparently have working hours that are compatible with escorting, somewhat more limited access to car use, and jobs closer to home. Lastly, we do not highlight in this model, interaction between morning and afternoon escorting for households escorting in the mornings.

TABLE 5 Logistic Model: Probability that the father rather than the mother will escort the children in the mornings (only households escorting in the mornings)

		Estimate	Std.Error	t-value	Pr(>|t|)	
Father escorts		-0.95	0.44	-2.148	0.032	*
Father escorts	Start work mother > 08:30	-21	0.41	-5.162	2E-07	***
Father escorts	Start work father > 08:30	1.5	0.37	4.122	4E-05	***
Father escorts	Start work both > 08:30	0.28	0.31	0.864	0.387	
Father escorts	Car father	0.63	0.30	2.116	0.034	*
Father escorts	Foot father	-4.2E-03	0.47	-0.009	0.993	
Father escorts	Car mother	-0.58	0.27	-2.093	0.036	*
Father escorts	Foot mother	-0.35	0.49	-0.698	0.485	
Father escorts	1 or more adult children	0.66	0.41	1.618	0.106	
Father escorts	Commute father (m)	-3.9E-05	1.2E-05	-3.385	0.001	***
Father escorts	Commute mother (m)	6.3E-05	1.5E-05	4.064	5E-05	***
Father escorts	Level of effort father	-2.5E-04	8.5E-05	-2.978	0.003	**
Father escorts	Level of effort mother	3.2E-04	8.5E-05	3.758	0.000	***
Father escorts	Home in outer suburbs	-0.21	0.36	-0.582	0.561	
Father escorts	Home in rural area	-0.45	0.44	-1.003	0.316	

Escorting in the evenings is in the great majority of instances done by women too, in a ratio of 1 to 2 (Table 6). Later work finishing times for men are amenable to more escorting for women than for men in the afternoons. The model predicting the likelihood of escorting in the afternoons for men compared with women shows, as for the morning model, a degree of symmetry of effects between men and women (Table 7). However, work finishing times aside, there is less symmetry for afternoon

than for morning escorting. Thus, the length of the commute of one parent significantly increases the likelihood that the other will escort more in the afternoons, but less so than in the mornings. Moreover, the symmetry observed in the mornings in terms of car use or level of effort disappears. In the evenings, the likelihood the father will escort more than the mother depends above all on the fact that the mother travels by car or has a sizeable level of effort.

To conclude, in these two models, the spatial dimension does not seem to be directly involved since the household residential area has little or no effect on escorting by one parent rather than the other.

TABLE 6 Descriptive variables of households escorting in the afternoons

Variables		N	%
Escorting	Mother	330	66.2
	Father	169	33.8
Finish work < 18: 00	Neither	64	12.9
	Mother only	182	36.6
	Father only	92	18.5
	Both	160	32.0
Father's transport mode	Public transport	140	28.0
	Car	313	62.6
	Foot	47	9.4
Mother's transport mode	Transports publics	185	37.1
	Car	278	55.7
	Foot	36	7.2
Adult child	None	458	91.8
	1 or more	41	8.2
Home area	Urban	399	79.9
	Outer suburbs	55	10.9
	Rural	46	9.2

TABLE 7 Logistic Model: Probability that the father escorts in the afternoons rather than the mother (only for households escorting in the afternoons)

		Estimate	Std.Error	t-value	Pr(>|t|)	
Father escorts		-0.35	0.453	-3.771	0.437	
Father escorts	Finish work mother > 18:00	-2.3	0.431	-5.427	6E-08	***
Father escorts	Finish work father > 18:00	2.1	0.389	5.492	4E-08	***
Father escorts	Finish work both > 18:00	0.11	0.329	0.341	0.732	
Father escorts	Car father	4.6E-03	0.297	0.015	0.987	
Father escorts	Foot father	-0.29	0.489	-0.599	0.549	
Father escorts	Car mother	-0.60	0.294	-2.041	0.041	*
Father escorts	Foot mother	-0.52	0.564	-0.924	0.355	
Father escorts	1 or more adult children	0.50	0.429	1.155	0.248	
Father escorts	Commute father (m)	-2.9E-05	1.23E-05	-2.401	0.016	*
Father escorts	Commute mother (m)	3.4E-05	1.54E-05	2.217	0.027	*
Father escorts	Level of effort father	-6.5E-05	4.62E-05	-1.415	0.157	
Father escorts	Level of effort mother	1.5E-04	6.17E-05	2.504	0.012	*
Father escorts	Home in outer suburbs	0.67	0.372	1.792	0.073	.
Father escorts	Home in rural area	-0.16	0.449	-0.349	0,727	

DISCUSSION

In dual-earner families in Ile-de-France, half escort their children, and those with young children escort them more than those whose children are adults. Unsurprisingly, women escort twice as much as men, conducting two-thirds of the escorts. Above all, gender inequalities are marked by the proportion of women accompanying both mornings and afternoons. They are four times as many and represent 35% of women who escort their children.

Observation of gender differences with respect to the factors that lead parents to escort their children reveals that the main factors are nonetheless common to men and women. They produce the same type of effect on the likelihood of escorting, especially in the mornings and to a lesser degree in the afternoons. These factors are, by order of importance, the presence of young children in the household, then work starting and finishing times, and their compatibility with the child-care or school times. Differences between men and women are few and have little effect in the respective models predicting the probability of escorting. However, men escort less in the afternoons when they are private sector employees or in the professions whereas women who are employed in the private sector escort more in the mornings. Next, men are more likely to escort in the mornings the more children they have, while this effect is weak or non-existent for women. Lastly, and conversely, the presence of a grown-up child in the household greatly reduces the probability women will escort in the mornings or afternoons. However, for men, these effects are weak (mornings and afternoons) but above all non-existent. Moreover, women appear more sensitive to the length of their commutes for escorting in the mornings and for morning and afternoon escorting.

This first series of results highlights the slight gender differences as to the determinants of escorting practices for dual-earner households that can be captured with this type of model. The explanations for the very marked inequality between men and women in escorting are therefore to be sought ahead of the escorting decisions. The models reveal that the parents' employment conditions are the main determinants of the decision to escort. Now, as has been seen, there are inequalities with respect to the parents' working days. The mother's working day is often more compatible with escorting than the father's, especially in terms of starting and finishing times, commuting distance, type of employment and means of transport. She then does most of the escorting. Unfortunately, the HTS does not enable us to determine whether the mother's choice of a job which is compatible with escorting is dictated by the need to ensure such escorting or whether there are other determinants.

The second series of models pertaining to escorting dual-earner households confirms the observation about unequal escorting between parents prompted by the difference between their working days rather than by greater investment by mothers, regardless of the constraints of their working day and of the fathers' working day. The second series of models shows symmetry between parents of the effects of factors affecting escorting. It will be observed that this symmetry is stronger overall in the mornings than the afternoons, which might be in part because there is more escorting in the mornings than in the afternoons.

Thus for dual-earner households, gender inequalities in their escorting practices are not to be sought in the relations between these practices and the parents' working days. Ahead of this, the inequality lies in the choice of employment and the working day it involves. Many results show that women in dual-earner households tend to have jobs with shorter and more flexible working hours, jobs that are closer to home and that allow them to do most of the care-giving and escorting for the children (England, 1993).

The link for escorting between the partners and/or between afternoon and morning revealed by Schwanen (2007) in the Netherlands is also apparent in the case of Paris. It is above all apparent as a negative link between the probability of one partner making escorting trips and the other partner doing so too, particularly in the morning. It is also apparent as a negative link between the probability of one partner conducting escorting trips both in the morning and afternoon. These effects express what has been said above and what emerged from the descriptive analysis: the dominant model is that of a household where a single partner is responsible for escorting either in the morning or in the evening. The strongest and most systematic effect involves a link between the partners for escorting trips during a given half day, which we shall characterise as optimisation by the sharing of escorting trips between the couple before and after work. This sharing, which we shall characterise as complementarity, occurs when one partner takes on escorting duties before work and the other does so after work. The probability of complementarity between the partners with regard to escorting is low. Next, the third form of interaction between escorting practices involves the performance of escorting duties in the morning and evening by the same partner.

A final element is the spatial dimension of escorting practices. Parents in dual-earner households escort their children when they live in the outer suburbs of cities, in low-density areas. Schools there are less commonly within walking distance but there are also no safe and pleasant paths

for pedestrians. Yet the spatial effect identified remains slight and is applicable only in certain cases. It tends to increase the likelihood that one of the parents will escort the children in the mornings or afternoons. Children are escorted more systematically in such areas. This effect is more striking because longer average commuting distances in these areas tend to reduce the likelihood of parents escorting their children. The spatial dimension of escorting practices therefore arises less directly, through commuting distances or levels of effort which appear to be greater in less densely populated areas. These variables act more significantly on the relative likelihood of escorting by one or other of the parents.

CONCLUSION

We had three working hypotheses. The first is that escorting practices are shared unequally between men and women, all else being equal (H1). For a working day of equal length, with the same starting and finishing times, it is more likely women will do the escorting. The second hypothesis is that interaction occurs between parents and that despite male/female inequality, the escorting practices of one partner depend on their own occupational constraints and those of their partner and on the partner's escorting practices (H2). Thus the probability that the father will escort the children home in the afternoon will be greater if the mother works late and takes the children to school in the morning. The third hypothesis postulates a spatial dimension to escorting (H3).

Exploitation of the HTS for Ile-de-France reveals that the practice of escorting children differs between men and women within dual-earner households, with mothers being more active than fathers. Nonetheless, in dual-earner households, interactions are often at work in the sharing of escorting since the escorting practices of one parent affect the practices of the other parent.To return to the research by Schwanen et al. (2007), interactions between fathers and mothers most probably result in complementarity (if one escorts at one time, the other will have significantly less chance of escorting at the same time) or specialisation (just one parent takes charge of all escorting) in the management of these trips (H2). More generally, looking at factors which influence escorting by one or other parent and especially the factors relating to the other parent (work times, commuting distance, etc.), these factors operate in similar ways on the escorting of children and the way it is shared. All else being equal, differences in escorting practices between mothers and fathers would seem to be minimal (H1).

But it is known that in terms of gender and the sharing of activities within the household, all else is far from equal. If there is parity between the partners in terms of activity or of residential location, many inequalities remain in terms of employment conditions (working hours, location, etc.) and modes, etc. These differences necessarily affect the population structure and ultimately the escorting practices that depend on it. The results presented are therefore the outcome of a structure effect related both to the conditions in which our sub-sample was selected and to the inherent and persistent inequalities in gender and the sharing of daily activities and trips. A better understanding of the inequalities in terms of escorting would require a better understanding of the gender-based distribution of all of the household's travel patterns.

Inequalities in terms of domestic activities and more especially of care-giving for children are largely determined by the socio-spatial or cultural characteristics of the populations under study (Craig and Mullan 2011). The greater propensity of women in France to work part time seems to explain why an activity like escorting is less evenly shared than in other countries, especially Scandinavia. On a finer scale, like that of Ile-de-France and its various areas, these differences are not readily observable, here again because of the selection of our sub-sample of dual-earner households. This selection bias would explain why spatial variables have little effect on escorting trips within our population (H3). However, being persuaded of the importance of geography in gender-based mobility (Uteng and Cresswell 2008), further exploration should be done by examining the data of mobility surveys of other regions and cities in France.

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GENDER IDENTITY AND RISKY BEHAVIORS AMONG YOUNG DRIVERS

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ABSTRACT

Globally, men, and particularly young men, are involved in more road traffic crashes than women, which may be due to a greater tendency to engage in risky behaviors. Understanding and explaining this "gender specificity" in risky behaviors, specifically among young drivers, has become a major public-health issue. The present study extends research on the effect of gender identity on risky driving behaviors by investigating the effect of sex, sex-stereotype conformity and gender group identification on self-reported driving behaviors among young drivers. 75 young drivers (28 males, 47 females) filled in a form including a series of scales assessing gender group identification by measuring three components of gender identity (typicality, contentedness and centrality), a French version of the Bem Sex-Role Inventory, an extended version of the Driver Behaviour Questionnaire (assessing violations, dangerous and inattention errors and positive behaviors) and questions about mobility and accident history. The effects were tested on outcome variables by using hierarchical regression analysis. It was found that sex (being female) only predicted the inexperience errors, while the femininity score negatively predicted the number of accidents. No effects of maleness and masculinity were observed in other driver behaviors, contrary to what was expected. Gender identity variables only had an effect among males, with typicality positively predicting dangerous errors and contentedness negatively predicting positive behaviors. Lastly, results showed that gender identification appears to be associated with low conformity to feminine stereotypes among males. Hypotheses were not confirmed but results underlined the importance of taking gender identity variables into account when explaining risk-taking differences between and within gender groups. Implications of these results are discussed.

1. INTRODUCTION

Gender differences are well known in accidentology and manifest themselves very early on in different types of accidents, and in particular in traffic injury rates. Men are involved in more road traffic crashes than women. In most Western countries, male drivers are 2 to 3 times more likely to die in road traffic crashes than female drivers *(1, 2)*. In France, men were nearly four times more likely to die and twice as likely to be injured for the same number of miles travelled, in 2007 *(3)*. Male drivers also commit more traffic offenses than females *(4)*, which is associated with active and passive accidents *(5, 6)*. This sexospecificity in accidents and offenses is particularly noticeable among young drivers. Studies underline several variables behind the high accident rates among young drivers, like life style, driving inexperience, lack of skills, risk perception, drinking and driving and risk taking *(7–11)*. Risk-taking would also explain gender differences in accidents rates. Generally, males tend to engage significantly more than women in high-risk activities *(12)*. More particularly, young male drivers are more prone to taking risks *(13)*, engaging in aggressive driving behaviors, driving fast, and committing more violations than other age groups *(14, 15)*, which contributes to increase the frequency and extent of trauma in this population.

Men's tendency to take more risks has been generally explained in the past by biological theories and notably by the effect of testosterone, a male steroid hormone, that has been associated with sensation seeking *(16)*, aggression *(17)* and venturesomeness *(18)*. However, according to recent researches, these relationships could be influenced by socialization *(19)*.

Recent studies have explored social environment influences on adults' gender differences in risk-taking behavior and transgression, taking into account the effects of gender roles, that is social expectations in terms of behaviors, personality traits and activity, depending upon the individual gender group *(20)*. The majority of people's beliefs regarding male and female behavior can be summarized in terms of differences on two dimensions, the communal and the agentic *(21)*. Women are expected to be friendly, unselfish, concerned with others, emotionally expressive, sensitive and caring, whereas men are expected to be assertive, directive, instrumentally competent, autonomous, adventurous and independent *(22–27)*. Gender roles are based on gender stereotypes, which can be defined as the set of beliefs regarding what it means to be a male or a female in a given society *(23)*. In particular, risk-taking is characterized as a typically masculine type of behavior *(28)*, which is consistent with risk-taking gender norms: while females are expected to be passive and non-competitive, and to not take risks, males are encouraged to be more aggressive and to take risks *(29)*. Thus, gender roles, through differential socialization, could lead to gender differences concerning compliance with traffic regulations *(29)* and risk taking *(30, 31)*. Nevertheless, an individual can conform to stereotypes associated with both sex groups *(28)*, thus gender roles could explain differences in risk-taking between and within sex groups.

Most of the studies showed the deleterious effect of masculinity on risky driving behaviors. For example, men who have been primed with the concept of masculinity exhibit more risky driving behaviors, particularly in terms of speed *(32)*. Men who exhibit a macho personality have been showed to report more aggressive driving behavior than other men *(33)*. Conformity to masculine stereotypes has been showed to predict self-reported injury risk behavior and driving style, with masculine people reporting more violations and offenses than feminine people *(34)*, overestimating their driving skills *(35)* and perceiving themselves as having better perceptual-motor skills *(36)*, which is associated with a risky driving style and road accidents.

On the other hand, femininity seems to have beneficial effect on risky behaviors. In driving, femininity has been showed to negatively predict the number of accidents and offenses, aggressive and ordinary violations, and errors *(34)*. Plus, high levels of femininity buffer the effects of masculinity on accidents and aggressive violations *(34)*. Özkan and Lajunen *(36)* highlighted the link between femininity and skills in terms of safety that are negatively related to the number of accidents. Thus, although masculinity seems to reinforce risky driving behaviors, femininity seems to be negatively associated with risky driving behaviors.

Research showed that sex-stereotype conformity would be a better predictor of declared injury-risk behaviors than biological sex *(31, 37)*. For example, in a study about risky driving behaviors, Özkan and Lajunen *(34)* showed that being male positively predicted only self-reported ordinary violations, while masculinity positively predicted the number of offenses, and aggressive and ordinary violations. Sibley and Harré *(35)* showed that gender role identification fully mediated the effect of gender on driving self-enhancement that is linked to risk-taking. Other researches assume that there may be a double risk factor for men due to both biological and social gender *(38)*.

Studies investigating the link between gender roles and risky behaviors generally used the Bem Sex Role Inventory *(28)*. In BSRI, masculinity and femininity are independent dimensions constituted with male-typed and female-typed traits, according to their social desirability in society. That is to say, masculinity consists of traits evaluated to be more suitable for males than females, whereas femininity consists of traits evaluated more acceptable for females than males in the society. Masculinity is ‘‘an instrumental orientation, a cognitive focus on ‘getting the job done’; and femininity has been associated with an expressive orientation, an affective concern for the welfare of others” *(28, p.156)*. Studies using the inventory have found masculine sex role orientation - that is to say, conformity to agentic traits such as competition, assertiveness or self-confidence - to be associated with sensation seeking *(39)* agression *(40)* and self-enhancement *(35)*, which have been linked to risky driving *(41, 42)*. On the other hand, conformity to communal traits appears to be linked to lower hostility *(43)*.

Most studies that have examined the relationship between gender roles and risky driving behaviors focus on the effect of masculinity and femininity on risky behaviors, considering gender identity in terms of gender stereotype conformity only. However, gender identity is now viewed as a multidimensional construct *(44)*, including not only the traditional dimensions of gender identity, that is to say, sex-stereotype conformity, but also other dimensions, such as the perception the individual has of his/her own gender identity. Egan and Perry *(45)* developed a multidimensional series of scales to assess the gender identity of 9-10 years-old and 13-14 years-old. These scales include traditional measures of gender identity (two scales assessing male and female-typed traits and two scales assessing male and female-typed activities), but also take into account other dimensions of gender identity: typicality (feeling one is a typical member of one’s gender group), contentedness (satisfaction of belonging to the sex-group to which one has been assigned), feeling under pressure (felt pressure from peers, parents and oneself to conform to gender roles associated with one’s gender); and intergroup bias (feeling that one’s gender group is superior to the other group). Researchers studied other dimensions of gender identity, such as centrality, that is the importance of gender identity in their self-concept *(46, 47)*.

The present study extended research on the effect of gender identity on self-reported risky driving behaviors among young drivers. More particularly, the aim was to replicate studies showing the effect of sex and sex-stereotype conformity on driving behaviors, including positive behaviors, which has not been studied yet *(34)*, and to investigate the

effects of gender group identification by assessing different dimensions of gender identity (typicality, contentedness and centrality), which has not been studied in the area of driving to the best of our knowledge. Plus, it is assumed that depending on the feeling of being a typical member of one's gender group, the contentedness with one's biological gender group and the importance of gender in the self-concept, individuals will try to conform either more or less to stereotypes associated with their group and, thus to behaviors associated with their group such as risky behaviors in driving.

In particular, the following hypotheses were examined:

Hypothesis 1: Male drivers report more risky driving behaviors than females.

Hypothesis 2: Drivers who highly conform to masculine stereotypes report more risky driving behaviors, whereas drivers who highly conform to feminine stereotypes report fewer risky driving behaviors.

Hypothesis 3: Gender group identification, through centrality, typicality and satisfaction levels explains risky driving behaviors, a strong identification among male group leading to more risky behaviors.

2. METHOD

2.1. Material

2.1.1. Gender Identity

2.1.1.1. Sex-Stereotype Conformity. Sex-stereotype conformity was measured by using a French version of Bem Sex-Role Inventory which contains three scales (masculine, feminine and neutral) *(28, 48)*. The masculine scale (9 items) includes characteristics that are perceived as male characteristics in society; that is, agentic traits (e.g., authoritarian, strong personality, dominating, etc.). The feminine scale (9 items) includes characteristics that are perceived as female characteristics in society; that is, communal traits (e.g., understanding, affectionate, sympathetic, etc.). The rest of the characteristics (9 items) consisted of neutral items that are perceived as neither male nor female characteristics (e.g., conscientious, frank, serious, etc.). Participants were asked to indicate the degree to which each of the 27 personality characteristics described their own personalities on a 7–point scale (from 1=almost never true to 7=almost always true).

2.1.1.2. Gender Identity Variables. Gender typicality, that is, feeling one is a typical member of one's sex, and gender contentedness, that is, feeling content with one's biological sex, were measured by using scales adapted from the French series of scales validated by Jodoin & Julien *(49)* among eight to 16-year-olds. The series of scales was originally validated by Egan and Perry *(45)* with an American sample. Items were adapted to adult people and were either for men or for women. Gender typicality scale includes four items (e.g. "I feel annoyed that I'm not supposed to do certain things just because I am a man/ a woman"). Gender contentedness scale includes six items (e.g. "I think I'm like all the other men/women of my age"). Gender centrality, that is the importance of gender as part of the self-concept, was measured by using the centrality subscale from Luhtanen and Crocker's collective self-esteem scale *(47)*. The scale includes four statements that were modified to assess the centrality of being a man or a woman to their self-concept (e.g., "My sex group is an important part of what I am"). For each scale, participants were asked to indicate the degree to which they agree with each item on a 7–point scale (from 1=strongly disagree to 7=

strongly agree). The scale had been previously pre-tested and validated on an adult population.

2.1.2. Driving Behavior

Driving behaviors were measured by using an extended version of the Driver Behavior Questionnaire *(4)* validated among a large population of French drivers *(50)*. The new extended version of DBQ differentiates between six types of behaviors. The tool includes two types of violations: aggressive violations (3 items), which refer to behaviors of aggressive interpersonal violence, and ordinary violations, which refer to deliberate deviations in driving but without any aggressive purpose (6 items). Dangerous errors (6 items) contain unintentional behaviors that deviate from the planned action and are potentially dangerous. The tool includes two types of lapses: inattention errors (7 items) that refer to unintentional and slightly dangerous behaviors that appeared to be due to a lack of attention, and inexperience errors (4 items) that refer to unintentional and slightly dangerous behavior that appeared to be caused by the individual's lack of driving experience. Lastly, the tool includes positive behaviors (9 items), that is, pro-social behaviors intended to facilitate interactions with other users. Participants were asked to indicate on a 7-point scale how often they committed each of the 35 behaviors in the previous year (0= never to 7= very often). Even if lapses and positive behaviors are not critical for safety and not related to accidents, the whole tool was used in order to explore the link between gender identity and different types of driving behaviors.

2.1.3. Demographic Variables

Participants were asked to indicate their age, sex, frequency of driving and kilometers driven per week, the number of years as a fully licensed driver, and number of accidents and offenses since holding a license.

2.2. Population and Procedure

The data reported in this study was collected from 75 undergraduate students (28 males and 47 females) between 18 and 25 years of age (mean = 20.75 years, SD = 1.9). All individuals had a license B with a range of 0-8 years of driving experience (mean 2.2, SD = 1.6) and half the sample had less than 2 years of driving experience. 53.33% of the sample learned driving with AAC (early driver training). Concerning driving frequency, 20% of the sample declared that they drive every day, 28% stated that they drive four or five times a week, 45.33% stated that they drive one to three times a week, and just 6.67% of the participants said that they never drive. 34.33% of the sample drove a car less than 50 km a week and 32% drove 50 to 150 km. 30.66% of the sample drove more than 150km a week. Finally, as showed in table 1, the number of accidents since obtaining the category B driver's license ranged from 0 (69.33%) to 3 (4%), with 20% of the sample having had one accident and 6.67% having had two accidents since obtaining the category B driver's license. The number of offenses since obtaining the category B license ranged from 0 (78.67%) to more than 3 (2.67%) with 12% of the sample had one offence and 6.67% had two offenses since obtaining the category B driver's license. Characteristics for the whole sample as well as for male and female drivers separately are presented in Table I.

They were recruited at the University Library for an online survey. The link to the questionnaire was sent to all students by mail. They were guaranteed anonymity and confidentiality. The participants filled out a French version of the DBQ, after which they

filled out a tool measuring different aspects of gender identity, and items related to demographic variables. The questionnaire took about 20 minutes.

2.3. Data Treatment

The data were analyzed by using reliability analyses, Pearson correlations, linear regression analyses and hierarchical regression analyses.

TABLE 1 Sample characteristics

		Total	Males	Females
N		75	28	47
Age	Mean	20.75	21.43	20.34
	SD	1.9	2.12	1.66
Years holding a license	Mean	2.2	2.67	1.94
	SD	1.6	1.77	1.45
Number of accidents	Mean	.45	.36	.51
	SD	.79	.56	.91
Number of offenses	Mean	.39	.43	.36
	SD	1.01	.74	1.15

3. RESULTS

3.1. Reliabilities of scales

3.1.1. Sex-stereotype Conformity and Gender Identity variables

Reliability analyses of the French version of the BSRI answers indicated that Cronbach's alphas for the masculinity and femininity scales were 0.74 and 0.84, respectively. Reliability analyses have also been carried out for each cognitive dimension of gender identity. Cronbach's alphas for typicality, contentedness and centrality were .69, .83 and .72, respectively. Thus, the reliability of the masculine and feminine stereotypes and of the gender identity variables can be considered satisfactory.

3.1.2. DBQ

Cronbach's alphas have been calculated for each DBQ scale: "positive behaviors" (α =.50), "dangerous errors" (α =.54), "inexperience errors" (α =.64), "inattention errors" (α =.70), "ordinary violations" (α = .73) and "aggressive violations" (α =.43). A general score of violations including ordinary and aggressive violation items has been calculated (α =.75).

3.2. Correlates of DBQ and Gender Identity variables

Pearson's *r* correlations between background variables, the scores of DBQ and gender identity variables and sex-stereotypes conformity were calculated for men and women separately (see Table 2).

As regards background variables and the number of accidents and offenses among females, the number of years holding a license correlated positively with the number of kilometers driven per week and the number of accidents and offenses. The number of kilometers driven per week correlated negatively with contentedness. The number of accidents correlated positively with the number of offenses and violations, and negatively with positive behaviors and feminine-stereotypes conformity. Regarding DBQ scores, the inattention errors score was positively correlated with inexperience and the dangerous errors scores. Lastly, as regards gender identity variables, typicality was positively correlated with centrality. Correlations were moderate.

As regards background variables and the number of accidents and offenses among males, the number of offenses was positively correlated with violations. Correlation was relatively high. Regarding DBQ scores, inexperience errors, inattention errors and dangerous errors were positively inter-correlated. Correlations were relatively high. Furthermore, the dangerous errors score was positively correlated with typicality. Violations correlated positively with centrality. Positive behaviors were negatively associated with centrality and contentedness. Correlations were moderate to relatively high. Finally, as regards gender identity scales and sex-stereotype conformity, contentedness correlated positively with typicality and centrality, whereas feminine-stereotype conformity was negatively associated with contentedness and centrality. Correlations were moderate.

Correlations among the three measures of gender identity and sex stereotype conformity were either modest or insignificant, confirming the utility of a multidimensional approach to gender identity.

TABLE 2 Correlates among DBQ scores, Gender Identity variables and Background variables, by sex

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sex-stereotype conformity														
1. Masculine traits	-	-.02	.15	-.09	.08	-.01	-.17	.09	-.21	.14	.20	.12	-.08	.05
2. Feminine traits	-.11	-	.04	.12	.10	.07	-.15	-.10	.18	-.16	-.3*	-.27	-.01	-.14
Gender identity														
3. Gender contentedness	-.13	-.52**	-	.03	-.15	.06	-.15	.04	-.21	.26	.02	-.21	-.29*	.06
4. Gender typicality	.06	-.21	.37*	-	.49***	.16	-.03	-.17	-.10	.01	.19	.04	-.11	-.09
5. Centrality	.01	-.44*	.5**	.20	-	.27	.02	-.04	-.13	.04	.26	.04	.02	-.08
DBQ scales														
6. Inexperience errors	.22	-.05	-.24	.25	-.27	-	.34*	.13	.07	.10	.05	-.18	-0.04	-.13
7. Inattention errors	-.11	.14	-.14	.24	-.20	.63***	-	.42**	.09	.20	.14	-.09	0.22	-.07
8. Dangerous errors	.21	.08	-.20	.40*	-.02	.73***	.44*	-	-.07	.28	.09	.05	0.15	.10
9. Positive Behaviors	.14	.20	-.62***	-.28	-.46*	.27	.18	.19	-	-.26	-.36*	-.22	-0.00	-.11
10. Violations	.13	-.29	.30	.08	.44*	-.03	-.01	.16	-.25	-	.31*	.11	-0.14	.25
Background variables														
11. Number of accidents	-.06	-.19	-.08	-.35	.03	.06	.08	-.14	.13	-.00	-	.42**	.04	.39**
12. Number of offenses	-.26	.02	.15	.12	.17	.14	.07	.18	-.07	.50**	-.13	-	.22	.34*
13. Kilometers driven weekly	.14	.11	-.09	.16	-.27	.27	.36	.19	.20	.06	-.16	.07	-	.29*
14. Years holding a license	.15	-.06	-.15	.07	-.03	.31	.14	.29	.19	.25	.09	.29	-.23	-

*Note : Correlations for females are above the diagonal; correlations for males are below the diagonal. * p < .05 ; ** p < .01 ; *** p < .00*

3.3. Effect of Gender Identification on Sex-stereotype Conformity

Linear regression analyses were carried out to observe the effect of gender identification on sex-stereotype conformity. Two analyses were carried out among males and females separately: the first one tested the effect of gender identification on the masculine-stereotype conformity; the second one tested the effect of gender identification on the feminine-stereotype conformity. A global score of gender identification was calculated by averaging the scores of items constituting the three specific scales: centrality, contentedness and typicality. A low score indicated weak gender identification and a high score indicated strong gender identification.

Results showed no effect of gender identification on masculine stereotype conformity among females and males. No effect of gender identification was observed on feminine stereotype conformity among females, but gender identification negatively predicted feminine-stereotype conformity among males (see Table 3).

TABLE 3 Linear regression analyses of Gender Identification on Sex-stereotype Conformity, by sex

	Females						**Males**					
	Masculine traits			Feminine traits			Masculine traits			Feminine traits		
	R2	F	béta	R2	F	Béta	R2	F	béta	R2	F	Béta
Gender identification	-.02	.14	.06	-.01	.8	.13	-.04	.00	-.01	.24	9.63*	-.52*

** p < .05 ; ** p < .01 ; *** p < .001*

3.4. Effect of Sex

3.4.1. Effect of Sex on Sex-stereotype Conformity

T tests were carried out to discern sex differences among masculine and feminine stereotype conformity scores. Results showed no effects on masculine and feminine traits. Means and standard deviations by sex are present in Table 4.

TABLE 4 Means and standard deviations of Sex-stereotype Conformity, by sex

	Males		Females		
	Mean	SD	Mean	SD	t
Sex-stereotype conformity					
Masculine traits	4.01	0.92	3.94	0.82	0.3
Feminine traits	5.14	0.99	5.33	0.86	-0.9

* $p < .05$; ** $p < .01$; *** $p < .001$

3.5. Effect of sex and Gender Identity on DBQ scores, Accidents and Offenses

3.5.1. Effect of Sex and Sex-stereotype Conformity on DBQ scores, Accidents and Offenses

In order to examine the effect of sex and sex-stereotype conformity on driving behaviors, accident involvement and traffic offenses, seven separate hierarchical regression analyses were performed on each of the outcome variables (inexperience errors, inattention errors, dangerous errors, violations, positive behaviors, number of accidents, number of offenses). In each of these regressions, years holding a license, kilometers driven weekly and sex were entered in the first step to initially control for their effect, and masculine and feminine stereotype conformity were entered in the second step.

As presented in Table 5, the number of years holding a license positively predicted the number of accidents and offenses. Kilometers driven weekly positively predicted the inattention score. Finally, sex significantly predicted the inexperience and inattention errors' score, suggesting that females declared more inexperience and inattention errors than males. The variance explained accounted for by these variables was 8% for inexperience errors, 11% for inattention errors, 6% for dangerous errors, 4% for violations, 3% for positive behaviors, 9% for accidents and 12% for offenses.

After controlling the effects of kilometers driven weekly, number of years holding a license, and sex, the results of the regression analyses in the second step showed no effect of masculine stereotype conformity on driving behaviors, number of accidents and traffic offenses. Nevertheless, feminine stereotype conformity negatively predicted the number of accidents. The proportion of variance accounted for by masculine-stereotype conformity and feminine-stereotype conformity was 1% for inexperience errors, 3% for inattention errors, 2% for dangerous errors, 6% for violations, 3% for positive behaviors, 7% for accidents and 3% for offenses.

TABLE 5 Hierarchical analyses on DBQ scales, number of Accidents and number of Offenses

		Inexperience errors			Inattention errors			Dangerous errors			Violations			Positive Behaviors			Number of accidents			Number of offenses		
		R2	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**
1.	**License (years)**	.08	2.15	.04	.11	3.02	.08	.06	1.39	.10	.04	0.98	.17	.03	.69	-.01	.09	2.29	.29*	.12	3..23	.31**
	Weekly km			.06			.25*			.16			-.07			.06			-.04			.16
	Sex[1]			.28*			.24*			.15			-.13			-.15			.15			.05
2.	**Masculine traits**	.01	1.33	.06	.03	2.38*	-.17	.02	1.01	.11	.06	1.78	.08	.03	.96	-.07	.07	2.38*	.09	.03	2.29	-.02
	Feminine traits			.03			-.08			-.04			-.17			.18			-.23*			-.15
	Total R2	**.09**			**.15**			**.07**			**.12**			**.07**			**.15**			**.14**		

[1] *males = 1 ; females = 2* * *p < .05 ; ** p < .01 ; *** p < .001*

3.5.2. Effect of Sex-stereotype Conformity and Gender Identity variables scales on DBQ scores, Accidents and Offenses

Observing the effect of gender identity on the whole sample without taking the gender group of the individual into account would not be relevant and would not provide interpretable results given that the effect of gender identity on driving behaviors is expected to be different according to the gender group. Thus, in order to examine the respective effects of sex-stereotype conformity and gender identity variables on driving behaviors and accident involvement and offenses, seven separate hierarchical regression analyses were performed on each of the outcome variables (inexperience errors, inattention errors, dangerous errors, violations, positive behaviors, number of accidents, number of offenses) among males and females separately. In each of these regressions, years holding a license and kilometers driven weekly were entered in the first step to initially control for their effect. Masculine-stereotype and feminine stereotype conformity were entered in the second step and the three variables of gender identity, typicality, contentedness and centrality were entered in the third step.

3.5.2.1. Effects among Males. Regarding males, as presented in Table 6, the number of years holding a license positively predicted the inexperience errors score. Plus, although the model is not significant, results showed that kilometers driven weekly positively predicted inattention errors. The variance accounted for by these variables was 22% for inexperience errors, 18% for inattention errors, 15% for dangerous errors, 8% for violations, 10% for positive behaviors, 3% for accidents and 1% for offenses.

When entering sex-stereotype conformity into the model, results of the regression analyses showed no effect of masculine and feminine stereotype conformity on driving behaviors, accidents and traffic offenses. The proportion of variance accounted for by masculine-stereotype conformity and feminine-stereotype conformity was 1% for inexperience errors, 9% for inattention errors, 2% for dangerous errors, 8% for violations, 5% for positive behaviors, 4% for accidents and 21% for offenses.

Finally, when entering gender identity variables, although models were not significant, results showed that typicality positively predicted the score of dangerous errors and that contentedness negatively predicted positive behaviors. The variance accounted for by these variables was 15% for inexperience errors, 6% for inattention errors, 19% for dangerous errors, 18% for violations, 33% for positive behaviors, 16% for accidents and 9% for offenses.

3.5.2.1. Effects among Females. Regarding females, as presented in Table 7, the number of years holding a license negatively predicted the number of accidents and offenses, and although the model was not significant, negatively predicted violations. The variance accounted for by these variables was 2% for inexperience errors, 7% for inattention errors, 3% for dangerous errors, 11% for violations, 1% for positive behaviors, 16% for accidents and 13% for offenses.

When entering sex-stereotype conformity into the model, results of the regression analyses showed no effect of masculine stereotype conformity on driving behaviors, accidents and offenses. Feminine-stereotype conformity negatively predicted the number of accidents. The proportion of variance accounted for by masculine-stereotype conformity and feminine-stereotype conformity was 0% for inexperience errors, 4% for inattention errors, 2% for dangerous errors, 3% for violations, 7% for positive behaviors, 9% for accidents and 7% for offenses.

Finally, when entering gender identity variables, results showed no effect of typicality, contentedness and centrality on the variables tested. The variance accounted for by these variables was 8% for inexperience errors, 0% for inattention errors, 2% for dangerous errors, 4% for violations, 6% for positive behaviors, 11% for accidents and 5% for offenses.

TABLE 6 Hierarchical analyses on DBQ scales, number of Accidents and number of Offenses for Males

		Inexperience errors			Inattention errors			Dangerous errors			Violations			Positive Behaviors			Number of accidents			Number of offenses		
		R2	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**
1.	**License (years)**	.22	3.44*	.4*	.18	2.67	.23	.15	2.15	.19	.08	1.0	.28	.10	1.28	.25	.03	.36	.06	.1	1.36	.32
	Weekly km			.36			.41*			.19			.13			.25			-.15			.14
2.	**Masculine traits**	.01	1.68	.09	.09	2.08	-.29	.02	1.09	.08	.08	1.06	-.05	.05	.97	.14	.04	.38	-.08	.21	1.52	-.35
	Feminine traits			-.05			.09			.10			-.3			.20			-.19			-.01
	Typicality	.15	1.71	.29	.06	1.36	.24	.19	1.51	.48*	.18	1.39	-.19	.33	2.49	-.11	.16	.8	-.37	.09	1.2	-.01
3.	**Contentedness**			-.28			-.14			-.34			.25			-.54*			-.13			.17
	Centrality			-.27			-.13			.07			.37			-.2			-.0			.26
	Total R2	**.39**			**.33**			**.36**			**.34**			**.48**			**.23**			**.31**		

** p < .05 ; ** p < .01 ; *** p < .001*

TABLE 7 Hierarchical analyses on DBQ scales, number of Accidents and number of Offenses for females

		Inexperience errors			Inattention errors			Dangerous errors			Violations			Positive Behaviors			Number of accidents			Number of offenses		
		R2	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**	**R2**	**F**	**béta**
1.	**License (years)**	.02	.35	.12	.07	1.65	.15	.03	.61	-.06	.11	2.74	-.32*	.01	.29	.12	.16	4.12*	-.41**	.13	3.36*	-.3*
	Weekly Km			-.01			.27			.14			-.23			.03			-.08			.14
2.	**Masculine traits**	.00	.2	-.01	.04	1.42	-.15	.02	.50	.10	.03	1.64	.11	.07	.93	-.2	.09	3.48*	.17	.07	2.59	.12
	Feminine traits			.06			-.17			-.09			-.11			.17			-.25*			-.23
	Typicality	.08	.6	.01	.00	.78	-.03	.02	.42	-.16	.04	1.22	-.02	.06	1.00	-.09	.11	3.13*	.15	.05	1.88	.13
3.	**Contentedness**			.11			-.04			.09			.21			-.22			-.00			-.22
	Centrality			.27			.04			.05			.11			-.13			.24			-.02
	Total R2	**.10**			**.12**			**.07**			**.18**			**.15**			**.36**			**.25**		

** p < .05 ; ** p < .01 ; *** p < .001*

4. DISCUSSION

The aim of the study was to replicate findings showing the effect of sex and sex-stereotype conformity on driving behaviors *(34)* and to examine the effect of gender group identification by investigating the effect of three components of gender identity (typicality, contentedness and centrality). It was assumed that depending on the feeling of being a typical member of one's gender group, satisfaction with one's biological gender group and the importance of gender in the self-concept, individuals would more or less try to conform to stereotypes associated with their group and, thus to behaviors associated with their group such as driving behaviors.

The results did not confirm the first hypothesis which expected an effect of gender on driving behaviors. Males did not report more violations, accidents and offenses than women which is not consistent with literature *(14, 34, 36, 51, 52)*. Nevertheless, being a female is associated with higher inexperience errors which is in line with the results of many studies that have shown a greater propensity among women to declare more lapses *(4, 6, 36)* and inexperience errors *(51)*. This lack of effect of biological sex on other types of behaviors could provide the idea to take into account social variables in explaining gender differences, supporting the idea that gender differences are fully explained by gender roles, contrary to integrationist models that suggest that gender differences are due to both biological and social factors *(38)*. Nevertheless, the rest of the results did not support that idea.

Gender-stereotype conformity was expected to be associated with driving behaviors, replicating previous findings that showed this relationship *(34)*. No effect of masculine stereotype conformity on driving behaviors was observed in the results of the present study. Nevertheless, feminine-stereotype conformity was negatively associated with the number of accidents. That is to say, after controlling the effect of sex, individuals who highly conform to feminine stereotypes report a lower number of accidents, which is in keeping with a previous study by Özkan et al. *(34)* among Turkish drivers. This effect also appears when looking at females separately. Previous findings on DBQ showed that accident involvement was predicted by violations, both retrospectively and prospectively *(6)*, and in the present study, violations correlated with the number of accidents among females. Thus, the negative link between feminine stereotype conformity and violation and error scores that can be observed in literature *(34)* was not observed in the present study, but the low number of accidents among individuals who highly conform to feminine stereotypes could nevertheless be due to a lower tendency towards risky driving behaviors. Thus, it could be argued that caring for others could lead to more careful driving, and thus, fewer accidents. The results showed no relationship between accidents and masculinity. This might be due to the fact that an accident is a relatively rare event, as not all risky behaviors result in an accident. In addition, the study was conducted among young drivers, with a relatively short driving history. Nevertheless, the percentage of variance explained by gender stereotype conformity was only weak, suggesting that other social variables must be taken into account in order to explain differences between and within gender group in risky behaviors.

The third hypothesis predicted that gender identification of males and females would have an effect on driving behaviors. More particularly, it was assumed that males who strongly identified with their gender group would demonstrate greater conformity to masculine gender roles and would report more risky driving behaviors than males who weakly identified with the male gender group.

Results showed no effect of contentedness, typicality and centrality on driving behaviors among females, whereas results showed effects of typicality and contentedness on driving behaviors among males. More precisely, the typicality 'score positively predicted the

dangerous error ‘score, whereas contentedness negatively predicted positive behaviors. In other words, the dangerous errors ‘score increases as a function of the male individuals ‘feeling of typicality within their group. Thus, it seems that gender identification leads to riskier driving and exhibiting more errors, in order to conform to gender roles, since risk-taking is seen as a typically masculine type of behavior *(28)*. The positive correlation between centrality and violations among men seems to suggest the same. Furthermore, the positive behaviors’ score decreases as a function of the contentedness of belonging to the group of males. Thus, it seems that high gender identification, as assessed by contentedness, leads to exhibiting less positive behavior that could be socially linked to feminine stereotypes. Indeed, results also showed that conformity to feminine stereotypes decreases as a function of the global gender identification’ score among males. Additionally, among males, contentedness correlated negatively with feminine stereotype conformity, which negatively predicted the number of accidents. Thus, it can be suggested that high gender identification among males leads to lesser conformity to communal traits, which can lead to less positive behaviors as regards contentedness level. In terms of implications, it may be helpful to attach feminine characteristics (e.g. “caring for others”) which were found to be related to more careful driving and fewer errors *(34)* to masculine characteristics through role models, in driver education and media campaigns.

The percentage of variance explained improves by adding variables of gender identity, showing the importance of taking gender identification into account. Indeed, studies investigating the effect of gender roles on risky behaviors used to focus on gender stereotype conformity, given the relationship between masculine attributes and variables associated with risk taking *(39, 40)*. Although popular, the practice of assessing self-perceived gender typicality in terms of self-perceived personality traits thus has limitations. Sex typing is multidimensional *(53, 54)*, meaning that there is only modest consistency in the degree to which people display male-typical or female-typical behavior across different domains (e.g., personality traits, activity preferences, academic pursuits, and occupational preferences). Thus, it could be hazardous to infer an individual's overall gender identity from self-perceived sex typing in any single domain. Furthermore, the degree to which one identifies with one’s gender group may partly explain the conformity to attributes associated with one’s gender group or the other one and the behaviors associated with it. That’s why it is suggested to take gender identity variables into account rather than only sex-typed attributes in explaining differences between and within gender group in risk-taking. Interestingly, effect of gender identity variables on driving behaviors only appears among men, not among females. Plus, the proportion of variance explained obtained by adding gender identity variables to the model is greater among males than among females. In this type of activity, the effect of gender identity must be particularly relevant among males, given that risk taking is a masculine type of behaviors and that driving is an activity associated with maleness.

Furthermore, those results highlighted the importance of taking feminine stereotype conformity into account when investigating sex and gender differences in risky driving. Most of the studies investigated the effect of masculinity on risky behaviors because of the relationship that exists between attributes associated with masculinity and variables associated with risky behaviors, such as aggressiveness, self-enhancement and sensation seeking *(35, 39, 40)*. But few studies investigated the effect of femininity on risky behaviors *(34)*. However, it can be suggested that it is the lack of femininity that leads to taking more risks instead of high conformity to masculine stereotypes *(37)*. Indeed, people can conform to both masculine and feminine stereotype and it can be assumed that femininity buffers the effect of masculinity as it has been shown by Özkan et al. *(34)*.

The present study has some methodological limitations that have to be taken into account when planning future research. First, the data was comprised of drivers' self-reported behaviors, which may have limits, notably concerning the negative impact of social desirability. It is possible that some respondents embellished their answers about aggressive driving, although the bias caused by social desirability has been shown to be minimal in the answers on the DBQ *(55)*. Consequently, observational studies combined to surveys are needed, and would allow comparison between self-reported and effective behaviors. Second, the sample is relatively small, which can explain the lack of reliability of the scales and can impact the validity of the results. Plus, there were clearly more female drivers than male drivers in the sample, which is unbalanced. Besides, young male drivers are the most problematic drivers. Next, half the sample consisted of novice drivers, so they may not actually be active drivers, which can lead to less exposure to traffic situations and so, explain the lack of expected results. Plus, the effect of inexperience may interact with the effects of gender identity. Finally, the study has been carried out on a student sample, which may not be representative of the young driver population, as psychosocial and cultural variables, such as level of education, can influence people's driving behaviors and gender identity. Thus, the study must be replicated in a wide sample equivalent in terms of sex, age and socioeconomic status.

5. CONCLUSION

In summary, the present study showed neither the effects of sex nor masculine-stereotype conformity on driving behaviors, but an effect of feminine-stereotypes on the number of accidents. Plus, this study showed the effect of contentedness and typicality, respectively on positive behaviors and dangerous errors among males. The proportion of variance explained by sex-stereotype conformity was low but was increased by adding gender identity variables to the models. Thus, even if hypotheses are not confirmed, this study can highlight the importance of taking gender identity variables into account when explaining differences between and within gender group in risk-taking, rather than only look at the effect of sex-stereotype conformity. Furthermore, it highlighted the beneficial effect of feminine-stereotype conformity on risky behaviors, suggesting that lack of femininity might be one of the key factors behind high traffic accident mortality among young male drivers. Nevertheless, results need to be put into perspective, given the size of the sample.

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MEASURING THE PERCEPTION OF MEN AND WOMEN DRIVERS AMONG YOUNG ADULTS

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Abstract
Gender differences in driving accidentology are actually particularly explained in the literature by the conformity to gender stereotypes, notably the association of risk-taking with social expectations concerning masculinity. To date, no research was interested in the effect of the perception of men and women drivers (PMWD) on driving behaviors. The aim of this research was to create a questionnaire measuring PMWD among young French adults. The PMWD was measured on 108 participants (33 men and 75 women), from 18 to 29 years old. Principal component analyses indicated that the organization and content of the perception of men drivers differed from the organization of the perception of women driver. The results are discussed in terms of in-group/out-group relations in the PMWD.

Key words: perception, gender, driving, questionnaire

1. INTRODUCTION

Worldwide, men are involved in about three more crashes than women and young men are over-involved in these crashes (*1*). In 2007, for the same number of kilometers, French male drivers were nearly four times more likely to death, two times more likely to be injured, and twelve times more likely to be sentenced for driving offenses than women (*2*). Men drivers reported more driving injury risk behaviors (*3*) and more traffic offenses (*4*). This sex difference is actually explained by sex and gender of individuals. Gender refers to characteristics and traits which are culturally associated to men and women (*5*, *6*) whereas sex refers to biological and physiological differences between them.

Sex is a predictor of driving accident (*7*). Indeed, compared to women and whatever their age, men reported more driving injury risk behaviors (*3*), more violations and errors on the road (*8*), and higher scores on perceptual motor skills which are positively related to traffic accidents (*7*). In contrast, women reported more harmless lapses than men (*8*), and higher scores on safety skills which are negatively related to traffic accidents (*7*).

From another side, risk-taking has a greater social value for men than women. Masculinity is indeed stereotypically associated with risk-taking (*9, 10, 11*) whereas femininity is stereotypically associated with careful behaviors. In this way people adhering to masculine traits would have more risky practices than people adhering to feminine traits (*12*). Furthermore, studies show that in driving, high masculinity is associated with a high level of offenses, aggressive violations, ordinary violations, accidents, perceptual motor skills, and low inattention and inexperience errors (*7, 13, 14*). This association between masculinity and perceptual motor skills suggests that "being a skillful driver is seen as a masculine trait" (*7*). In contrast high level of femininity is associated with high safety skills, few accidents, offenses, and aggressive and ordinary violations, and with low inattentions, dangerous and inexperience errors and ordinary violations (*7, 13, 14*). Finally masculinity among French pedestrian adolescents brings to a lower internalization of traffic rules and both are good predictors of declared risky behaviors (*15*).

Gender seems to be a better predictor of risk-taking than biological sex. Furthermore, for several years studies are interested in gender stereotypes associated with driving and their implications. The stereotype of women drivers is that they are unable to manage stress when a quick decision is needed (*16*). Moreover in stereotypes definitions women have to be passive, uncompetitive, and no risk takers whereas men are encouraged to be aggressive and risk takers which lead them to commit more traffic offenses (*3*).

In France, Granié and Papafava (*17*) explored the gender stereotypes associated with driving among French adolescents from 10 to 16 years old. Thereby they showed that adolescents define men drivers as skillful, involved in an activity consistent with their social roles although imprudent and committing more traffic offenses. In contrast they defined women drivers as careful, compliant with traffic rules and having less accident although being unskilled, having a lot of accidents, and involved in an activity inconsistent with their social roles. They also showed that the stereotype of men driver is stable from 10 while the stereotype of women driver appears to strength with age.

Based on this study, Degraeve, Granié, and Pravossoudovitch (*18*) analyzed the contents of gender stereotypes associated with driving among French adults (from 16 to 50 years old and over). They showed that people see men drivers as skillful although impatient, reckless, uncivil, committing offenses, and driving too fast while they see women drivers as civic, careful, vigilant, and conforming to traffic rules although unskilled, dangerous, inattentive, and driving slowly.

Based on this study on gender stereotype associated with driving (*18*), the aim of this study is to develop a questionnaire designed to measure the perception of men and women drivers (PMWD) among young French adults. This could permit to study the effect of

stereotyped image of men and women drivers on driving behaviors and provide a better understanding of risky driving behaviors.

2. METHOD

2.1 Draft questionnaire

The aim of the present study was to construct a questionnaire measuring PMWD among young French adults. To measure PMWD among young French adults, four main dimensions of driving behaviors were differentiated, as obtained by Degraeve *et al.* (18) for men and women drivers through free association questionnaire: driving skills, compliance to traffic rules, courtesy behind the wheel, and risk avoidance in driving.

Eight items were developed for each dimension. These items were made from contents that participants gave to describe men and women behind the wheel in the study from Degraeve *et al.* (*18*). These items were the same for men and women. The questionnaire was divided into two sections (men / women behind the wheel). In each section, items were alternated between each dimension (driving skills, compliance with traffic rules, risk avoidance, courtesy). The order of items was the same for both sections. For each item, participants had to indicate their degree of agreement with the statement on a seven points scale (1 = not agree at all to 7 = strongly agree).

2.2 Pretests

The purpose of the pretests was to determine whether the items that make up the experimental version of the questionnaire are clear, unambiguous and expressed in a language that is understood by the target population. Several pretests were made to improve comprehension of items among targeted population. In a first stage 14 participants were asked to first filled a paper and pencil questionnaire and then were interviewed by the experimenter. During this interview, participants had to explain their impressions on the questionnaire, to explain what they have not understood and what they think should be changed to improve the comprehension of items in each dimension.

In a second stage participants were asked to complete the questionnaire online. A principal component analysis (PCA) was then made to test the structure of the questionnaire. A new version of the questionnaire was finally made on the basis of the PCA results and proposed online to new participants. Thus several principal component analyses (PCA) were made to test the structure of the questionnaire. Between each PCA, changes were made on the questionnaires on the basis of these results in order to improve the structure and the differentiation between the four dimensions measured. Totally, this second stage was completed by 109 participants.

2.3 GSAD Questionnaire

2.3.1 Questionnaire

Four dimensions were measured in the experimental version of the questionnaire, for each driver's gender. Dimensions concerning skills, compliance to traffic rules, and risk avoidance were each made up by seven items; courtesy dimension included six items. The questionnaire was proposed online in a counterbalanced order (i.e., half of the participants began with the men behind the wheel section and half of the participants began with the women behind the wheel section). In each section, items were alternated between each dimension. The order of items was the same for both sections. For each of the 27 items for each driver's gender, the response was classified on a discrete ordinal scale. Participants had to indicate their degree of

agreement with the statement on a seven points scale (1 = not agree at all to 7 = strongly agree).

2.3.2 Participants

The questionnaire was completed online by 108 participants (33 Men and 75 women), from 18 to 29 years old. Their mean age was 23.57 years old (SD = 7.78). Eighty six percent of them (93) had their driving license. Preliminary analyses treating the putative role of participant possession of driving license found no main effects. As such, the role of possession of driving license was not considered further.

3. RESULTS

3.1 Analysis of the questionnaire structure

To analyze the structure of the questionnaire, PCA with an oblimin rotation were performed on the 27 items of each section of the PMWD questionnaire for the whole sample. A first PCA was then perform with all the responses of the 108 participants on the 27 items of the perception of women driver section and a second PCA was perform with all the responses of the 108 participants on the 27 items of the perception of men driver section. Each item with eigenvalues < 1 was excluded as well as items with loading values < .30 or those which filled equally on several axes. Several *t* tests were then performed on final axis to test gender differences on each dimension of each section.

3.1.1 Perception of *women drivers*

For women drivers, the scree plot indicated that the data best fitted with a four-factor solution which explained 77.52 % of the total variance.

TABLE 1 Principal component analysis on perception of women drivers

	Items	F1	F2	F3	F4
7	I think that women refrain from having dangerous behaviors behind the wheel	.897			
23	I think that women avoid dangerous behaviors behind the wheel	.888			
15	I think that women avoid to adopt a risky driving	.869			
3	I think that women avoid taking risk while driving	.838			
19	I think that women refrain from having risky behaviors behind the wheel	.758			
11	I think that women avoid risky behaviors behind the wheel	.752			
27	I think that women avoid engaging in risky situations behind the wheel	.688			
22	I think that women don't exceed the permitted alcohol limit for driving	.490			.420
6	I think that women respect the permitted alcohol limit for driving	.372			.324
17	I think that women are dexterous behind the wheel		.894		
25	I think that women know how to maneuver their vehicle		.883		
5	I think that women are skillful behind the wheel		.880		
13	I think that women have good driving abilities		.837		
21	I think that women have a good driving dexterity		.823		
9	I think that women have good driving skills		.811		
1	I think that women have a good mastery of their vehicle		.789		
8	I think that women are respectful of others road users			-.870	

20	I think that women show politeness behind the wheel	-.851	
16	I think that women show manners to others road users	-.814	
12	I think that women are civic behind the wheel	-.794	
24	I think that women show consideration to others road users	-.761	
4	I think that women are courteous drivers	-.760	
18	I think that women don't exceed speed limitations		.797
10	I think that women don't break speed limitations		.665
26	I think that women respect speed limitations		.657
14	I think that women never run red lights		.646
2	I think that women comply to speed limitations	-.313	.606

Both items of compliance with alcohol restriction in driving were removed because they equally loaded on axis one and axis four. A new PCA was performed without these two items and created the final factor structure. The scree plot indicated that the data best fitted by a four-factor solution which explained 79.31 % of the total variance (Cronbach's α =.96).

The first factor (F1) concerning risk avoidance of women drivers was composed by seven items and explained 52.95% of the total variance (Cronbach's α = .96). The second factor (F2) concerning women driver skills was composed by seven items and explained 15.42% of the total variance (Cronbach's α = .95). The third factor (F3) concerning women driver courtesy was composed by six items and explained 6.85% of the total variance (Cronbach's α = .96). The fourth factor concerning women driver compliance with traffic rules was composed by five items and explained 4.09% of the total variance (Cronbach's α = .88). Table 1 shows the items that were included in each factor of the questionnaire of adherence to PMWD concerning women.

3.1.2 Perception of *men drivers*

For men drivers, the scree plot indicated that the data best fitted with a four-factor solution which explained 77.72 % of the total variance (Cronbach's α =.96). No items had to be removed (i.e., no item has loading value < .30 on one axis or loaded equally on several axes).

TABLE 2 Principal component analysis on perception of men drivers

	Items	F1	F2	F3	F4
11	I think that men avoid risky behaviors behind the wheel	.968			
23	I think that men avoid dangerous behaviors behind the wheel	.913			
27	I think that men avoid engaging in risky situations behind the wheel	.889			
3	I think that men avoid taking risk while driving	.879			
7	I think that men refrain from having dangerous behaviors behind the wheel	.860			
15	I think that men avoid to adopt a risky driving	.856			
19	I think that men refrain from having risky behaviors behind the wheel	.841			
2	I think that men comply to speed limitations	.625			
26	I think that men respect speed limitations	.600			
18	I think that men don't exceed speed limitations	.592			
10	I think that men don't break speed limitations	.494		.308	

17	I think that men are dexterous behind the wheel		.937		
25	I think that men know how to maneuver their vehicle		.923		
5	I think that men are skillful behind the wheel		.886		
13	I think that men have good driving abilities		.877		
9	I think that men have good driving skills		.873		
21	I think that men have a good driving dexterity		.839		
1	I think that men have a good mastery of their vehicle		.794		
12	I think that men are civic behind the wheel			.913	
20	I think that men show politeness behind the wheel			.878	
8	I think that men are respectful of others road users			.874	
16	I think that men show manners to others road users			.863	
4	I think that men are courteous drivers			.825	
24	I think that men show consideration to others road users			.810	
14	I think that men never run red lights				.866
6	I think that men respect the permitted alcohol limit for driving				.631
22	I think that men don't exceed the permitted alcohol limit for driving	.359			.599

The first factor (F1) concerning risk avoidance and compliance with speed limitations of men drivers was composed by eleven items and explained 50.60% of the total variance (Cronbach's α = .96). The second factor (F2) concerning men driver skills was composed by seven items and explained 16.58% of the total variance (Cronbach's α = .96). The third factor (F3) concerning men driver courtesy was composed by six items and explained 6.19% of the total variance (Cronbach's α = .95). The fourth factor concerning men driver compliance with alcohol restrictions was composed by three items and explained 4.36% of the total variance (Cronbach's α = .77). Table 2 shows the items that were included in each factor of the questionnaire of adherence to PMWD concerning men.

3.2 Correlations

Four scores were calculated on PMWD questionnaire concerning women drivers and four scores concerning men drivers. Correlations between scores of each items and the axis they belong were calculated. Analysis of the relationship between scores of PMWD for men and women drivers was made through Bravais Pearson "*r*".

3.2.1 Perception of *women drivers*

For women drivers the results showed that the items were highly correlated to their own factor (r > .80) and were stronger correlated to their own factor than to the others three factors.

TABLE 3 Bravais Pearson correlations between scores of perception of women drivers

	F2 : Driving skills	F3 : Courtesy	F4 : compliance with traffic rules
F1 : Risk avoidance	.438***	.665***	.748***
F2 : Driving skills		.557***	.27**
F3 : Courtesy			.644***

The score of risk avoidance was significantly correlated with the score of courtesy and the score of compliance with traffic rules: the more the participants perceived women drivers as

avoiding risk and complying with alcohol restrictions, and the more they perceived that they are courteous drivers and compliant with traffic rules (mainly speed limitations). The score of courtesy was significantly correlated with the score of compliance with traffic rules and the score of driving skills: the more participants perceived women as courteous drivers, and the more they perceived they are compliant with traffic rules (mainly speed limitations) and skillful drivers.

3.2.2 Perception of *men drivers*

For men drivers the results showed that items were highly correlated to their own factor (r > .80) and were stronger correlated to their own factor than to the others three factors.

TABLE 4 Bravais Pearson correlations between scores of perception of men drivers

	F2 : Driving skills	F3 : Courtesy	F4 : Compliance with alcohol restriction
F1 : Risk avoidance and speed restriction	.322***	.724***	.624***
F2 : Driving skills		.439***	.256**
F3 : Courtesy			.596***

The score of risk avoidance was strongly correlated with the score of courtesy and the score of compliance with alcohol restriction (r > .60): the more participants perceived men drivers as avoiding risk and complying with speed limitations, and the more they perceived that they are courteous drivers and compliant with alcohol restrictions. The score of courtesy was almost strongly correlated with the score of compliance with alcohol restriction (r = .60): the more participants perceived men drivers as compliant with alcohol restrictions, and the more they perceived them as courteous drivers.

For both men and women questionnaire, the correlation between driving skills and compliance to traffic rules is lower than the five others correlations.

3.3 Skills and courtesy scores differences

The perception of women and men drivers was compared through paired sample t test on the driving skills and courtesy only, as the other scores were not composed by the same items for men and women drivers..

3.3.1 Skills scores differences

Concerning driving skills, results revealed that participants judge men drivers significantly more skillful (M=35, SD=6.83) than women drivers (M=29.41, SD=7.50, t(107) = -6.11, p < .001). They also show that men participants judge men drivers significantly more skillful (M=34.82, SD=6.94) than women drivers (M=26.88, SD=7.85, t(32) = -3.90, p < .001) and that women participants judge men drivers significantly more skillful (M=35.08, SD=6.83) than women drivers (M=30.55, SD=7.10, t(74) = -4.78, p < .001).

3.3.2 Courtesy scores differences

Concerning courtesy behind the wheel, results revealed that participants judge women drivers significantly more courteous behind the wheel (M=26.56, SD=6.51) than men drivers (M=21.70, SD=6.06, t(107) = 5.94, p < .001). They revealed that women participants judge women drivers significantly more courteous behind the wheel (M=27.15, SD=6.56) than men drivers (M=20.61, SD=5.60, t(74) = 7.28, p < .001). For men participants there is no difference between the courtesy of women and men behind the wheel.

3.4 Gender differences

Independent sample *t* tests were performed to analyze the differences between men and women participants on their scores on the different dimensions of the PMWD

TABLE 5 Mean and SD on PMWD

		Perception of women drivers				Perception of men drivers			
		F1	F2	F3	F4	F1	F2	F3	F4
Entire sample	Mean	34.19	29.43	26.56	22.79	34.90	35	21.70	9.69
	SD	7.92	7.50	6.51	5.86	11.15	6.83	6.06	3.30
Women participants	Mean	34.71	30.55	27.15	23.01	32.56	35.08	20.61	9.28
	SD	7.63	7.10	6.56	5.71	10.41	6.83	5.60	3.06
Men participants	Mean	33	26.88	25.24	22.27	40.21	34.82	24.15	10.64
	SD	8.55	7.85	6.28	6.23	11.10	6.93	6.44	3.67

The *t* tests conducted on the dimensions of the perception on women drivers revealed no statistically significant differences between the scores of men and women participants on PMWD concerning risk avoidance, courtesy, and compliance with traffic rules. T test on score of perception of women driving skills revealed that women participants (M=30.55, SD=7.10) more than men participants (M=26.88, SD=7.85) perceived women as skillful drivers $t(106) = -2.39$, $p < .05$).

Independent sample *t* tests on the dimensions of the perception of men drivers revealed no statistically significant differences between the scores of men and women participants concerning perception of men driving skills. T test on risk avoidance revealed that men participants (M=40.21, SD=32.56) more than women participants (M=32.56, SD=10.41) perceived men drivers as avoiding risk taking and complying with speed limitations ($t(106) = 3.45$, $p = .001$). T test on courtesy revealed that men participants (M=24.15, SD=6.44) more than women participants (M=20.61, SD=5.60) perceived men drivers are courteous behind the wheel ($t(106) = 2.88$, $p < .01$). T test on compliance with traffic rules revealed that men participants (M=10.64, SD=3.67) more than women participants (M=9.28, SD=3.06) perceived men drivers are compliant with alcohol restrictions ($t(106) = 2$, $p < .05$).

4. DISCUSSION

Many studies are interested in the effect of gender and sex on driving risk taking but rarely studied the perception of men and women as drivers. Measuring these perceptions is necessary before observing its effects on driving behaviors. The aim of this study was then to create a questionnaire designed to measure perception of men and women as drivers among young French adults. Furthermore, gender differences between the scores of men and women participants on perception of women and men drivers were measured.

The variance explained by the axes determined by the PCAs and homogeneity indices are satisfactory, showing a good content validity and a good internal reliability. Results indicate that the organization of the perception of men driver differs from the organization of the perception of women driver. Indeed, in their perception of women driver, participants differentiate between the skills of women drivers, their compliance to traffic rules (speed limitations mainly), their courtesy behind the wheel, and their avoidance to driving risk taking. Alcohol restrictions do not seem to clearly contribute to define the perception of women drivers however. From another side perception of men driver seems to differentiate driving skills, courtesy, alcohol restriction compliance, whereas speed limitations compliance and risk avoidance load both on a fourth dimension. It seems that for participants men driver risk taking is manifested mainly by violations of speed limits. These results are in line with

the fact that men drivers are mainly defined by their risk taking and their fast driving (*17, 18*). Nevertheless these results should be confirmed in a larger sample.

Concerning driving skills dimension, results show that even if they perceived their driving skills as higher than male participants did, women perceived men drivers as more skillful than women drivers. As participants of both genders have a higher score on this dimension for men drivers than for women drivers, the stereotype of skillful men drivers seems consensual. These results are in keeping with that "being a skillful driver" is seen as a masculine trait (*7*).

However, results also reveal gender differences concerning PMWD. Indeed, men, more than women, perceived men drivers as avoiding risk, complying to speed and alcohol restrictions, and courteous behind the wheel, while women, more than men, perceived women as skillful drivers. Except for the dimension concerning driving skills, men participants do not attribute more negative characteristics to women drivers than women participants. However, men denigrate drivers from the out-group (i.e. women drivers) by weakly adhering to the most differentiating dimension: driving skills. Women denigrate drivers from the out-group, by attributing negative characteristics more strongly to men driver. These results are in keeping with research on gender stereotypes and, more generally on intergroup relations, which have shown how individuals seek positive distinctiveness, by denigrating the out-group while promoting the in-group (*19, 20, 21*).

Power-based gender stereotype approaches (*22*) and the effects of social asymmetry between genders (*23*) can provide an additional understanding of these results. Thus, research has shown that the dominant position of the men group (*24, 25, 26*) leads members of the socially dominated women group to over-promote the in-group (*27, 28, 29*). It appears that associating the driving activity with the men role in society causes women to ''defend'' their gender identity more than men need to.

5. CONCLUSION

The aim of this study was to create a questionnaire designed to measure perception of men and women drivers among young French adults. These results showed that despite the higher proportion of men involved in road accidents, both men and women think that men drivers are more skillful than women drivers. This could be used during the driving training to make learner drivers aware of the discrepancy between their own perceptions of men's and women's driving and safety skills and the reality of women's and men's road crash risk. The results kept with previous work on driving stereotypes and on in-group and out-group relations. This tool can be used as a basis for further research on the relation of perception of men and women drivers, the adherence to gender stereotypes, and risk taking behaviors on the road. Future studies should extend their research to all ages of the driving population to permit a better understanding of sex differences in risk taking and accident in driving.

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Perceptions, Barriers, and Strategies Regarding Helmet Use among Females Pillion Riders– a Qualitative Study from Pakistan

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Abstract (251)

Introduction: Despite the importance of a helmet in prevention of head injuries among motorcyclists, there is limited use of helmet both by drivers and pillion riders in Pakistan. The objective of the study is to explore perceptions, barriers, and strategies related to helmet use by female pillion riders..

Methods: Data was collected from nine focus group discussions (FGDs) held with male riders and pillion riders (males and females) working at the Aga Khan University (AKU). FGDs were transcribed verbatim and checked for accuracy before being imported into NVivo2. Written informed consent was taken from each participant before the beginning of each discussion.

Results: Some major themes included motorcycles are a risky transport; majority of male participants claimed to wear helmet as riders but usually not as pillion rider but none of the females ever wore a helmet nor thought about wearing one although the most important benefit of helmet use expressed was "safety". Possible barriers to helmet use included lack of awareness regarding helmet law, uninvited attention from people from wearing a helmet, the saddle-sided sitting style of females and concerns about their looks and discomfort from wearing a helmet. Suggested strategies for implementing helmet use included awareness campaigns through media, use of helmets by female police, free distribution of helmets, strict law enforcement in the form of fine, role of manufacturing companies and role of religious leaders.

Conclusion: Motorcycle is a risky transport and there are several social and cultural barriers in the use of helmets by female pillion riders.

Introduction

Globally about 46% of all road traffic injuries affect pedestrians, cyclists and motorcyclist (1) with highest percentage of road traffic deaths in pedestrians (22%) and users of two–wheeler vehicles (10%). Studies from Asian countries show that the road traffic injury death occur commonly in users of motorized two-wheelers for example 27% in India, about 60% in Malaysia (2) and 70‑90% in Thailand (3). A survey from Pakistan has shown that road traffic injury due to motorcycles was the third common cause accounting for 21% of total road traffic injuries (4). The use of motorized two-wheelers and bicycles is growing rapidly along with a global increase in motorization, particularly in low-income and middle income countries (LMICs) where it is used as an economic family transport. In India 69% of the total number of motor vehicles are motorized two-wheelers (5). Out of 5 million registered vehicles in Pakistan 51% are 2-and 3-wheelers vehicles (1).

Previous studies done in Pakistan have shown that rates of helmet wearing by motorcycle riders varies widely from 7% - 57% (6-9) and only 5.8% for pillion riders (7). This wide range of using helmet among riders was due to due to different study settings and periodic enforcement of the helmet law. Studies have shown that wearing a good-quality helmet can reduce the risk of death (10-12) from a road crash by more than 37% (13) and risk of severe injury by over 70% (11, 12). The helmet law in Pakistan states that both motorcycle rider and pillion passenger should wear a helmet. Females in Pakistan generally do not drive a motorcycle; their use of motorcycle is as pillion rider; while males can either be riders or pillion riders. However, the enforcement by traffic police is mostly on male riders but sometimes also on male pillion riders and almost never on female pillion riders (14). This is despite the presence of the helmet law in Pakistan which is applicable to both the rider and the pillion rider and does not discriminates based on gender (1).

In the context of Pakistan, it is important to understand that use of motorcycles as pillion riders by females is driven by the social and cultural norms. It is in fact considered a “taboo” for females to drive motorcycles (15) . Despite the importance of helmet in prevention of head injuries in motorcyclists, there is limited use of helmet by riders and pillion riders and particularly use by females in Pakistan (16). . Our objective was to gather the perceptions, barriers, and strategies related to the use of helmets by female pillion riders and their safety in Karachi, Pakistan.

Method

Design and setting

This was a qualitative study done through conducting focus group discussions (FGDs) with both males and female who use motorcycle as a mode of transportation. Males included participants who use motorcycle as riders as well as pillion riders while all females were pillion riders. The study was conducted at the Aga Khan University (AKU) after approval from the AKU Ethical Review Committee. Separate FGDs were conducted with females and males. The FGDs with females were conducted from January – March 2011 and the ones with males were conducted in April 2012. Total nine FGDs were done, five with females and four with males. A total of 61 participants participated in the FGDs; 32 (52.46%) females and 29 (47.54%) males. Majority of our focus group participants were between 20 – 29 years of age. Their occupation ranged from administrative secretary, research staff, and laboratory technicians to field workers.

Participants

All the study participants were the males and females who were working in different departments at the Aga Khan University (AKU) at the time of the study. Participants who use motorcycle as a main mode of transportation were included into the study. The team members identified females who were commonly observed to use motorcycle as the common mode of transport. The eligible females were identified by the team members and approached to participate in the study. The male participants were approached through snowball technique. The purpose and objectives of the study were explained. The name, contact number, department name and name of their supervisors were recorded separately. The supervisors of the participants who agreed to take part in a FGD were then contacted to grant permission to the participants for participation in FGD. The participants were then contacted to confirm the date and time of the FGD in which

they were to participate. All the FGDs were conducted on the premises of AKU to enhance the sense of control and ease among the participants. (17) Following the FGD, tea and biscuits were served to the participants for their time.

Data collection

The FGDs were conducted by an expert facilitator who had prior training and experience in conducting qualitative research. Written informed consent translated into Urdu was taken from each participant before beginning of the formal FGD. None of the participants of any focus group declined the permission to be recorded and the discussions were tape-recorded. A co-facilitator took notes. Both the facilitator and co-facilitators was trained by the principle investigator before beginning collection of data. FGDs of approximately 45 minutes were done using a questionnaire guide with open-ended questions to allow the unbiased expression of participants' opinion and experiences. The guide was developed from previous helmet studies. (8, 12, 18, 19) The facilitators also used probes as per the need to get maximum information from the participants. The topics covered in the FGDs guide were related to the awareness of participants towards the motorcycle rider safety, their knowledge about the helmet law, their perceptions about the pros and cons of usage of helmet by female pillion riders. The size of the FGD varied between 6 – 8 participants (20-23). The FGD guide was pre-tested on a similar group of participants before the beginning of study. The changes were then made in the FGD guide.

Analyses

The qualitative analysis was iterative, involving multiple hours of discussion. Interviews and focus groups were transcribed verbatim and checked for accuracy before being imported into

NVivo2 (24). The software was used to assist with coding, sorting, and retrieval of the data. A step-by-step analysis of the data was followed (25).

1) ***Pre-coding step:*** The first step in the review process involved pre-coding relevant text and information from the transcript that reflected the experiences of the pillion riders. The pre-coding step was done initially together by all members of the research team. Once all reviewers agreed upon the type of information and a sense of understanding of the data was achieved, the remainder of the documents was reviewed independently.

2) ***Category construction:*** The output from pre-coding steps consisted of a large number of identified quotations. The research team reviewed the quotations associated with the constructs and identified categories through discussion and comparison.

3) ***Completion of categorical assignments:*** Significant team discussion occurs at this stage to aggregate quotes that were associated with each reviewed category.

4) ***Thematic identification:*** In the final stages of review, thematic categories were named and reviewed for consistency using a group process that involved re-reviewing the content of the interviews and discussing each identified theme. Final consolidation of pre-codes produced four overarching themes with 13 subthemes. Table 2 gives the summary of major themes and subthemes.

Validity was ensured by repeated reading of whole transcripts to keep the analysis comprehensive; by the use of a form of constant comparison using an active search for counter examples to emerging analysis. Data analysis was led by two members of the research team under supervision of an experienced qualitative researcher. For the qualitative thematic analysis reported here, we generated NVivo reports on specific codes, containing excerpts from all relevant transcripts, and analytic themes were developed in discussion with all authors.

Interpretation was verified using independent transcript analysis and research team meetings to scrutinize emerging categories and themes to ensure reliability. The results then mainly focus on themes that represent the typical perceptions of the sample.

Results

The four major themes emerged from the analysis are as follows:

1. Motorcycle - Risky Mode of Transport

The majority of the study participants reported that a motorcycle is used as an economical family transport especially for the middle and lower socio-economic groups. It is convenient and saves time especially during traffic congestion. However, there was consensus among participants that motorcycle is a risky and dangerous mode of transportation.

> *"It is economically feasible but it comes at a cost of compromising your safety as the riders are more susceptible to injury because the two-wheelers construction is not relatively stable as compared to a four-wheeled vehicle and one may end up experiencing severe injury."*
>
> *"A female riding a motorcycle with a baby; faces the most difficult situation, As it is challenging whether to take care of the child or wear a helmet*."

According to one of the male participants

> *"(Motorcycle is) dangerous even if helmet is used because the rest of the body is open (prone to get injuries). I have observed that motorcyclists try to move even through smallest of the space (available on the road) so that their time is not wasted. Some drivers (of cars) try to hit (such) motorcyclists because (they get irritated) as to why the motorcyclist is moving in front of them (in such a manner). Therefore, there are issues. "*

2.Perception on Use of helmet by Female Pillion Riders

Interestingly, none of the female FGDs participants had ever thought of wearing a helmet while riding the motorcycle. Many participants commented that there is no precedent in Pakistan among pillion riders to wear helmets.

They commented

"It is a strange feeling. When I look at a helmet I feel that it is a rigid structure is not meant for female."

"In Pakistani culture we (females) can't drive a bike and similarly we can't wear helmets."

Male participants thought that due to cultural and social norms, use of helmet by female pillion riders would not be appropriate. They commented

"(Helmet wearing by females pillion riders) will not look nice; will look odd"

One participant who works in the emergency department of a hospital shared:

"We look after the emergency department patients, this is our everyday observation that those who wear helmets are saved from head injuries as compared to the ones who don't wear it. Wearing of helmet saves them from head injury, cervical injury and neck injuries during road accidents"

Despite the fact that they do not use helmets; female pillion riders acknowledge safety of helmet and articulated it various times

"I fell from the bike and had an injury; the first thought which came to my mind was if I were wearing a helmet I could have been protected."

"Using helmets is very important because it gives protection for the head."

3.<u>Barriers to Helmet Use</u>

Our focus group participants drew attention to possible barriers for not using helmets.

a. Lack of Helmet Law Awareness

Females accepted their lack of awareness regarding the law.

"I don't know the law but I have a feeling that the rules regarding the pillion riders of the bike are neglected."

Interestingly, not all the males were aware of the helmet law in Pakistan. According to them due to lack of transparent license process, people are not aware of helmet laws. Those participants who had gone through the correct license process commented that the license authorities give a rule book at the time of issuance of license which mentions helmet law. However, still there is lack of knowledge and awareness about traffic rules.

b. Non-use of side mirrors

Male participants mentioned that one of the reasons that they do not use helmets is because it limits their side vision. Majority of the participants mentioned that they remove their side mirrors because they look odd and also there is higher likelihood of getting stolen.

"When (I) wear helmet, cannot see on the left or the right (because of lack of side mirrors) but without helmet one can see easily"

Another reason for non-use of helmet by male pillion riders was the police harassment that they had to face especially during the time when the police conduct raids to catch criminals. According to them, use of helmets makes them susceptible to being stopped by police for search and investigation.

c. Uninvited Attention by Others

Both females and males respondents felt that helmet use by female draws uninvited attention of people.

"Even if we (female pillion riders) start wearing helmets we may become an object of uninvited attention and I don't want people to stare at me."

One male participant mentioned that

"Not only people will laugh but will also stare (at female pillion riders), four more motorcycles will be accompany (our motorcycle) to see who are we taking with us!...Is there a lady or a male under the helmet?"

d. Sitting Style and Clothing of Females on Motorcycles

A common problem highlighted was wearing of flowy clothes including veil (*abaya*), long scarves (*dupatta*) by the female pillion riders and the way females sit on the motorcycle (saddle-sided). The females in Pakistan sit on the motorcycle with their legs hanging on one side, without back support. They usually have to hold the motorcycle driver for support. There is also no support for feet making it difficult for the females to sit on the motorcycle. This is a further barrier in wearing helmet.

"The girls in Pakistan wear dupattas (long scarves) and loose trousers which often get stuck in the moving wheel of the motorcycle, resulting in pulling of the dupattas especially around the neck, the result of which can be death".

"The big issue is the way we sit and dress. How will we look on the bike sitting saddle crossed and wearing a helmet?"

Some male participants shared that females should not sit on the motorcycle because the saddle-sided position makes them more prone to injuries. Therefore is a potential barrier to the use of helmet by females.

"It is (commonly) heard that females have more (motorcycle crashes) because of the way they sit (saddle-sided), therefore their position is not comfortable, their dupatta gets strangled (into the motorcycle)… this makes them 50% more at risk … If there is a speed breaker and the (motorcycle) speed is high, they will fall"

e. Cconcerns about Physical Appearance

Most of the females in our FGDs were consciousof their appearance and articulated

"Helmets are ugly. Though it may protect from sun and dust, it spoils the hairdo. Imagine getting decked up for a party and make-up and hair going haywire because of helmet."

"If you are going with your family, it would seem odd to me that all riders are wearing helmets including children."

Surprisingly, male participants shared the same as the female participants with regards to the helmets for the females.

"It can be so that the helmets designed for females should be different. Their designing should be such that females could wear it (helmet). Male helmets on females would look odd."

f. Discomfort Caused by Helmet Wearing

Majority of the participants were also concern about the discomfort caused by the use of helmets.

"The weight of the helmet causes headache and neck pain."

"One is prone to skin infections and hair loss due to excessive sweating as a result of wearing helmet."

Some male participants even questioned the use of helmet by females due to weather conditions and culture of the country.

"…But do you think especially keeping in view the environment of Pakistan, as there is hot weather for almost nine months (of the year), also females are covered in abaya from head to toe and on top of that they wear helmet…is that realistic?"

g. Quality, Design and Storage of Helmets

Concerns regarding the quality of helmets available in markets were also raised. The participants commented

> *"These days all types and varieties of helmets are available in the market and the prices range and they will end up buying the cheaper one which is of low quality and of no use as it can't protect them from injuries."*
>
> *"Even the helmet is not 100% safe but there may be some degree of prevention (against road traffic injury) because these days the helmets are made of the material so that if (a person) gets hit (during a road traffic crash), the helmet breaks which can harm the person. But at least the head is not hit directly so it is better to use helmet."*

Most of the participants also commented on helmet designs and thought placement/storage of helmets would be difficult at the work place, one participant shared:

> *'The helmets should look feminine. Helmets for females should come in different designs and colors."*
>
> *"Fifteen people work in one room in my office. It is difficult to find place for keeping our hand bags. Where would we keep the 15 helmets in the office?"*

4. <u>Strategies to Implement Helmet Use</u>

Several strategies to implement helmet law were put forward by the focus group participants. All of them agreed that preventing injuries is very important. Many people were of the opinion that .wearing of helmet can be practiced if it is accepted in the Pakistani culture and implement as rule with proper follow-up.

One respondent remarked that:

"In neighboring countries females drive motorcycles. If we (females in Pakistan) can drive cars then why can't we drive a motorcycle? It's just about acceptance in the society. If society as a whole adopts the habit of wearing helmets while riding bikes; we all can easily follow it."

Some strategies put forward by the participants were:

a. Awareness Campaigns through Involvement of Media

Most of the females were of the view that these days media is very strong and can play an important role to encourage females to wear helmets.

"Seminars should be arranged to highlight the importance of wearing helmets for the female pillion riders."

"If media is involved in making public aware about the use of helmets; it can prevent road traffic injuries. Public service messages for the use of helmets by female pillion riders can be given through a variety of means like radio, television, advertisements etc.

b. Free distribution of helmets

According male participants, one of the ways by which female helmet use can be increased it to distribute it for free.

"It happens that if distributed for free than all (females) will wear it (helmet)".

c. Use of Role Models and Female Police Officers for Setting Examples

Participants emphasized that celebrities can play an influential role in setting example for people and can encourage the use of helmet.

"Celebrities (like actors, cricketers) can also influence the public by setting examples."

"Female police officers should be given motorcycles to drive and they should also be given helmets so that at least this will be an innovation towards execution of helmet law."

d. Strict Law Enforcement Use of Helmets

Wearing of helmet as a requirement by law is an effective strategy to increase helmet use and to reduce death and injury. However, a participant commented:

> *"Who follows the law and order? The traffic police take 10-15 rupees and let the law violating person free."*

However, others emphasized that:

> *"It (law) should be implemented strictly with government support. Once it is started (helmet wearing), no female pillion rider will feel odd wearing a helmet.*
>
> *"If the person is not using a helmet, a fine should be imposed."*

e. Role of Manufacturing Companies and Employers

The other recommendations given by the participants included

> *"The dealers and manufacturers of motorcycles should sell two helmets along with the vehicle to promote wearing of helmets by the pillion riders."*
>
> *"Employee's organization should provide the helmets."*

f. Role of Religious Leaders

The participants also propose the involvement of religious leaders to endorse the use of helmets by female pillion riders.

> *"If religious leaders give Fatwa (A ruling on a point of Islamic law given by a recognized authority) on wearing (of helmets by females) then everyone will agree (to the use of helmet by females)."*

Discussion

This is first ever study in Pakistan to look at the perception regarding female pillion riders through focus group discussions (FGDs). The major themes were unawareness on helmet use, barriers including clothing, sitting style (both legs on one side), and discomfort and strategies including media involvement for awareness on helmet.

The most surprising fact was that almost all female pillion riders neither thought of wearing a helmet nor were asked to or fined by police officers. Previous literature confirms low use of helmet by pillion riders as compared to riders, (26-29) this can be because of lack of awareness regarding the safety of pillion riders through the use of helmets. However, there are mixed results when gender differences were observed among helmet users in previous studies; some showed no gender difference, (26, 30) others reported more female (28, 31) or male use (32, 33). In Karachi an ongoing road traffic surveillance reported 55 deaths of female pillion riders in 3-years (September 2006- September 2009). This suggests efforts should be made to make the pillion riders particularly females aware about helmet use. It is equally important to have campaigns that focus on helmet wearing by pillion riders irrespective of gender.

There was consensus on the benefits of helmet by the participants which is in contrast to the finding in a study from Greece where secondary school students who were non-users of helmets perceived the efficacy of helmet to be low (19). It is interesting to note that all participants thought that motorcycle is a risky vehicle but none of the females thought about using helmet for their own safety. Even males acknowledge that females are at a greater risk of injury due to their clothing, sitting posture and also because they sometime also have children in their lap but were little resistant to the concept of use of helmet by female pillion riders. This is because in Pakistan even when helmet law is enforced it does not focus on pillion riders

especially females. No law enforcing agency penalizes female pillion riders for not wearing the helmet. All participants admitted to not knowing about the helmet law for pillion rider particularly females. The actual situation is different in Pakistan; there exists a law for helmet use for pillion riders however, it is not enforced. Experience has shown that mandatory helmet law with proper enforcement lessens the burden of traffic injuries and it is one of the most cost effective strategies (16, 34). A recent enforcement campaign on a highway in Pakistan showed the highest use of helmet wearing by pillion riders of almost a 13% increase (7).

The possible barriers in helmet usage as reported in our study were fear of mockery by others, sense of awkwardness, possible discomfort and the issues of helmet storage space. These barriers were identified by both male and female participants. Previous studies of Pakistani male motorcycle users also reported discomfort and awkwardness as reasons for their non–compliance (8, 9). A qualitative study done in Greece on adolescent students also articulated similar reasons; lack of convenience, vision and hearing disturbance, and style reasons (19). The lack of a storage compartment for a helmet on the motorcycle was also reported as a barrier to use helmet in an Iranian study (35). Another important finding was inconvenience caused by saddle-sided sitting posture of females which along with child/ children further hampers the helmet wearing. Recently, the city officials of Aceh, a city in Indonesia proposed a law whereby it was mandatory for females to sit on the motorcycle like males do. This measure was taken to reduce the vulnerability associated with saddled-sided sitting position of females while riding motorcycles as pillion riders (36). Even if females want to sit like males, it may be taken as taboo in the context of Pakistan. This is an issue which needs discussion at various forums (37). In India, neighboring country with similar culture as in Pakistan, females drive motorcycles but the legally they are not forced by the law to wear helmets. This is in contrast to the law for male riders in

India (15). Moreover scarves / *dupattas* that females wear do not complement helmet use because of the warm climate and potential danger from entanglement (38-40).

Female pillion riders also hinted on the design and quality of helmets. Availability of high-quality helmets is not widespread and costs are an additional expenditure for people in low socio-economic strata. Two-thirds of nearly 5000 motorcyclists observed in China were wearing helmets that were substandard(16). A study from Iran also reported use of substandard helmets as they are cheap and light in weight (18). Availability of helmets specifically for female pillion riders might promote helmet use in Pakistani females. However, there is a direct relationship of price and quality so even if there is high utilization of helmet; it does not guarantee protection.

Despite the barriers participants in our study showed positive attitude towards helmet use similar to what was found in India (27) and recommended the involvement of media and other celebrities in such campaigns. Male participants suggested that free feminine looking helmets should be distributed among female to encourage its use. Participants in our focus groups also proposed to impose a fine for non-compliance of helmet use. Another study in India that included a media campaign and fine for failure to wear a helmet increased the proportion of helmet use from 10% to 70% over a six-week period (16). Previous studies have also shown increased helmet wearing rates from 20% to over 96% and reduction of 18% fatality and 16% injuries after the introduction or revision of a mandatory helmet law in Italy (41) and Vietnam respectively (42). The strategy of involving religious leaders in helmet use among females is also very interesting. Such strategies were proposed (43) earlier in reproductive health care and the engagement of religious leaders has proved instrumental in success of family planning Bangladesh and Afghanistan(44, 45).

A major strength of this study is that it has brought light to an important and amenable source of injury for many females in Pakistan. The study results provide a new dimension to the subject area and support previous studies, thus adding to the picture of what needs to be done.

Limitations

Some limitations of the current study must be taken into consideration when interpreting the findings. As a qualitative study, it must be acknowledged that this study was a single institute study and the opinions and concerns of this group may not likely represent the opinion of a wider population of Pakistan representing different age groups, socioeconomic backgrounds, occupation and educational status. A further limitation is that those who responded to the invitation to participate in the focus group discussion may have had a greater interest in the topic, or a vested interest in having their voices heard as compared to those who did not or could not attend.

Conclusion

This study highlighted the barriers and possible solutions to increase helmet wearing in female pillion riders. The helmet use in pillion rider is a challenge, more so in females, however, publicizing the laws on helmets as well as improving law enforcement, with the clarity that it includes both gender are essential for helmet use by pillion riders. Involvement of different stakeholders including media, road safety education targeting high schools, manufacturers and suppliers of helmet, and policy-makers could be the steps leading to buckle the helmet.

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Table 1: Summary of major and minor themes

1.Motorcycle - Risky Mode of Transport

2.Perception on Use of helmet

3.Barriers to Helmet Use

- a. Lack of Helmet Law Awareness
- b. Non-use of side mirrors
- c. Uninvited Attention by Others
- d. Sitting Style and Clothing of Female on Motorcycles
- e. Concerns about Physical Appearance
- f. Discomfort Caused by Helmet Wearing
- g. Quality, Design and Storage of Helmets

4. Strategies to Implement Helmet Use

- a. Awareness Campaigns through Involvement of Media
- b. Free distribution of helmets
- c. Use of Role Models and Female Police Officers for Setting Examples
- d. Strict Law Enforcement Use of Helmets
- e. Role of Manufacturing Companies and Employers
- f. Role of Religious Leaders

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"GenderDifferences in On-line Social Networking and Travel Behavior of Adolescents"

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Abstract

The aim of this paper is to investigate how much and why adolescent females use ICT (Information Communication Technologies) and OSN (Online Social Networks) and how these affect their trip making behavior for social trips. The analysis consists of two stages: First, we investigate all the characteristics (time spent, purpose etc.) of the usage of ICT and OSN through the means of a descriptive analysis for each gender. Next, we developLatent Class Poisson Regression models, which employ the latent construct to represent the differences in trip making behavior for social purposes among the OSN latent classes. One model is developed for female and one for the male participants in order to compare their OSN usage styles and trip making behavior.The methodology is tested with data from a large-scale survey that refers only to adolescents (12 to 18 years old) and took place in the Republic of Cyprus in 2012. The sample consists of 9,735 teenagers covering the 20% of the total high-school population (5,586 girls and 4,608 boys). The class membership models of both models indicate that there are three latent OSN usage styles, while the results of the class-specific models indicate that the rational OSN usage style (Class 1) and the OSN addiction (Class 2) conduct more social trips than those who are indifferent to OSN usage(Class 3), while gender differences are noticed in the class-specific models, with adolescent females to conduct more trips for social purposes than males. The results of the study provide insights into how OSN usage affects adolescent females and males' travel behavior, while the class specific model is rich in interpretation, and serves as a harbinger for policy-makers.

Key words: Travel Behavior,ICT, On-line Social Networking, Social trips, Latent Class Models, Adolescents

1. Introduction

Social media are designed to foster social interaction in a virtual environment and millions of contemporary adolescents use them. Using social media web sites is among the most common activities of today's adolescents. Any web site that allows social interaction is considered a social media site, including on-line social networking (OSN) sites such as Facebook, MySpace, and Twitter; gaming sites and virtual worlds such as Second Life, Club Penguin, and the Sims; video sites such as YouTube; and blogs. Members use these sites for a number of purposes. The root motivation is communication and maintaining relationships. Popular activities include updating others on activities and whereabouts, sharing photos and archiving events, getting updates on friends' activities, displaying a large social network, sending messages privately, posting public testimonials and presenting an idealized persona.

This culture of innovation and rapid technological adaptation is particularly strong among the younger generations, especially the New Boomers or Net Generation (born between 1983 and 2001; PRB, 2009). These so-called "internet natives" grewup in the era of personal computing and the internet or, as Tapscott (2009) puts it, they have been "bathed in bits and bytes" since birth and easily integrate technology into their daily lives. This generation has no memory of a life without Web browsing, cell phones, texting, and high-definition video (Fay, 2013). This discourse has a wide social impact and its echoes can be found in psychology, business literature and government policy. The general claim, made in this generation's discourse, is that this material context has led young people to develop natural aptitude and high levels of skill in relation to the new technologies. In contrast, those older people who grew up in an analogue world are portrayed as always lagging behind, like immigrants to the new world(Tapscott, 2009).It is suggested that these older digital immigrants are never likely to reach the same levels of skill and fluency that were developed naturally by those who grew up with the new technologies (Qualman, 2012).Thus, a generation gap is developing.

The emergence of OSN has upended the way teenagers interact with each other and the world, and there is now little room for doubt about its impact on aspects of social life such as friendships, information sharing and leisure activities. More than ever before, using social media means creating as well as receiving, with user control extending far beyond the selection of ready-made, mass-produced content. Against this background, in recent years a growing body of researchers have tried to investigate the kind of activities teenagers conduct using OSN and the effects on teenagers' personalities and psychology. However, little is known about how much, why, and how individuals, and more specifically adolescent females and males, utilize social media, and how its usage affects their travel behavior.

Having these in mind, the aim of this paper is to investigate how much and why adolescent females and males use ICT and OSN, how these affect their trip making behavior for social purposes and potential differences between females and males. The analysis consists of two stages: First, we investigate all the characteristics of the usage of ICT and OSN (time spent, purpose etc.) through the means of a descriptive analysis. Next, we develop one Latent Class Poisson Regression model for each gender, which incorporates OSN usage styles as higher-level individual orientations influencing the number of trips made for social purposes. The methodology is tested with data from a large-scale transport survey conducted in Cyprus in 2012 and refers only to adolescents. In cooperation with the Ministry of Education and Culture (MOEC) of Cyprus, the web-based questionnaire was forwarded to all Cypriot high schools and the sample consists of 9,735 participants (20% of the total student population), aged from 12 to 18 years old in 2012 (born 1995-2001; Net Generation). The data set provides information for 15,693 social trips that recorded over a Saturday of 5,586 females and 4,608 males.

The innovation of this research covers several topics. First of all, to our knowledge it is the first time that such a large-scale survey on travel behavior, focusing only on teenagers, has been conducted. Secondly, the questionnaire used for the data collection was designed specifically to investigate teenagers' perceptions of travel behavior; it was designed not only by transport planners but also by psychologists and economists, with the aim of approaching the multidimensional nature of transportation problems in depth. Third, although the effect of ICT on travel behavior has been widely studied the last decade, there are only few surveys that investigate the travel behavior of different OSN usage styles of females and males. Fourth, Net Generation behaves in a different way than their parents, thus a generational gap is created which may affect transportation sector as well. Furthermore, the findings of this study offer guidelines to transport policy makers as to how Net Generation and more specific females and males use on-line social networking. Finally, the investigation of teenagers' travel behavior may explain many of the trends and undesired behaviors that adults adopt.

The remainder of the paper is structured as follows. Section 2 reviews the literature. Section 3 describes the modeling framework and associated mathematical formulations. The case study, the sample's descriptive statistics and the OSN usage patterns are presented in section 4, while section 5 describes the model estimation results. Section 6 concludes the paper by providing a summary of the findings, and implications for policy and further research.

2. Literature Review

2.1 ICT and Travel Behavior

The importance of technology in our daily lives has increased, and the adoption of ICT has changed the way we live, communicate, work and entertain, and consequently how we travel. ICT provides people with alternatives to face-to-face communication and thus have the potential to substitute for physical travel. In response to this rapid expansion, a new literature has emerged to explain the potential effects of these trends on travel behavior. A vast body of researchers has been investigating the impact of ICT on transportation, examining concepts such as telecommuting/teleworking, e-commerce and time planning. Results on telecommuting and travel behavior vary, with some studies concluding that teleworking substitutes for daily travel (Walls &Safiro, 2004; Choo et al., 2011) and others that teleworking modifies the daily commute (Polydoropoulou&Tsirimpa, 2012). Also, the overall effect of e-shopping on travel behavior remains unclear, with different studies reporting contradictory and ambiguous findings, depending on the type of goods purchased (Farag et al., 2007;Dijst et al., 2008; Papola&Polydoropoulou, 2006; Mokhtarian, 2004). These studies have greatly contributed to our understanding of the possible and potential impacts of ICT on physical travel, which can be grouped into four categories (Mokhtarian, 1990; Mokhtarian, 2004; Pendyala et al., 1991; Salomon, 1986): 1. *Substitution*: usage of technology replaces a physical trip; 2.*Complementarity*: usage of technology creates additional demand for travel; 3. *Modification*: usage of technology does not affect the frequency of physical travel, but may change the characteristics of trips, such as timing and chaining; and 4. *Neutrality*: usage of technology is independent of the traditional trip and has no effect on regular trip making.

Although the relationship between ICT and travel patterns has received a substantial amount of attention, not many studies focus on leisure or social travel even though it is the fastest-growing segment of travel (van de Berg et al., 2011; Mokhtarian et al., 2006; Axhausen, 2005). It is highly probable that the effect of ICT on social travel differs from its effect on travel for other purposes, such as work or shopping. Travel behavior is influenced by someone's social network characteristics, as they are relevant to his or her propensity to engage in social activities (Carrasco & Miller, 2006).

According to Mokhtarian et al. (2006), complementarity and modification are more likely than substitution in the case of social activities, because ICT-based alternatives to these activities (if available) are rarely satisfying substitutes. This is confirmed by Senbil and Kitamura (2003), who studied the relations between telecommunication and travel for the three types of activities distinguished by Chapin (1974): 1. mandatory (work and work-related) activities, 2. maintenance activities (grocery shopping, eating, household maintenance, etc.), and 3. discretionary activities (leisure, sports, hobbies, etc.). They found substitution effects for work activities; for maintenance activities, the effect appeared to be neutral, and for discretionary activities they found complementary effects. The complementary effect of ICT on social activities was also identified by Tillema et al. (2007), who found a positive correlation between frequency of face-to-face contacts and electronic communication.

However, the majority of these studies refers to adults (the Baby Boomers Generation), while there is little work, particularly produced by psychiatrists and sociologists, on how young people and teenagers (the Net Generation, or Net Geners) use social media and how this affects their activities and travel behavior.

2.2 On-line Social Networking and Face-to Face Communication

Since it is difficult to find similar research in the transportation sector with which to build links between OSN and the number of trips, we use findings from the social sciences regarding virtual and face-to-face communication.

As adolescent OSN usage grows in prevalence, so do psychologists' concerns about the effects of virtual communication on their social development. After we reviewed the research, it became obvious that there was a debate over whether on-line communication is used most by those already socially adept for additional interactions to bolster already thriving social networks, or by those adolescents who lack social skills and employ social networks as a form of social compensation(Sheldon, 2008). This is called the "rich get richer"theory (Wilks, 2012).

More extraverted teens who already have well-established peer groups report using the communication websites for additional peer interaction to reinforce already formed friendships and keep in touch with long-distance friends. On the other hand, less socially adept youth explain their on-line social networking as a place to anonymously self-disclose and make friends when they might otherwise be too uncomfortable to do so (Anderson-Butcher et al., 2010). There is much debate and contradictory research as to which of these motives takes precedence, because past research (Finkelhor et al., 2002) has shown that less socially capable teens are more likely to turn to the worldwide web, while current research is showing the opposite (indicatively: Barak-Brandes& Levin, 2013; O'Keefe et al., 2011; Craig Watkins, 2009; Greenfield &Subrahmanyam, 2008).

Nevertheless, the majority of the most recent surveys verify the "rich get richer" theory. DeGroot et al. (2011) found that on-line social networkinghas a positive relationship with the frequency of face-to-face communication with Facebook friends and that communicating on Facebook is positively correlated with personal interactions with Facebook friends. Allen et al. (2010) found out that teens who had displayed negativity in friendships and reported symptoms of depression were less likely to possess a social networking profile, while adolescents who reported more positive intimate friendships were more likely to possess a profile. Regan and Steeves (2010) discussed the way on-line social networking could empower young people. Thus on-line social networks are able to both bridge and bondsocial capital by connecting large groups of people in loose networks and allowing communication that fosters relationship closeness. In their final comments on relationships, the

authors suggest that on-line social networking positively affects face-to-face communication.

Since the massive popularity of social networking sites did not arise until the early 2000s, research in this field is obviously incredibly young and there is still much to be done. Especially in transport sector, it is difficult to identify similar surveys. The studies reviewed in this article appear to indicate that, despite initial concern, on-line social networking may have more positive than negative effects on adolescents' face-to-face communication. Internet communication is an outlet for both extraverted and introverted youths. Teens most often use social networking sites to connect with friends and build communities, something they are also doing off-line.

Having all these findings in mind, we try to identify the links between adolescent virtual or on-line social networking and the number of trips they conduct for social purposes. It is obvious that teenagers use social media in order to enhance communication and social connection. Also, it is highlighted that there are groups in the total population that are affected by different ways of using social media. In doing so, we hypothesize that there are different OSN styles, which are not directly observable, and that each OSN style affects in a different way the number of trips conducted for social purposes (face-to-face communication).

2.3 Gender Differences in ICT and OSN usage

Studies on on-line social networking to date have not uncovered gender differences in usage (Barker, 2009). However, according to the 2007 Pew Internet and American Life Project, gender differences exist. Their research has reported that older (age 15-17) adolescent males (54%) are less likely to have used an online social network compared with 70% of older adolescent females. Older adolescent males (57%) are less likely than older adolescent females (70%) to have created an online profile on an OSN. Adolescent males are less likely (40%) to post photos online when compared with females (54%). Older females are the mega "posters", with 67% of them uploading photos, compared with 48% of older males. Younger females and males are equally as likely to upload photos; however, 39% of younger females aged 12 to 14 upload photos whereas 33% of younger males do so. Online teen males are nearly twice as likely as online teen females to post video files (19% vs. 10%). Twenty-one percent of older males post video, whereas just 10% of older females do.

Pujazon-Zazik and Park (2010) also highlighted gender differences in Internet use of adolescents in California; adolescent males were reported to focus more on the entertainment aspects of the Internet, whereas females seem more interested in the relational aspects of social media and were more likely to talk to friends on the Internet about romantic relationships, secrets, and deep feelings (Rainie, 2003). In addition.Siomos et al. (2008) identified that Greek girls are more possible to be addicted to Internet than boys.

With regard to social networking sites, teens, particularly girls, reported using the sites to keep in contact with peers from their offline lives, either to make plans with friends that they see often or to keep in touch with friends they rarely see (Lenhartet al., 2007). The girls in this study also reported using social networking sites to reinforce pre-existing friendships whereas boys reported using them to flirt and make new friends.

3. Modeling Framework

The dependent variable to be dealt with in this paper is a count of the total number of trips T_i, measured in a sample of N individuals. That is, our data form a cross-section. We assume that there are X_n independent explanatory variables that affect the number of social trips. To assess the impact

of the explanatory variables on the trip making of each gender, we specify a Poisson regression model in which the intercept and the coefficients of the covariates vary across the sample according to some distribution. This unobserved mixing distribution is assumed to be discrete, which results in a finite mixture model formulation (Weder et al., 1993). The results of Laird (1978) and Heckman and Singer (1984) show that estimates of such a finite mixture model may provide good numerical approximations even if the underlying mixing distribution is continuous. Heckman and Singer (1984) state, however, that maximum likelihood theory cannot be invoked to justify the large sample properties of the estimators in such cases. Because of the assumption of a discrete mixture distribution for the intercepts and coefficients, the point masses of this distribution can be interpreted as latent classes (see Lazarsfeld and Henry, 1968; McCutcheon, 1987; Gopinath, 1995; Green &Hensher, 2003) of subjects, which differ in terms of the relationship between the explanatory variables and the rate of occurrence of trips.

LCMs are appropriate for our analysis as the hypothesis is that OSN usage styles exist, that these styles are not directly observable and that each OSN style has a different social-trip making behavior. Furthermore, one LCM is developed for each gender, in order to be able to identify potential gender differences. This section describes in depth the model specification process. The LCM comprises two components: the class membership model and the class-specific model, as shown in Figure 1.

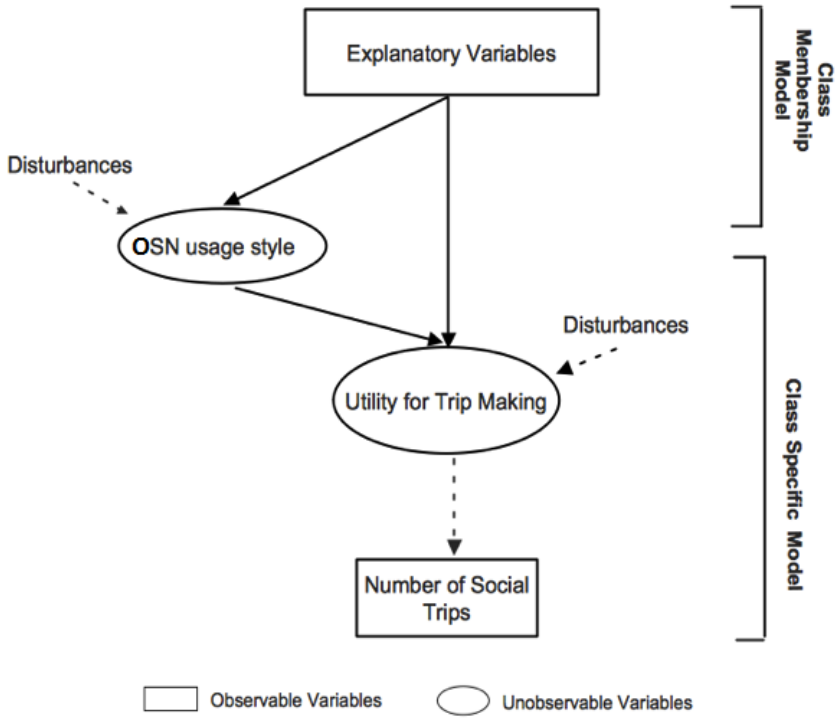

Figure 1: Modeling Framework

The class-specific model shows the influence of an OSN usage style and socio-economic variables on the number of trips made for social purposes.

Class-Specific Model

It is assumed that each individual belongs to one and only one class. The class-specific model is a Poisson Regression and represents the number of trips conducted by a latent class, varying among the latent classes. The Poisson model assumes that the number of trips any individual makes in a given time period is independent and has a constant rate of occurrence (Ben-Akiva et al., 1996). It is given by:

$$P(T_i \mid s) = \begin{cases} \dfrac{e^{-\lambda_{is}}(\lambda_{is})^{(T_i)}}{(T_i)!} & for\ \lambda_i > 0 \ \text{ and T=0,1,...} \\ 0, otherwise \end{cases} \quad (4.1)$$

where$T_i$is the number of trips, and $\lambda_{is}$is the mean number of trips made by person *i*belonging to class *s*.

For each class *s*, the mean number of trips for each individual *i* is an exponential-linear function of the explanatory variables, as follows:

$$\lambda_{is} = \exp[\alpha_s + X_{ik}\beta_{ks}] \quad (4.2)$$

whereα is the constant of class *s*, and β_s depicts the impact of the X_{ik}explanatory variables on the mean number of trips in class *s*.

The formulation of the probability density in equation (4.1) is conditional upon individual *i* belonging to class *s*. Considering the observed frequencies T_i as arising from a mixture of *S* unobserved Poisson distributions (Heckman & Singer, 1984), we obtain the unconditional probability:

$$P(T_i \mid \beta_{ks}, s) = \sum_{s=1}^{S} P(T_i \mid \beta_{ks}) \quad (4.3)$$

which is the probability that individual *i*conducts *T* number of trips, conditional on the characteristics of the individual and conditional on individual *i* being a member of class *s*.

In this way, we capture heterogeneity across individuals, since: 1. a formulation is used in which the mean event rate has a discrete mixture distribution, i.e. it varies across a finite number of unobserved classes; 2. the mean trip making varies within each class, depending upon the explanatory variables.

Class-Membership Model

The class-membership model links the latent OSN usage styles to socio-demographic variables and segments all individuals into s_n classes (Swait, 1994; Hess et al., 2007; Walker & Ben-Akiva, 2011; Vij et al., 2011). While the latent class to which an individual belongs cannot be deterministically identified from the observable variables, it is presumed that the class membership probabilities can be estimated. The probability that individual *i*has OSN usage style *s*, conditional on the characteristics of that individual, X_n, is given by:

$$P(s \mid X_n) \quad (4.4)$$

LCMs simultaneously estimate class-membership functions and class-specific functions. The model simultaneously breaks down teenagers' OSN behaviors into classes and estimates the class-specific functions in a manner that maximizes model performance. Since the class of each individual is unknown, neither of the above equations can be estimated separately. The two components are estimated simultaneously via an LCM:

$$P(T_i \mid X_{ik,} X_{in}) = \sum_{s=1}^{S} P(T_i \mid X_{ik}, s) P(s \mid X_{in}) \quad (4.5)$$

where the probability of an individual *i* making *T* number of trips is equal to the sum over all the latent classes *s* of the class-specific membership model conditional on class $P(T_i \mid X_{ik}, s)$, multiplied by the probability of belonging to that class, $P(s \mid X_{in})$.

Likelihood Function

In writing the likelihood function, an individual's probabilities of conducting specific numbers of trips are conditionally independent, conditioned on the individual's SN usage style (the classic latent class assumption) and on the error components. Combining the class-membership model, the class-specific choice model, the error components, and the number of social trips observed for an individual, the joint likelihood function for an individual *i*is given by:

$$L = \prod_{i=1}^{N} P(T_i \mid X_k, s) \sum_{s=1}^{S} P(s \mid X_n) \quad (4.6)$$

Defining the number of latent classes

One of the limitations of latent class choice models is that the researcher has to decide on the number of latent classes to use. The model cannot determine this automatically. This limitation is addressed by systematically estimating LCM based on different numbers of classes and then choosing the model that performs best. This approach requires a performance statistic that penalizes decreased model parsimony. To compare the estimated models and their goodness of fit, we use the log-likelihood, the corresponding values for the Rho-bar-squared, the Bayesian Information Criterion (BIC) and the Akaike Information Criterion (AIC). Rho-bar-squared indicates how well the model predicts class memberships. AIC and BIC differ from one another according to how much weight is applied to penalize for each additional model parameter.

The $\bar{r}^2$ is calculated as follows:

$$\bar{r}^2 = 1 - \frac{L^* - k}{L^0} \quad (4.7)$$

The AIC is given by:

$$AIC = -2 \ln L^* + 2k \quad (4.8)$$

The BIC imposes an additional penalty on the log-likelihood as compared to the AIC, and therefore tends to favor more parsimonious models. The equation for the BIC is:

$$BIC = -2L^* + \ln(N)k \quad (4.9)$$

where
k denotes the number of estimated parameters;
L^0 is the initial log-likelihood (the log-prior) for the estimated parameters;
$L^*$is the log-likelihood calculated at the values of the fitted parameters (log-posterior);
N is the number of respondents.

The lower the values of BIC and AIC criteria, the better the model fits that number of classes. The BIC is often used with LCMs because it imposes a harsher penalty on the number of parameters than the AIC.

4. Survey

4.1 Case study

A web questionnaire that refers only to teenagers was designed specifically for the needs of our research. As mentioned above, traffic engineers and psychologists cooperated in designing the questionnaire with the aim of capturing the fundamentals of travel behavioral processes (for more details about the questionnaire and data collection, see Kamargianni&Polydoropoulou, 2013a; 2013b). In 2012, in cooperation with MOEC, the questionnaire was forwarded to all Cypriot high schools. The students filled in the web questionnaire during informatics lessons, under the supervision of their teachers who had received extra guidance to assist with any questions. For this paper, the sample consists of 5,586 adolescent girls and 4,608 adolescent boys (total: 9,714 - 20% of the total high school population of the country).

Table 1 presents the descriptive statistics of the sample. 55% are female and 41% are between 12 and 14 years old. 95% of the teenagers have a mobile phone, and 56% of them use their mobile phones to connect to the internet. Understandinganindividual'stechnologicalenvironmentisavitalcluetounderstandinghowthat personusestheinternet,connectswithothersandaccessesinformation.Theaverage teenager owns2.9gadgetsout of thefourweasked aboutinoursurvey:cellphones (conventional or 3G/smartphones),computers (desktops and laptops),gameconsolesandportablegamingdevices. All these gadgets increase teenagers' virtual connectivity as they provide internet access.Laptopshaveovertakendesktops as the most commonly owned computers. Teensareenthusiasticconsumersofgamingdevices, both wiredandportable.In total,80%of the teens in our sample haveagameconsolesuch asa PlayStation, an Xbox or a Wii, while 59% own a portable game device such as aPSP or a Nintendo 3DS. Nowadays, gamedevicesandconsolesprovidenewwaysforteenstogoon-line. Also, the survey indicates that the predominant purpose for which teenagers use OSN sites is for communicating with their friends. 9% of the participants indicated that they use OSN mainly for playing interactive games, while 5% use them for keeping up-to-date with various events and friends' activities.

Table 1: Sample's Characteristics

		Girls	**Boys**
High School	Gymnasium (12-14 years old)	42%	41%
	Lyceum (15-18 years old)	58%	59%
Grades	Low (<14/20)	11%	17%
	Medium (14-18/20)	46%	46%
	High (18-20/20)	43%	37%
Own a mobile phone		96%	95%
Connect to internet via mobile		52%	53%
Mobile contract (vs. top-up)		40%	45%
Own a game console (PS, Xbox, Wii etc.)		61%	89%
Own a portable gaming device (PSP, Nintendo 3DS)		55%	62%
Own a desktop		51%	57%
Own a laptop		80%	88%
Own a tablet		60%	68%
Time spent on OSN (hours per Saturday)		(Std. Dev. = 2.30)	1.7 (Std. Dev. = 2.30)
Internet use on Saturday (hours)		2.7 (Std. Dev. = 2.29)	2.7 (Std. Dev. = 2.29)
Purpose using OSN: communicate with friends		85%	74%
Purpose using OSN: flirt		23%	65%
Purpose using OSN: stay update about social events		79%	62%
Household size		4.8 (Std. Dev. = 1.34)	4.5 (Std. Dev. = 1.16)
Siblings		2 (Std. Dev. = 0.98)	1.8 (Std. Dev. = 1.52)
Household car ownership		2.5 (Std. Dev. = 1.12)	2.7 (Std. Dev. = 1.27)
Family's monthly income	Less than 2000 Euro	14%	16%
	2000 to 4000 Euros	26%	28%
	More than 4000 Euro	36%	35%
	N/A	24%	21%

Number of social trips – Saturday	2.9 (Std. Dev. = 1.19)	2.5 (Std. Dev. = 0.92)

5. Model Estimation Results

This section presents the process of defining the latent classes and the results of the model estimation. The Latent Class Poisson Regression model described in this paper was estimated using Latent GOLD 4.5 by Statistical Innovations Inc.

5.1 Defining the number of classes

A number of different model specifications with different number of classes and explanatory variables were tested for each gender. We also estimated the three-, four- and five-classes models with predefined classes. To determine the optimal number of latent classes for the model, the Rho-bar- squared, BIC and AIC values of models with various numbers of latent classes were estimated and the key results are presented in Table 2.

Table 2: Summary Statistics of Models with Different Numbers of Latent Classes

		Number of Parameters	AIC	BIC	Rho-bar-squared
GIRLS					
G1.	Model without segmentation	18	17476	17548	0.0010
G2.	Model with two latent classes	33	17309	17493	0.1179
G3.	Model with three latent classes	54	17199	17495	**0.5360**
G4.	Model with four latent classes	75	16997	17404	0.2447
G5.	Model with five latent classes	96	**16829**	**17348**	0.4620
BOYS					
B1.	Model without segmentation	18	12771	12841	0.023
B2.	Model with two latent classes	33	12668	12846	0.1456
B3.	Model with three latent classes	54	12582	12867	**0.6277**
B4.	Model with four latent classes	75	12390	**12783**	0.4972
B5.	Model with five latent classes	96	**12372**	12873	0.3595

All the statisticspresented in Table 2indicate that a model with OSN usage segmentation both for girls and boys ispreferred over one without. The BIC and AICof the model estimated for girls suggest that the model with five latent classes is superior, while the Rho-bar-squared suggests the model with three latent classes. Regarding the model that estimated for boys, BIC indicates that the model with four latent classes is superior, the AIC suggests the model with five latent classes, while the Rho-bar-squared the model with three latent classes. Although these statistics provide a lot of information they indicate a different model, while Rho-bar-squared indicates the three class model for both models. Thus, we examine further the estimation results of each model aiming to identify the model that provides the most satisfactory behavioral interpretation regarding the OSN usage latent classes and trip making behavior of girls and boys (logical signs and interpretability of classes). Although Models G5 and B5 have the lowest AIC value, they are rejected because the behavioral differences among the classes are not clear and the classes are difficult to interpret. In terms of comparing Model B4 and Model B3, the first one has the lowest BIC value, while the other one the highest Rho-bar-Squared. We prefer Model B3 to Model B2, as it provides the best and most interpretable results and was chosen to be presented thoroughly below. Similarly, we prefer Model G3 to models G4 and G2 as also provided the most logical signs and interpretable classes.

5.2 Estimation results for the class-membership model

Table 3 provides the parameter estimates of the class-membership models that help us to identify the predictors of the latent SN usage styles. The upper part of Table 3 presents the estimation results of the model that was estimated for girls, while the lower part of the table presents the model of the boys. Class membership model is a multinomial logit model (MNL) of the probability with which each individual belongs to one and only one of the three latent classes. In Table 3 are also given the Wald statistic results. For each set of parameter estimates, the Wald statistic considers the subset associated with each class and tests the restriction that each parameter in that subset equals the corresponding parameter in the subsets associated with each of the other classes. That is, the Wald statistic tests the equality of each set of regression effects across classes. Wald statistic results indicate that the parameters used for the class specific model vary significantly at 95% level of confidence indicating significant heterogeneity across the classes.

Table 3: Estimation Results of the class-membership model

	Class1		**Class2**		**Class3**		Wald statistic
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	
GIRLS							
α	2.11	5.60	-1.97	-4.61	-2.45	-2.57	34.18
Allocate no time on OSN daily	-1.34	-2.43	-6.03	-2.90	1.38	2.76	23.94
Allocate more than 4hours daily	-1.37	-4.45	0.78	7.17	3.67	4.30	27.46
Allocate 1 to 2 hours daily	4.73	7.42	-0.25	-4.62	-0.69	-2.15	5.62
Own 4/4 gadgets (mobile phone, tablet, game consoles, portable game device)	-1.57	-1.34	1.64	5.99	-2.56	-6.58	23.83
Own tablets, 3G phones (2-3/4)	2.18	5.55	-0.13	-1.32	-0.90	-2.53	24.02
Own 1/4 gadgets (conventional mobile phones)	-0.54	-4.45	-1.66	-8.77	0.57	3.84	48.74
Mobile contract (top up/ no contract)	1.53	3.43	-0.92	-2.43	2.12	4.21	11.45
Connect to internet via mobile	0.93	2.18	1.61	5.89	-0.76	-2.92	9.15
Have an account on more than 3 OSN	0.89	2.13	1.75	4.61	-2.39	-3.90	16.95
Have an account on 1 OSN	1.74	1.76	-1.51	-2.50	1.30	2.47	20.32
BOYS							
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	
α	3.09	3.99	-1.00	-2.15	-2.09	-3.72	16.70
Allocate no time on OSN daily	-0.98	-2.14	6.03	-2.90	1.38	2.76	28.71
Allocate more than 4hours daily	-0.79	-4.62	1.28	4.86	-0.48	-5.04	15.95
Allocate 1 to 2 hours daily	0.77	6.53	1.26	1.60	-0.49	-2.72	13.14
Own 4/4 gadgets (mobile phone, tablet, game consoles, portable game device)	-1.16	-1.80	1.89	3.99	-2.36	-7.58	43.51
Own tablets, 3G phones (2-3/4)	3.64	6.32	-1.70	-1.07	-1.94	-1.40	30.02
Own 1/4 gadgets (conventional mobile phones)	-1.85	-4.15	-1.96	-3.81	1.05	2.96	10.57
Mobile contract (v. top up/ no contract)	0.90	2.03	2.21	4.58	-3.12	-4.05	21.15
Connect to internet via mobile	0.24	2.75	1.34	4.32	-0.76	-2.92	9.32
Have an account on more than 3 OSN	0.44	3.09	0.96	4.79	-1.64	-4.27	21.90
Have an account on 1 OSN	1.78	4.29	1.51	1.97	0.30	1.47	23.50

In the model estimated for girls, Class 1 represents the 42% of the total sample, Class 2 the 39% of

the sample, and Class 3 the 19% of the sample. In the model for boys, Class 1 represents the 54% of the total sample, Class 2 the 30% of the sample, and Class 3 the 16% of the sample.

Generally the coefficients of the variables have the same signs in both models. Nevertheless the significance of them differs a lot. For readers' convenience, we are going to analyse the results and name the classes, instead of using the numbers.

Regarding the girls' model, the most statistically significant variables in Class 1 are "Spend 1 to 2 hours on a daily basis on OSN" and "Own 2 to 3 out of 4 gadgets". Connecting to the internet via mobile phone and having a mobile contract affect positively the probability of being in this class. Having an account on more than 3 SN affects the probability of belonging to this class as well. Based on the literature review of other social surveys on teenagers SN usage behavior, we conclude that this is a rational amount of time, since the average time that the majority of the current teenagers spend in a typical day on SN is 1.5 hours (Teen Facebook Statistics, 2012). In doing so, we name this class "Rational OSN users". As far as the estimation results of boys' model, the most statistically significant variables in Class 1 are "Spend 1 to 2 hours on a daily basis on OSN" and "Own 2 to 3 out of 4 gadgets". Having an account on one OSN affects positively the probability of boy to belong in this class. As the two most statistically significant variables are the same with the most statistically significant variable in girls, we also name the Class 1 of boys' model "Rational OSN users". Comparing the statistical significance of both models, it is noticed that these two variables are more significant for girls. More descriptive statistics for this class indicate that girls that belong in this class mainly use OSN in order to communicate with their friends, arrange their social activities and discuss the news, while their favorite OSN is Facebook. The descriptive statistics of boys that belong in this class show that these members usually use OSN in order to stay updated about their friends and in order to read the news.

Girls that belong in Class 2seem to spend a significant amount of their time budget on OSN. The most statistically significant variables are "Spend more than 4 hours on OSN daily" and "Owning 4 out 4 gadgets". Although we do not include psychological indicators in this paper to assess addiction, the results of this class indicate that girls who belong to this class spend more than 4 hours per day on SN (more than average), they have all the gadgets that we asked in our questionnaire (3G mobile phone or Smartphone, tablet, game console and portable game devices) and connect on the web via their mobile phones. Thus we name this class "OSN addicted". In boys' class-membership model the most statistically significant variables that positively affect the probability of belonging to this class are "Spending more than 4 hours on OSN daily" and having 3 or more accounts on OSN. These members seem also to be addicted to OSN usage and it is assumed that OSN is a part of their daily life. In doing so, boys that belong in Class 2 are also "OSN addicted". Furthermore, statistics for this class show that adolescent girls use OSN in order to communicate with their friends, to arrange their meetings with friends and to flirt.Boys that belong to this class usually use OSN to communicate with their friends, to make new friends and to flirt.

As far as the Class 3 of girls' model, it is noticed that these members use to not allocate considerable amount of time on OSN on a daily bases, while they gadget ownership is quite low (they own 1 out 4 gadgets). Also, these girls seem not to use their mobile phone in order to connect on the web. Their behavior indicates indifference to OSN, thus we name these members "Indifferent to OSN usage". In the same way, boys that belong in Class 3 are indifferent to OSN usage, as they do not spend time on OSN on a daily basis and have the lowest gadget ownership. Further statistical analysis of the girls that belong to this class show that these members believe that OSN is a source of gossip and waste of time. Boys that belong to this class seem to spend time on surfing the web generally and play on-line games, but they are not fun of OSN.

While no significant differences are noticed in the latent OSN usage styles between girls and boys regarding their time allocation and usage patterns, the further statistical analysis of each class' members indicate that there are differences in the purposes of OSN usage.

5.3 Estimation results of the class specific model

Taking into account the segmentation of the OSN usage patterns, we now continue with the class specific model to check whether the OSN usage styles indicate different social-trip making behavior. The estimationresults for the class specific model are shown in Table 4. The explanatory variables include characteristics relatedto age, internet access at home, number of devices with internet access in household interacted with the number of household size, monthly family income and residential area characteristic. All of the variables used in the class specific model are statistically significant at the 95% and have significantly different effects acrossclasses at the 95% confidence level.

Table 4: Class-specific Model Estimation Results

	Class Independent		**Class1** *Rational SN usage*		**Class2** *SN addicted*		**Class3** *Indifferent to SN usage*		Wald statistic
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	
GIRLS									
Household monthly income (continuous)	0.81	1.86	--	--	--	--	--	--	--
Intercept			1.95	3.78	2.31	4.39	1.56	2.58	17.47
Household's monthly income			0.10	1.99	0.24	1.70	-1.30	-4.87	32.78
15 to 18 years old (vs. 12-14)			0.27	4.04	0.70	2.67	-0.13	-2.87	11.41
Available internet access at home			0.38	3.93	1.93	5.56	-0.68	-1.73	8.53
Number of available gadgets with internet access in household divided by the number of household members			0.26	2.87	0.56	3.61	0.18	1.98	12.47
Urban (vs. suburban)			0.19	3.53	0.36	2.83	-0.88	-2.97	14.09
BOYS									
Household monthly income (continuous)	0.81	2.24	--	--	--	--	--	--	--
Intercept			2.13	3.32	2.73	5.72	1.05	3.03	7.38
Household's monthly income			0.88	2.27	0.62	2.00	-1.12	-3.37	12.58
15 to 18 years old (vs. 12-14)			0.62	5.43	0.73	1.63	-1.36	-3.02	18.31
Available internet access at home			0.45	3.65	1.35	3.65	-0.14	-1.05	12.73
Number of available gadgets with internet access in household divided by the number of household members			0.72	2.92	0.62	4.23	0.92	2.64	10.82
Urban (vs. suburban)			0.94	2.85	0.25	3.24	-0.26	-2.46	14.89

The mean number of social trips conducted in a typical Saturday is 3.0 for the Class 1 for girls and 2.6 for the Class 1 of boys; 3.2 for Class 2 of girls and 2.8 for the Class 2 of boys; 2.1 for Class 3 of girls' model and 1.9 for the Class 3 of boys' model, while the mean number of trips of the total sample of girls is 2.9 and of boys 2.5. The results of the both class-specific modelsindicate that the rational OSN usage style (Class 1) conducts more trips for social purposes than the average.OSN addicted users(Class 2) also conduct more social trips than average in a Saturday, whilst the indifferent to OSN conduct less social trips.

Demographic dummy variables are also used in order to explain the dependent variable, while the

signs of the coefficients are the same between the two models indicating that there are no gender differences in social trip making behavior, rather than the number of trips that they conduct. Younger male and female teenagers aged between 12 to 13 years old are more possible to categorized as indifferent OSN users having a negative sign indicating that contact less social trips. Teenagers from 15 to 18 years old seem to belong in Class 1 and Class 2 and they tend to conduct more social trips. This reflecting the fact that as teenagers reach the age of 18 (adulthood), both females and males, are involved more in social networking activities and conduct more social trips. As the ratio of available gadgets with internet access in household divided by the number of household size increases, the probability of making social trips increases for all the classes for both genders. Access to gadgets with internet access could be used for searching various information about activities or chatting with friends, thus creating need for travel. Adolescent girls and boys who live in urban areas and belong to Class 1 and Class 2 tend to conduct more social trips, while adolescent girls and boys who live in rural areas seem to be indifferent to OSN and tend to conduct less trips for social purposes. Finally, as monthly family income increases, the number of social trips both for females and males is affected positively, while this variable is class independent.

6. Conclusions

Having in mind that current adolescents have grown up in a completely different environment regarding internet, social media and on-line social networking availability than in that the current middle-aged persons have grown up, we strongly believe that it is worthwhile to clarify for the adolescents' travel behavior as a generational gap is created. Moreover, we further explore adolescents' social-trip making behavior based on gender. Investigation of adolescents' behavior could provide significant insights about the trends of this generation to policy-makers and in doing so to develop the future transportation policies and even more to develop the policies based on genders' needs.

This paper has explored the influence of various OSN usage styles of adolescent males and females' travel behavior. The specific aim was to find out if OSN usage substitutes for or stimulates teenagers' trip making behavior and if differences exist between genders. At the same time, we postulated that OSN usage is not unique across the sample and that OSN usage styles exist and affect the trip making behavior in different ways. In doing so, we built a behavioral framework that captures the influence exerted by OSN usage styles on adolescent' social trips. Next, we develop a Latent Class Poisson Regression model for females and one for males consisting of two parts: 1. the class membership model, which links the latent OSN usage styles to socio-demographic variables; and 2. the class-specific choice model, which is a Poisson Regression and shows the influence of an OSN usage style and socio-economic variables on the number of trips made for social purposes. The methodology is tested with data from a large-scale transportation survey that we launched in Cyprus in co-operation with the MOEC in 2012. The sample consists of 5,586 female and 4,608 male high-school students (aged from 12 to 18 years old).

Both class membership models of the female and malemodels, suggest that adolescents cannot be treated as one uniform group regarding the OSN usage but instead shows considerable heterogeneity. After the estimation of models with various latent classes for both genders and the assessment of their goodness-of-fit, we concluded that three latent OSN usage styles/classes exist. Class 1 of both models includes those teenagers who use OSN in a rational way. The females and males that belong to Class 2 are highly OSN oriented or in simple words OSN addicted. The female and male members of Class 3 show indifference toOSN usage.

The results of the class specific model assist us to respond to our research question regarding the trip making behavior of each OSN usage style and if there are differences between genders. The answer

is that both females and males that use OSN rationally and those who are addicted to OSN are more possible to conduct more trips for social purposes, thus OSN usage stimulates the number of trips made for social purposes. On the other hand, OSN indifferent females and malesconduct less trips for social purposes than the other two classes. Moreover, our analyses show that social media and social networking is a part of both adolescent females and males' daily life. They log in to their OSN accounts from wherever they are using their mobile phones. The differences that are noticed between females and males refer to the purposes of OSN usage. Girls use most OSN in order to communicate with their friends and to arrange their social meetings, while boys use OSN for other purposes as well, such as playing games, flirting and reading the news.Also, differences are noticed in the number of social trips that each gender conduct, with female girls to conduct more social trips in a Saturday.

Our findings are similar to those of the latest surveys in social sciences regarding the OSN and face-to-face communication (Barak-Brandes and Levin, 2013; O'Keefe et al., 2012; Craig Watkins, 2009; Greenfield and Subrahmanyam, 2008). Teenagers, both females and males, who spend significant amount of time on social networking are more social and conduct more trips than the average teenagers. Social networking does not substitute face-to-face communication. Thus, the "rich get richer" theory is verified.

The results make clear that in order to understand the impact of OSN usage on trip making behavior, it is important to distinguish different types of OSN users, while no significant differences exist between OSN usage styles of adolescent females and males. The approach taken here, by requiring less complicated econometrics, should remain within reach of many more practitioners with standard training in maximum likelihood estimation, and still deliver more plausible and substantively different estimates than when segmentation is ignored.

Regarding transport planners and policy makers, they should strongly take into account that the expansion of OSN sites generally boosts the number of social trips that both female and male teenagers conduct. These trends could shake some transportation policies created under the assumption that generally ICT usage substitutes for trip making. Moreover, the results of our survey verify that both female and male teenagers allocate a significant amount of their daily time budget on OSN, a fact that policy makers could benefit from. Policy makers could use OSN sites to promote their green transport policies andcampaigns as Net Generation stays updated via OSN and mobile applications, not brochures and newspapers. By using OSN sites, policy makers could shape the desired behaviors regarding green transport alternatives among teenagers, a behavior that could be maintained in their adulthood as well. Teenagers are the next generation, the agents of change.

In addition, this research provides insights into the rapidly growing literature investigating the relationship between ICT and more specific OSN and travel behavior. The innovative data collection used here and the variables that were tested could be of high importance to researchers dealing with social networking and travel behavior issues. A limitation of the estimated models is the fact that we did not use longitudinal data, thus we cannot capture potential changes in trip making behavior due to OSN usage. It would be desirable the usage of longitudinal data for the model estimation, as they capture individuals' social networking behavior over time providing better insights.

Concluding, this paper is a first attempt to investigate OSN usage styles and travel behavior and it will be extended in several directions in the future. Further work includes the incorporation of psychometric (attitudinal and perceptional) indicators regarding the OSN usage and variables that give more information regarding the type of activities that adolescents conduct on OSN sites. This will lead to the estimation of more advanced LCM providing a richer and more powerful explanatory ability.

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ABSTRACT
This research examines early drivers of plug-in electric vehicles (PEVs) from a gendered perspective. Women and men may have differing responses to the new performance attributes of PEVs, for example, the relationship between driving range per battery charge and charging locations. Without knowledge of such potential differences, PEV sales and charging infrastructure deployment may create differential barriers and opportunities for women and men. Thus, understanding any gender differences is vital to policy, marketing, and infrastructure development for electric-mobility to ensure that sustainable mobility is appealing and accessible to all people. Clarifying gender differences in the experience of PEV drivers would also broaden the understanding of the persistence of gender roles in travel behavior. We pose two primary questions. (*1*) How does the speech of women and men PEV drivers compare? (*2*) What factors contribute to observed differences and similarities? Data are from two sets of focus groups conducted in 2011 to 2012 as PEVs entered the market in California. A content analysis of the themes in these group conversations reveals that while women and men talk about their experience in many ways that are similar, there are important differences. Women talk about more themes in terms of their PEV as a practical travel tool and adapting to the existing system. Conversely, men are more likely to address these same themes in terms of research and development and how the system should change. Without attributing this distinction to either nature or nurture, the voices of women' PEV drivers are underrepresented in any conversation providing direction to future policy, marketing, and technology development both because there are so many fewer women PEV drivers and because the content of women and men's speech differ.

INTRODUCTION

This research seeks to understand whether differences in plug-in electric vehicle (PEV) purchase and use exist between men and women within gendered definitions of mobility. Before posing our research questions, we first review gender in mobility studies and PEVsas motivation for exploring their possible nexus.

Plug-in Electric Vehicles

The category of PEVs contains both plug-in hybrid electric vehicles (PHEVs) and electric vehicles (EVs). PHEVs have both an electric motor and an internal combustion engine integrated such that it is fueled by either or both electricity from the grid or a liquid fuel such as gasoline or diesel. In contrast, an EV is powered solely by electricity from the grid.

Substituting electricity from the grid for liquid fuels has several goals including reduced emissions of pollutants and greenhouse gases (*1, 2*) while lowering cost, improving reliability, and enhancing the integration of renewable sources of electricity (*3, 4*). In response to policy, activist, and automobile manufacturer initiatives around the world, markets for PEVs have begun to reemerge. Of interest here, one vehicle manufacturer leased pre-production EVs to households in southern California in 2009-10 and a few started sales and leases of production PEVs in the US in 2011.

PEV Charging Infrastructure

PEVs are able to charge at multiple rates. The slowest rate Level 1 charging is 1.1kW from 120 V electrical outlets. Level 1 charging can restore about 3 to 5 miles driving range per hour of charging. Faster charging requires more specialized electric vehicle supply equipment (EVSE). Most, but far from all, home charging is at a faster Level 2 supplied through an EVSE atup to 6.6kW. Level 2 charging can restore 10 to 20 miles per hour of charging. Away-from-home PEV charging stations are either Level 2 chargers or high voltage, direct-current (DC) fast charging stations up to 50kW. A DC fast charger can add between 60 and 80 miles of range to a PEV in approximately 20 to 30 minutes. While the PEV drivers we discuss here leased or purchased their PEVs with an expectation of coming DC fast chargers, none were in service at the time of this research.

One peculiarity does shape the conversations about away-from-home charging by our samples of PEV drivers. In California, electricity can't be bought and resold. At present operators of public charging stations typically bill for connection time, regardless of how much electricity is transferred. These prices vary by the charging provider. Though no DC quick charging existed in the study regions at the time of this research,it was imagined by respondents to be more expensive than Level 2.

Conceptualizing Gender

We use two analytical conceptualizations of gender. First, gender represents the socially agreed upon biological criteria that allow for bodies to be placed into a sex category, male or female. This conceptualization enables us to identify and analyze values and norms associated with men and women. If such gendered ideals are distinguished they can be understood not as an inherent characteristic of biological sex but as a normative behavior that is socially identified with a particular sex category. This approach permits an analysis of gender and mobility as we identify where and how men and women adhere to or deviate from the hegemonic conceptions of what is appropriate conduct for each sex category. That is, gender represents the learned behaviors associated with masculinity and femininity. Second and consequently, we also understand gender as a messy, ever-changing social construct that does not map clearly onto a biologically defined sex-binary.

(*5*) identifies two distinctive strands of thinking about the question of gender and mobility. The first focuses on the ways in which mobility shapes gender ideologies, meanings, and practices. She explains that research in this strand sees mobility (and immobility) is deeply embedded in traditional gender ideologies, which on the

> "…one side equate women and femininity with the home, the private, with domestic spaces and restricted movement (which translates into interactions that are routine, quotidian, familiar), and on the other, equate men and masculinity with the not-home, the public, with urban spaces and expansive movement (which translates into interactions that bring excitement, challenges, new experiences, encounters with the unknown)." (*5*)

This research defines gender not as a static entity but as a process of behaving in ways that adhere to the hegemonic conceptions of what is appropriate conduct for each sex category. That is, gender represents the learned behaviors associated with masculinity and femininity. Increased mobility among women is construed as a challenge to these

traditional gender ideologies (*6*). Recent work examines how gender norms and roles impact gender equality in transport policy and public agencies (*7,8*) and participation in public forums (*9*).

The second strand (*5*) identifies asks how gender shapes mobility. Work in this strand provides a breadth of evidence for the differences between male and female drivers (*10,11*). Many studies describe gender differences in travel behaviors: commute choices and trip chaining (*12,13*); automobile choice (*14*); and safe driving practices (*15, 16, 17*). These studies show that women are more likely to work at home or close to home and consequently drive shorter distances to work when compared to men. Women report higher levels of non-work related travel than men; transporting passengers and running errands (*18*). Other evidence concludes women use the car less often, drive fewer miles, and engage in trip-chaining more frequently (*8, 18, 19*). It seems that despite changing socio-cultural factors in the home and the paid labor market, gendered differences in daily travel—and daily automobile travel—persist between men and women.

Gender and PEVs?

Pre-market experience and early PEV sales in the US suggest gender is playing a role. Of the people who leased a pre-production electric version of BMW's MINI in California, 14% were women. Descriptions of the early buyers (and lessees) of PEVs in California indicate that so far women have purchased or leased only 29% of Nissan Leafs, 24% of Chevrolet Volts, and 16% of Tesla's Model S. In contrast, women make or are involved in over half of all new and used vehicle purchase decisions in the US. Even if it turns out the relative paucity of women participating in the market for PEVs is short-lived, decisions are being made now about the design of future PEVs, PEV charging devices, and networks of such devices. Given the differences in daily automobile travel between women and men, and given that the vehicle and infrastructure designs are emerging from technical fields still dominated by men (*20*), the risk only increases that gendered differences will be "hard-wired" into PEVs and their supporting infrastructures if the initial feedback from users is also disproportionately male. Whether this is true depends not only on the proportion of women and men, but on whether the experiences of women and men with PEVs differ.The literature on gender and PEVs has used gender as a categoricalindependent variableto describe the research sample whenexplaining consumer choice, driving behaviors, and perceptions of electric vehicles. Though this research differentiates between male and female participants, gender differences are rarely discussed in detail. An exception is (*1*), who explores gender differences inconcerns about EVs, EV safety, and belief in the sustainability of EVs. Our research lays a foundation for moving beyond the use of gender as an explanatory variable by drawing on both strands of gender and mobility research described by (*1*) to examine PEV purchase and use as behavior that may be experienced, and thus talked about,similarly or differently by men and women. Listening to PEV drivers talk about their vehicles, we can hear about the contextual conditions and gendered norms shaping (and being shaped by) the PEV experience.This approach supplements broad empirical data on gender differences in PEV drivers with information rich, detailed data. The following research questions guide our discussion of the role todate of women and men in the nascent markets for plug-in electric vehicles (PEVs).

1. How are women's location in the PEV market and experience of PEVs, associated socio-technical systems different from men?

2. How do user practices associated with femininity get overlooked in this electric vehicle market – from vehicle design to purchase and use of vehicles?

3. What do these mean for consumption and mobility practices pertaining to PEVs, and thus the private and social goals behind PEVs?

METHODS

Sampling

Data from two studies of PEV drivers in California are analyzed here. In June 2011, two focus groups were conducted in Los Angeles (LA), California. The LA focus groups were convened in one of the regional markets in which a PEV underwent pre-market testing. LA Group 1 had eight participants; three women and five men. LA Group 2 had seven participants; one woman and six men. All these people leased for one year an electric-version of BMW's MINI. 180 of these "MINI Es" were leased to households in southern California. Because of the high monthly lease payment, the requirements by the vehicle manufacturer that the EV not be the only vehicle in the household and that there be a place at home where the EV could be regularly recharged, these EV drivers tended to be high-income homeowners.

In November 2012, four focus groups were conducted in San Diego (SD), California among buyers and lessees of commercially marketed PEVs. For the four SD focus groups researchers created differences between pairs of groups. SD Groups 1 and 2 were differentiated by gender. SD Group 1 consisted of eight women and SD Group 2, ten men. SD Group 3 and 4 were differentiated by technological interest and savvy: the less savvy SD Group 3 included two women and four men, while the more savvy SD Group 4 was comprised of two women and seven men.

Nearly all of the SD participants drove Nissan Leafs (an EV); one drove a Chevrolet Volt (a PHEV) but their results were omitted so that all participants were talking about the same type of car. As with the LA population, the population from which households were sampled resided in San Diego County had to own their home and have a suitable parking and charging location for their PEV on their premises. Thus, distributions of age, education levels, and income skewed upward compared to both the general populations and the populations of new car buyers.

MINI E drivers charged almost solely at home and rarely at dealerships or elsewhere. Since their experience was "pre-commercial," they were given no further expectation there would be an increasing number of charging locations during their lease. The PEV buyers and lessees in San Diego also charged their PEV mostly at home, and rarely at a dealership. However, early market PEV drivers in San Diego had both the actuality of a growing number of Level 2 charging locations, i.e., shopping centers, parks, museums, workplaces, etc., and expectations of a network of DC fast chargers.

All of these drivers ranged from 33-77 years old, were a mix of employed and retired, and had annual household incomes ranging from $80,000 to more than $150,000 per year. We did not collect occupational data.

Data Collection and Analysis

All focus groups were guided by an outline of topics with possible prompts and follow-up questions. However, given the exploratory approach of both the Los Angeles and San Diego research projects, the groups were moderated in a semi-structured manner. The Los Angeles protocol differed from the San Diego protocol, in that it included a discussion linking PEVs to renewable fuels for electricity. Otherwise, all groups tended to cover similar topics such as PEV charging, driving range, and batteries. The moderator for all LA and SD groups was the same man, the third author.

The discussions were recorded and transcribed. Transcriptions were read as statements that might be several sentences, a phrase within a longer sentence, or a single word of agreement or disagreement with a prior more extensive statement. A researcher identified themes in these statements in a comparative and cumulative reading of the transcripts. Recognizing that the discussion outline imposes some limits on content, themes include ideasthat garner assent or dissent from other participants and ideas that sound important to the group. To identify themes in the data, the researcher conducted a three-step coding process that included (a) open coding on the first reading to locate themes and assign initial codes, (b) axial coding to review and examine initial codes, and (c) selective coding to look for examples to illustrate themes (*21*). Theme creation and the selection of quotes to define and exemplify themeswere carried out beforebeing coded for the speakers' gender (the initial transcripts distinguish but do not identify individual speakers). Two researchers then reviewed the thematically organized quotes repeating the three-step coding process to identify sub-themes by gender. These reviews were then compared to identify differences and similarities between male and female participants within themes and across themes.

Similarities and differences between statements by women and men are assessed by their content, not their frequency. As with the populations from which they were drawn, there were more men than women summed across all the groups. Normalizing counts of statementsfor that imbalance would not account for possible differences in style,e.g., whether speakers of one gender are more likely to make longer statements (thus leaving less time for different statements). Thus as a first level of analysis we note whether women or men said anything about a particular theme. The content of those statements are then compared and contrasted. Content analysis allows the researcher to compare content across texts by systematic recording procedures (*21*). We do not apply statistical analysis to the textual coding, instead we analyzed if the content existed or not. Practical statements are comments that concern using the vehicle in its current form and tend to have a present time element; typically it is how a driver adapts to the PEV. R&D statements concern ways to improve the vehicle, how a driver hopes it will change over time, or methods to understand the technology better; these tend to have an orientation to the future and focus on innovation. Although practicality and R&D tend to have a time element, it is not mandatory for placement into either category.

RESULTS: HOWDO THEEXPERIENCES OFWOMEN AND MEN COMPARE?

To frame the rest of the discussion, we first state this result: while much of what women and men had to say is similar in content, women were more likely to frame their PEV and their use of it in present-oriented practical terms while men were more likely to frame their PEV and their use of it in terms of a research project, whether a present, personal one or with an eye to future research and development (R&D). Women spoke of their PEV as a tool to use in their normal, every day lives. Men elaborated on their explorations of what PEVs are, how they work, and how they would like PEVs to improve in range, decrease in price, and increase body style and size options in the future.

We start by reviewing the themes for which this generalization holds: charging the PEV, driving range, community, environment, and money. We then describe those themes for which the generalization appears not to hold in our data, that is, both women and men talk about these themes in terms of practicalityor R&D: family, batteries, electricity. Finally, for two themes neither women nor men spoke in terms of practicality or R&D: safety and politics. Following the order in Table 1,we will detail similarities and differences between women and men and review the evidence for whether women focused more on their PEV as a pragmatic tool and men on theirs as an object of R&D.Some material will be distinguished by whether the speaker was from the earlier, pre-market experience of MINI E drivers in Los Angeles or from the early market experience of PEV drivers in San Diego.

TABLE 1 Definitions of Themes

Theme	Definition
Stronger practical/R&D distinction between women and men	
Charging	The act of plugging a carinto a charger and the contexts in which that occurs, including all away-from-home charging and incipient DC fast chargers.
Driving range	How far a car can go on a charge, including desired range, taking a risk of running out of charge, planning, and remaining range instrumentation.
Community	Do PEV drivers form a community or not? Through what types of exchanges and media are those who see or want community attempting to construct it. This includes “outreach” to non-PEV drivers.
Environment	The physical environment and the effects people, their driving, and their PEV may have on it.
Money	The costs associated with a PEV: cost savings compared to gasoline, cost to charge at home or away-from-home, potential cost of DC fast

	charging, home charger as an investment, buying more range as a dealership option
Both women and men speak in terms of either or both practicality and R&D	
Family	How a family uses the PEV, running out of charge with children in the car, size of the PEV as it relates to the family
Batteries	The PEV battery itself (not the services, e.g., driving range, that it provides), loss of battery performance, cost to replace
Electricity	The sources of electricity to charge PEVs and the effects of PEVs on the grid Solar photovoltaics, utility companies, grid impacts
Neither women nor men speak in terms of practicality or R&D	
Safety	Personal safety a public charger, crash safety
Politics	Road taxes, Reducing dependence of foreign oil, subsidies, getting public chargers installed

Women and practicality: Men and R&D

Charging

Women and men shared many similarities in discussions of charging their PEV. Faced with the disappointing pace of the deployment of workplace, public and other away-from-home charging, PEV driversin San Diego relied mostly, if not solely, on home charging. Public charging was important for some;whether the respondent used the cost of gasoline or electricity for charging at home as the basis for assessing the cost of public charging influenced who would use public charging. Few had access to a workplace charger and some had negative experiences charging at work: confiscated cords and policies disallowing charging due to perceived safety hazards or not wanting to provide freebies to select employees. Etiquette to guide behavior at any away-from-home charger was something they wanted: “With the electric cars…nobody really knows yet, so anything you do, it sounds like you're being rude, if you unplug somebody because they're done charging…it'd be nice if a group of electric car owners got together and made up a code of ethics and published it somewhere just so you could refer to it” (*22*).

Respondents in Los Angeles and San Diego spoke of planning their PEV charging as a part of their daily routines. All were able to use their PEV for daily driving but were unable to go on long trips due to the unavailability of DC fast chargers. This caused frustration for many Leaf drivers because at the time they bought or leased their PEV they were told public charging would be increasingly available.

The distinction between the practical implications of charging a PEV and the R&D of charging between women and men arose in how they talked about trips too long to make on a single charge and public charging. Women who drove a Leaf discussed their

options within the present slow deployment of Level 2 charging. One woman Leaf driver said, “Stopping at a [a restaurant] for six hours to charge…you’d have to go eat for a long time or shop at a mall while your car charged.” Most women judged this to be impractical and said they would take a gasoline car on long distance trips. In contrast, men discussed long distance trips in their PEV in terms of using (imagined future) DC fast chargers. These men talked less aboutwhether DC fast chargers would extend their PEV driving, rather—almost as if their use of DC fast charging was assumed—focused on the potential price of the service, politics surrounding installation, and desirable locations. Women in the all-women group in San Diego did not mention DC fast chargers; in mixed gender groups women participated in conversations about DC fast chargers but did not initiate or add to the discussion.

Driving Range

Women and men, MINI E and Leaf drivers,discussed most of the same topics within the theme of driving range. They confirmed the real-world driving range of 70 to 90 miles of their PEV met most of their daily driving needs: “Really, 99% of my driving is within 20 or 30 miles so it’s perfect for me.” Others would like a slightly longer range so they could include more daily destinations, rather than charging less often. As with charging, a few participants explained that planning is an important aspect of driving a PEV: “If I’m going to make a trip…look it up on a map, find out how many miles it is, what’s the terrain, figure out if there are going to be any side trips besides where I’m going and include that into what I know my range is on the Leaf…Otherwise, I don’t make the trip.”

Concern about being running out of charge short of home or other charger was mentioned as a concern primarily when they first got their MINI E or Leafbut only occasionally once they became comfortable with the range. Rather than being anxious, some were excited to take risks testing the range: “I purposely did some test drives to see how far it could go to make sure I could get back to the house to figure out what my comfort level is.” Others, in anticipation of not being able to make an entire trip, have chosen to drive a gasoline car instead.

Differences between women and men centered around their response to the remaining range information provided by their car’s instrumentation. Almost all the Leaf drivers—women and men—believed the information was unreliable; the difference was in their response to this perceived unreliable information. Many women refused to drive the PEV before charging it again if it had less than a threshold amount of range left, generally double or triple the amount needed for a trip. They were frustrated with the rapid fluctuation of the indicator. Many women thought the Leaf to be impractical if they couldn’t travel the distance they desired¯which is assessed partly through range indicator. Men also distrusted the Leaf range indicator, however, they were more likely to continue to drive the PEV and were more comfortable taking trips without having double the range required. Rather, their lack of confidence in the remaining range information was less likely to deter men from driving and in some instances challenged them to push on. Many men decided to conduct their own research and devised a calculation to produce their own estimated remaining range.

Community

Both women and men discussed the idea of a community of PEV drivers. One Leaf driver shared an experience of charging at a popular charging station: “It just seemed like that was the convention hall. If you plug it in, the next thing you know two more would show up and we’re all sharing ideas.” Many had conversations with other PEV and non-PEV drivers about their vehicle.Some Leaf drivers turned to online forums, blogs, and crowd-sourced databasesto learn from other PEV drivers. For most, the amount of time they spent on these sites diminished the longer they had their Leaf: “I learned a lot initially before I got it and maybe the first few months [after I got the car] and I was on the Nissan [Leaf] blogs and all that. But since I found out everything I need to know, that was it.” In contrast some PEV drivers disdained the idea of a community: “I never felt like I was doing this to get into some sort of community.”

While women and men all talked about community, they differed in their eagerness to seek out or form such a community. Men were very excited about talking to people about their PEV.Men were eager to share their ideas and exchange information to build on their own R&D. Women were willing to answer questions in a chance, face-to-face conversation but were less likely to seek communication or information online. Most cited a lack of time as the cause; devoting time to these conversations, interactions, and information searches was impractical.

Environment

For many women and men, the environment was the primary reason for purchasing a PEV, i.e., buying and driving a PEV was putting their environmental beliefs into action: “We are environmentalists, so we always try to support things we believe in. So we thought an electric vehicle would be the logical choice.” These motivations could be about doing something to reduce their environmental impact and about reducing feelings of guilt: “I literally had a sense of guilt driving a gas car so that’s what brought me to buy a Leaf.”

Of those women and men who were motivated by environmental concerns, buying and driving a PEV put those concerns into action in the here and now. For women, this tended to be where the conversation stopped. Environmentally motivated men were more likely to continue on to discuss R&D. Their environmental assessments were reached after they researched environmental impacts of gasoline and developed ideas about how to make PEVs desirable to a broader base of people. Some of these men looked to other aspects PEV, e.g., acceleration and driving performance as being as important—both as additional motivators for themselves now and as the way to continue to bring other people to PEVs. This research expanded their ideas about how PEVs changed the sources of pollution: “Even if there’s pollution in manufacturing electricity, that can be redistributed someplace where it’s not got near the impact [in] this basin we’re in environmentally.”

Money

Women and men shared several ideas regarding money and PEVs. Primarily, they appreciated what they perceive to be cost savings because they paid less for electricity than they would have for gasoline: “I like telling people that I can run for 3 cents a mile and they’re running for 22 cents a mile. I just like the look on their face.” Other positive

important financial considerations included the Leaf purchase (or lease) incentives: a California state rebate of $2500 and a US federal tax incentive of $7500.

When public charging first rolled out in San Diego the electricity was free. Public charging was shifting toa paid service at the time of the San Diego focus groups in Fall 2012. Women and men spoke about this change: “A dollar an hour isn't that big of a deal, but there's a big gap between $1 an hour and free.” With the advent of pricing, some declined to use public charging unless they were going to run out of charge: “It’s become in the event of an emergency.” Some were no longer interested in charging in public because they could charge for less money at home and didn’t need to charge in public to get home.

For women and men who drove a Leaf, much of the conversation about money was devoted to fairness. Women and men prefer to be billed for the amount of electricity required to charge their car, not how long their car is connected to the EVSE. DC fast chargers were not available at the time of the San Diego focus groups but drivers had heard rumors of the pricing and were displeased. This driver compared the cost of one DC fast charge to a month of home Level 2 charging, “My whole [bill for charging my PEV at home] for the month will be maybe $30. So if you tell me it’s going to take me $15 to do one [DC fast] charge, that’s ridiculous.” All agreed that pricing for DC fast charging would be higher than they thought fair.

Differences between women and men appear in the additional topics men address. Women focused on monetary motivations for purchasing a PEV; they were tired of paying so much for gasoline and liked that electricity costs less. The perception that their PEV saved them money now won them over. Men were likely to also express concern about gasoline prices going up in the future; they were excited they didn’t need to worry about that. Men also discussed their home PEV charger as an investment: “This improves the value of my home because I’ve got a universal charger already built in.” Men also talked about whether to pay more for more driving range in a future PEV.

Practicality or R&D, But Not Both

Three themes did not fit into the construct of women’s interest in PEVs as a practical tool and men’s interest in R&D: family, batteries, and electricity. Family was discussed only in terms of practicality, whereas discussions about batteries and electricity focused only on R&D.

PEVs and Families

Women and men with young children spoke about parenting needs and how their PEV fulfilled themin terms of the practicality; there was no discussion of R&D. They used their PEV for daily needs and only occasionally did their PEV not meet their parenting needs, generally for a long trip. For these occasions, the drivers were amenable to using a gasoline car in the household or renting one for the trip.

The prospect of running out of charge with a child in the car produced two different responses to public charging. On one hand, public chargers could be used to ensure the PEV met their daily needs of errands and parenting needs: “I can charge up while I’m running errands, then I can pick up my kids, run my kids around and then get home.” Others avoided using public chargers with their children in the car because they didn’t want to entertain their children while waiting.

Women and men were distinguished in their discussions of the size of the PEV: the MINI-Es were two-seaters and the Leafs are small five-seat hatchbacks. Women did not make any mention of the size of the vehicles in the context of whether or not they were practical cars. Men split on this matter. Some men were pleased: "The Leaf it has everything – the range, the power, the space. The kids throw their baseball stuff in." Other men found the size impractical for their families: "I want to grow my family. So where is, for lack of a better term, the minivan version of [a PEV]? Where is the wagon version with seven passengers?" They wanted the car to work for their family and for many the size of their current PEV was impractical for the future of their families. Despite these men being concerned about the future, this does not fall into the R&D category; instead, it is commentary on future practicality, and so belongs in the practicality discussion.

Batteries

Here we distinguish the battery from the services it provides, e.g., driving range. Women and men spoke about R&D regarding the battery; no one discussed batteries in terms of practicality. Some were worried about a loss in battery performance over time. Some claim they are experiencing it now: "The battery capacity is going down. I've lost over 15% in my range in my car. So I'm needing to charge much more often." Many of the drivers charged their Leaf to 80% instead of 100% because they were told by the dealership and manufacturer this would forestall battery degradation; this was their attempt at conducting research on their own vehicle.The potential cost to replace the battery was an important issue to these drivers, Still, most remained confident—or maybe hopeful—that in the future battery prices will come and driving ranges will go up.Most of the discussions about batteries came from men as they did their own research on battery technology and development and were eager to share their ideas with others.

Electricity

Electricity was another theme that men and woman talked in terms of R&D but not practicality. Many drivers spoke about researching solar photovoltaic (PV) systems for their home and appreciated the connection of driving a PEV powered by solar electricity, although not all drivers had PV installed at their homes. Drivers had concerns about the electrical grid and the demand that PEVs place on it: "The public chargers are mostly daytime and that's why people have been working hard on software systems for dynamic balancing and public charger infrastructure and the grid itself…You have to have some dynamic way of telling those chargers on the fly, 'whoa, doggie,' because we're already overloading the grid." Some agreed that time of use electricity pricing might mediate this problem.

When Practicality and R&D Did Not Apply

For two themes the ideas of practicality and R&D did not arise at all, and therefore can't distinguish whether the content of women's and men's speech are the same or different: safety and politics. Women did not speak of safety in practical matters and they did not discuss politics at all. Men did not talk about R&Dregarding safety or politics, though they had a lot to say on both. Still, there are other similarities and differences in the statements of women and men on these topics.

Safety

Safety at public chargers was important to women and men, especially the safety of women at public chargers. Men also discussed safety of the vehicle itself. That a PEV was a good family car in part because of crash safety was explained by one man who was impressed by another focus group participant's experience: "You've got a woman with four children in four different schools doing all that you do and doing it in an electric car. Go back five years and she'd be in a Honda Odyssey. This is a true five-passenger car. You feel absolutely safe in it. It rides incredibly well…I can't think of a better ad."

Politics, From Personal to Global

The only incidence of a woman saying anything about politics, either in the all-women group or mixed groups, is when she agreed when a man said that PEV drivers should not be exempt from paying a tax to maintain roads. Men, on the other hand, had a lot to say about politics. For some it was their primary reason for purchasing a PEV,in part because ofreducing dependence on foreign oil. Many men were pleased with the support for PEVs from the government, especially the subsidies to consumers. In contrast, many men were frustrated by perceived political barriers to the deployment of charging infrastructure. Finally, some believed that they were paving the way for the rest of the world: "Africa and in China and India and the Middle East they're just dumping oil and everything else and nobody seems to care. But it's nice to try and lead the way and I like to be able to brag a little bit."

DISCUSSION: WHAT FACTORS CONTRIBUTE TO DIFFERENCES AND SIMILARITIES IN THE EXPERIENCES OF THESE WOMEN AND MEN?

In general, these women and men discussed much in common regarding life with their PEVs. There were far more similarities than differences in conversations, regardless of group composition: all female, all male, or mixed gender. They agree their PEV meets their daily driving needs. They want to see a public charging network in their area—if not for themselves then for others so as to increase the number of PEVs on the road. They want to pay for the amount of electricity they take from a public charger instead of paying for the amount of time their PEV is connected to that charger.

Where there were differences between women and men, women PEV drivers in these focus groups talked about managing existing conditions and accomplishing immediate travel needs. They talked far less about active research, information gathering, and speculation about future conditions. Women talked little aboutlonger driving range and public charging, but talked more about how they made the existing capabilities of their PEVs and extant charging opportunities work for them. It is not possible for us to conclude why women did not talk about certain things—no one says why they don't talk about something. We know they did not discuss DC fast chargers; not talking about something that isn't present in their day-to-day lives fits a pattern of focusing on what is present. Women found the rapidly fluctuating range indicator untrustworthy and impractical; they wanted an accurate tool so they could gauge their remaining travel before arriving home or at another charging location. They found charging their PEV at home provided a practical convenience compared to buying gasoline for their car. Some

remained open to using public charging as it shifted to a paid service because public charging filled a present need.

While women would participate in the live and virtual PEV communities if they needed information, the time required was seen as impractical and a deterrent for most. Women typically were not contributors to on-line media or participants in public outreach events and were more circumspect about casual questions from strangers. Paying less for electricity than gasoline—even when paying for public charging—as well as thevehicle purchase incentives were built into a case for the present cost savings of a PEV. Those with young children found the car to be a practical car.

Where there were differences, the men PEV drivers in these focus groups treated their PEV more as an R&D project. Whilethey talked about problem solving for their PEV, this often extended to passing on solutions to problems they experienced as well as keeping up with, or even producing, information on technological developments. They spoke more about what they want from a future PEV. They were likely to be knowledgeable about technological developments, research, infrastructure technology, deployment, and talked about time spent to do research or gather information. They often looked at away-from-home charging in terms of as yet non-existent DC fast charging: locations, prices, contexts in which they would use them, and potential harm to the battery. They were less interested in public charging once it wasn't free. Rather, they were willing to push past their old comfort levels for driving range. They viewed the fluctuating range indicator as a challenge to overcome; a few developed their own range calculators. They viewed aPEV community as a resource for research and a platform to share their own developments; many devoted a lot of time to speaking with people in person and online. These men did considerable research regarding their PEV and the environment, the political and environmental impacts of gasoline, how and where their electricity was produced, and developed ideas about how to conjoin the environmental benefits of driving a PEV to the larger population of vehicle drivers by promoting PEV driving performance.

Men spoke in detail about the theme of money, specifically about the potential future costs of DC fast charging andbattery replacement. Through their research they learned about how battery degradation may impact them, future uses of batteries, and future battery chemistries. They wanted driving range options for future PEVs so they could purchase as much as they wanted. They researched PV energy systems for their homes. Some who had a home PV system prior to purchasing their PEV had designed the PV system for both their existing household demand and their anticipated PEV charging.

CONCLUSION: ARE WE HARDWIRING GENDER DIFFERENCES IN PEVS?

For all their similarities, the differences between women and men illustrate how each engage PEVs and highlight how PEV manufacturers, charging infrastructure companies, and policy makers can support both genders in their use of a PEV. There are differences in how women and men experience the PEV; women as a practical tool and men as an R&D opportunity. A similar distinction has been made in other contexts. (*23*)found people attributed similar differences to men and women's management styles; men were thought more likely to create innovative solutions, i.e., to change the system. Women were thought more likely to create adaptive solutions, i.e., to create change within the system. (*24*) found that graduate students perceive "men choose more theoretical subjects

for their theses and women more practical ones." However, noting similarities in the content of the statements offered by women and men on a variety of themes from conversation about their PEVS, we do not draw the conclusion that the biological female or socially-defined woman is inherently more practical than the biological male or socially-defined man.

We do say that if the future course of PEV vehicle design, PEV charging infrastructure, and more generally the course of PEV market development is being determined by voices *such as* those we heard, at present the voices of women are more likely to be silent than the voices of men regarding these future developments. In the present PEV market, more than 70% of consumers are men and the women who are present are less likely to discuss future developments: the early consumer feedback is male dominated. Paired with male dominated technological production, researchers argue that even objects that are ostensibly designed for everybody are designed unconsciously based on the male users' images. When the user is assumed to be universal it is often a masculine universal and masculine ideals are prioritized when thinking about vehicles. For example, (*25*) demonstrates how car design and manufacturing have limited women's access to public space and independent activity.

Much of women and men's use and experience with the PEV sounds similar, but the differences indicate a gendered approach to PEVs. Women's location in the PEV market is secondary to men's: there are fewer women and those there are speak less to future developments than do the more numerous men. User norms associated with femininity, such as trip chaining or transporting family members, may be overlooked in the PEV market from vehicle design to use of the vehicles. This lack of voice to what women want and need from a PEV may slow the future adoption of PEVs by women and therefore the total number of PEVs sold and the attainment of the policy goals underlying government support. Women may be left to adapt to a system designed by men for men, or not participate at all. Women and men speak differently about their driving experiences; they conceptualize, think about, talk about, and experience the driving experience differently and both perspectives are fundamental to the success and growth of the PEV market.

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WOMEN'S ACCEPTANCE OF AND WILLINGNESS-TO-PAY FOR CONNECTED VEHICLES

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ABSTRACT

When deployed, connected vehicles (CV) will communicate with the roadway and each other. Among the benefits of CV, safety stands out. It has been estimated that a full deployment of CV would mitigate 81 percent of all vehicle crashes involving unimpaired drivers. Decrease in crashes and vehicle conflicts would also improve mobility.

Sources in the popular media estimate that women in the U.S. buy 52 to 65 percent of all new cars and influence 85 to 95 percent of all car buying decisions. Studies have indicated that women are more automobile safety and environment conscious, but more vehicle price sensitive than men. Thus, consumer acceptance of and willingness-to-pay (WTP) for vehicle technology may vary by gender. The purposes of this research are to discern women's WTP for CV, accounting for CV costs, socioeconomic characteristics, and perceived safety benefits and suggest policies for CV promotion and diffusion.

The methodology consists of an on-line survey of drivers and conjoint analysis. Adaptive Choice-Based Conjoint analysis uses stated preferences for CV product bundles and estimates WTP by gender, income, education and age. For both men and women, price is the most important factor for choosing various bundles of CV technologies. The analyses indicate with statistical significance that women are more conscious of safety, fuel consumption, and environmental impacts when buying vehicles, but women had less knowledge of CV than men. Women's budgets for vehicle purchases were lower than men's; yet, women are willing to pay as much as men at the individual technology level (e.g., safety) as well as at the aggregated level. Thus, women have higher WTP than men relative to their budgets and lesser knowledge. The associations of gender with income, education and age do not show statistically significant differences, but are suggestive. Women's WTP declines greatly with high income and at age 50 and over. These findings have policy implications for CV promotion to mature women.

INTRODUCTION

Motor vehicles are on the verge of communicating with the roadway and each other. One should note that while there are various sensor-based "smart car" technologies (SCT) on the market today, connected vehicles (CV), those that communicate vehicles' intentions in order to avoid collisions, have not yet been deployed. The primary benefit of SCT and that expected of CV is enhanced traffic safety. According to the National Highway Traffic Safety Administration, a form of SCT, electronic stability control (ESC), saved an estimated 1,045 vehicle occupants' lives in the U.S. in 2011 (1). This estimate represents a substantial increase since 2009. In recent years, the percentage of passenger vehicles equipped with ESC has increased dramatically, because Federal motor vehicle safety standards required ESC to be standard equipment for all new passenger vehicles by September 1, 2011 (1). As the overall passenger vehicle fleet is renewed with ESC equipped vehicles, the lives saved should continue to rise.

The safety benefits of CV may be even more profound than that of existing SCT technologies. Najm et al. estimate that a full deployment of CV would mitigate 81 percent of all vehicle crashes involving unimpaired drivers (2). Decrease in crashes and

vehicle conflicts would also improve mobility and reduce congestion and environmental impacts. The ITS Joint Program Office of the U.S. Department of Transportation is convinced of CV safety and environmental benefits and is particularly focused on the social and institutional frameworks that would support transition to deployment (3).

Sociocultural factors, particularly associated with gender, could indeed have deployment effects. It is well established in the research literature that women have different behaviors from men regarding trip purpose and trip-chaining associated with household and child care duties (4, 5). Studies have shown that women drivers in Europe have more positive attitudes towards traffic regulations and safety and die at much lower rates in traffic than men (6). As women have driven more over time, they have not adopted men's driving behaviors.

Sources in the popular media estimate that women in the U.S. buy 52 to 65 percent of all new cars and influence 85 to 95 percent of all car buying decisions (7, 8). Yet, women's acceptance of and willingness-to-pay (WTP) for vehicle technologies may differ from those of men. A survey of plug-in electric hybrid vehicle acceptance in the U.S. indicated that women had different vehicle preferences, but had similar WTP for these advanced vehicles (9). Among Japanese early adopters of electric vehicles, women were more excited about purchasing new technologies and more environmentally conscious than men, willing to sacrifice some comfort for the sake of the environment (10).

While women may be more environmentally conscious than men, Croson and Gneezy conclude that women are also more risk averse and have different social preferences when making economic decisions (11). From data derived from a Toronto area car ownership study, Mohammadian modeled gender differences in automobile ownership choices (12). He found that women preferred practicality, safety and roominess in vehicles, while men preferred power and performance. Women were also more sensitive to price of automobiles than men. Vrkljan and Anaby found that Canadian women rated safety significantly more important among all age groups than men did when buying a motor vehicle (13). Women tended to rate safety similarly across the lifespan, while the importance of safety for male drivers increased with age. In a survey of SCT acceptance, more male vehicle owners had such technologies than women, but the numbers varied by age group and type of technology (14). More females between ages 18 and 44 owned vehicles with reversing aids (backup warning and cameras) and adaptive cruise control than their male counterparts. Thus, women would likely accept CV as much or more than men, but their WTP for these kinds of technologies is unknown. It is the hypothesis of this research that women have higher WTP than men for CV technologies that advance safety, but WTP will vary by age, perception of safety benefit, financial constraints, and sociocultural factors.

PURPOSE

The purposes of this research are to discern women's and men's WTP for CV technologies, accounting for costs and budgets, perceived safety benefits, sociocultural factors and demographics and to suggest policies for CV promotion and diffusion. Specific objectives are:

- Understand drivers' preference structures based on an on-line survey.

- Determine WTP of various bundles of CV technologies related to safety by demographic characteristics and other factors;
- Provide recommendations to government and the automobile industry related to promotion of CV acceptance;

One could argue that consumer acceptance and WTP would not be an issue for market penetration, if government mandates CV deployment. However, studies show that mandates do not necessarily diffuse technology rapidly. Mandated airbags took 16 years to achieve 100 percent penetration (14). The variety of CV technologies, the undefined safety benefits, and the significant costs may result in no mandates for the foreseeable future. Within a heterogeneous vehicle/driver population some may not wish to purchase CV technology. Hill and Garrett estimate a transition period of about twenty years for CV to penetrate the entire vehicle fleet (15).

LITERATURE REVIEW

The diffusion of a new technology usually requires a lengthy time period. The length of diffusion time (or rates of adoption) will be dictated by many social, technical, and political factors. “Diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system” (16). There is general agreement that most innovations experience an S-shaped rate of diffusion (Figure 1). Depending on characteristics of technology, acceptance by users, and other factors, the slopes (diffusion rates) on the curve would vary.

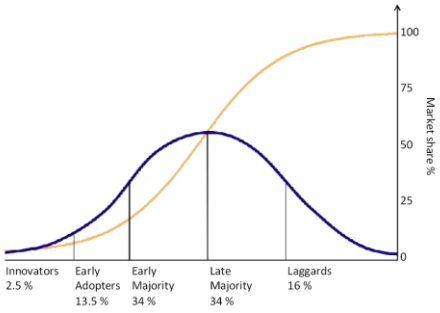


Figure 1. Diffusion of Innovation

Source: Rogers, E.M. *Diffusion of Innovations,* 5th ed. New York, NY: Free Press

An individual’s acceptance of a new product could be influenced by five characteristics of the innovation: relative advantage, compatibility, simplicity, trialability, and observability of the new product (17, 18). Relative advantage is the degree to which an innovation is perceived as being better (economically and socially) than previous products. Compatibility refers to the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters. Simplicity (as opposed to complexity) refers to the degree to which an innovation is perceived as being easy (as opposed to difficult) to use and requires little learning of new skills or information. Trialability deals with how easily a potential user can “test drive” the innovation. Observability focuses on the extent to which an innovation and its benefits are visible to others (is it private or public consumption?). Other factors have also been identified as being important to the diffusion process, including cost, profitability, and social approval (19). These innovation characteristics provide important insights in designing a stated preference survey.

Acceptance rates of a new technology are also influenced by the socio-economic characteristics of users. According to the Bass Diffusion Model, the adoption rate of a new product is shaped in part by the interaction between two types of adopters, namely

innovators and imitators (20). Innovators are those who decide to adopt an innovation independently of others. They are early adopters who are willing to take risks, are affluent, and base their decisions on external information (17). Imitators on the other hand are more likely to be influenced by the decisions of others. They are also called late adopters. The imitation effect eventually takes over, leading to rapid diffusion rates and has been described by a variety of terms, including “word of mouth,” contagion,” and “interpersonal communication” (21). The Bass Model has been successfully applied to forecast subscriber rates for DIRECTV and to plan the launch of 3G technology.

The diffusion theory discussed above was also employed in a 2011 USDOT study on the CV deployment plan (15). The study examines different CV deployment scenarios from the perspectives of the public sector interests and market and technology readiness. Depending on the scenarios, the study estimates that it would take 15 to 25 years to reach a deployment rate of over 80 percent (15). It may seem to be a reasonable estimate given evidence from the past. For example, anti-lock brake systems were first introduced in 1971 (on GM Cadillac and Chrysler Imperial models). It took about 19 years until the diffusion rate reached its peak (15). By 1994 it had reached a mature state where about 60 percent of vehicles employed the system. Since its first introduction, the airbag went from zero penetration in 1980 to 100 percent in 1996 (15). It should be noted that the airbag became mandatory for all new vehicles in 1991.

A long transition period similar to the aforementioned vehicle safety features is likely for CV technology. Acceptance of CV safety features could take longer because of the complicated nature of CV technologies. Unlike seat belts, for example, the benefit of which is independent of other drivers’ use, CV benefits can be fully realized only when interacting vehicles or infrastructure are equipped with CV technology. Hill and Garrett expect that the probability of obtaining benefits from a CV system is less than 50 percent over 17 years from the initial introduction (15). However, it is not clear from their report how this estimation was made.

CV technology is not as simple as retrofitting seatbelts in a car. CV systems may consist of numerous features that assist drivers. For example, six potential CV applications were tested during the USDOT sponsored driver clinic studies: Forward Collision Warning, Blind Spot Warning/Lane Change Warning, Left Turn Assist, Intersection Movement Assist, and Do Not Pass Warning (22). According to the team’s technology scan, there are at least 30 applications. Some of them may overlap, because some applications with similar functionalities may be named somewhat differently by manufacturers. The point is that unlike seatbelts, multiple combinations of CV applications are being considered, while there has been no clear idea about priority of applications and consumer acceptance. Given the complexity of CV technology features, a closer examination of technology diffusion should be made using user preference estimation.

Two methods are available for estimating consumer preference structures and WTP: revealed preference methods and stated preference (SP) methods. Revealed preference methods are based on the observation of market data or controlled laboratory experiments of consumer behavior, while stated preference methods infer information from interviews and/or surveys. A stated preference method has to be used when there is no market or controlled experiments are not possible. With that said a

preliminary review of literature, including a recent presentation on the preliminary findings for the USDOT driver clinic, found that no studies have utilized a sound methodology to estimate WTP for CV technology. A direct question is often employed, asking participants the maximum dollar amount that they are willing-to-pay. Such a question is not able to identify tradeoffs that consumers make when evaluating bundled equipment attributes and is therefore unable to establish associations between participants' valuation and real purchasing behavior (23).

SP methods can be further separated into two categories: direct SP surveys and indirect SP surveys. The former involves asking marketing experts and/or potential consumers to indicate acceptable maximum/minimum prices. This method has been employed by some WTP studies for new in-vehicle technologies in Europe (24, 25, and 26). However, this method focuses too much on prices and cannot relate stated WTP to real purchase behavior (23). The second category of indirect SP methods is conjoint analysis. Used in marketing research extensively, conjoint analysis is also known for its effectiveness in measuring preference structures of a new product that has no historical data (27, 28).

Conjoint analysis is "a technique for measuring individuals' preference structures via systematical variations of product attributes in an experimental design" (23). Since its introduction in 1971, conjoint analysis has been the most frequently used market research technique for measuring consumer preferences among alternative goods and services (29). It is a more realistic method to estimate the psychological tradeoffs that consumers make when evaluating bundled products. It identifies not only the relative importance of product attributes, but also the most preferred bundles of attributes. There are various types of conjoint analysis, including traditional conjoint analysis, choice-based conjoint analysis (i.e., discrete choice model) and a hybrid model. In particular a discrete choice model (also called choice-based conjoint analysis) can provide aggregate choice behavior of different product bundles, which can be used to estimate WTP.

In the field of transportation, conjoint analysis was successfully used by Green et al. in designing the launch of an integrated electronic toll system in the New York-New Jersey area (E-ZPass) (27). The study predicted a 38-50 percent adoption rate, which would vary among seven participating agencies. Four years after the study and with two E-ZPass agencies, the adoption rate reached 40 percent, implying that carefully designed conjoint analysis could reasonably predict future market penetration. This result provides important implications for policy formulation by the public sector and for private CV providers' marketing plans.

METHODOLOGY

Conjoint analysis was chosen for this research effort, because it is an appropriate method to identify preference structures and WTP for new products or products not yet on the market (27). For this study an Adaptive Choice-Based Conjoint (ACBC) survey was used to determine stated preferences (30). ACBC is a new conjoint analysis technique that mimics real purchasing behaviors better than previous conjoint analysis techniques.

An online survey was developed to measure drivers' acceptance of and willingness to pay for CV technology relating to safety and mobility. The survey was developed using Sawtooth Software's SSI Web software and was divided into three sections. The first section consisted of questions on key socio-economic characteristics (e.g., gender, age, and the number of adults and children under 18 in the household), last vehicle purchase/lease experience and research on safety features, current driving habits and the level of technology in the driver's current vehicle. Drivers were also asked the extent to which various attributes, including safety, mobility, vehicle performance, and environmental concerns, would be important to them when purchasing a new vehicle. Drivers were then asked the degree to which they were familiar with the concept of CV technology.

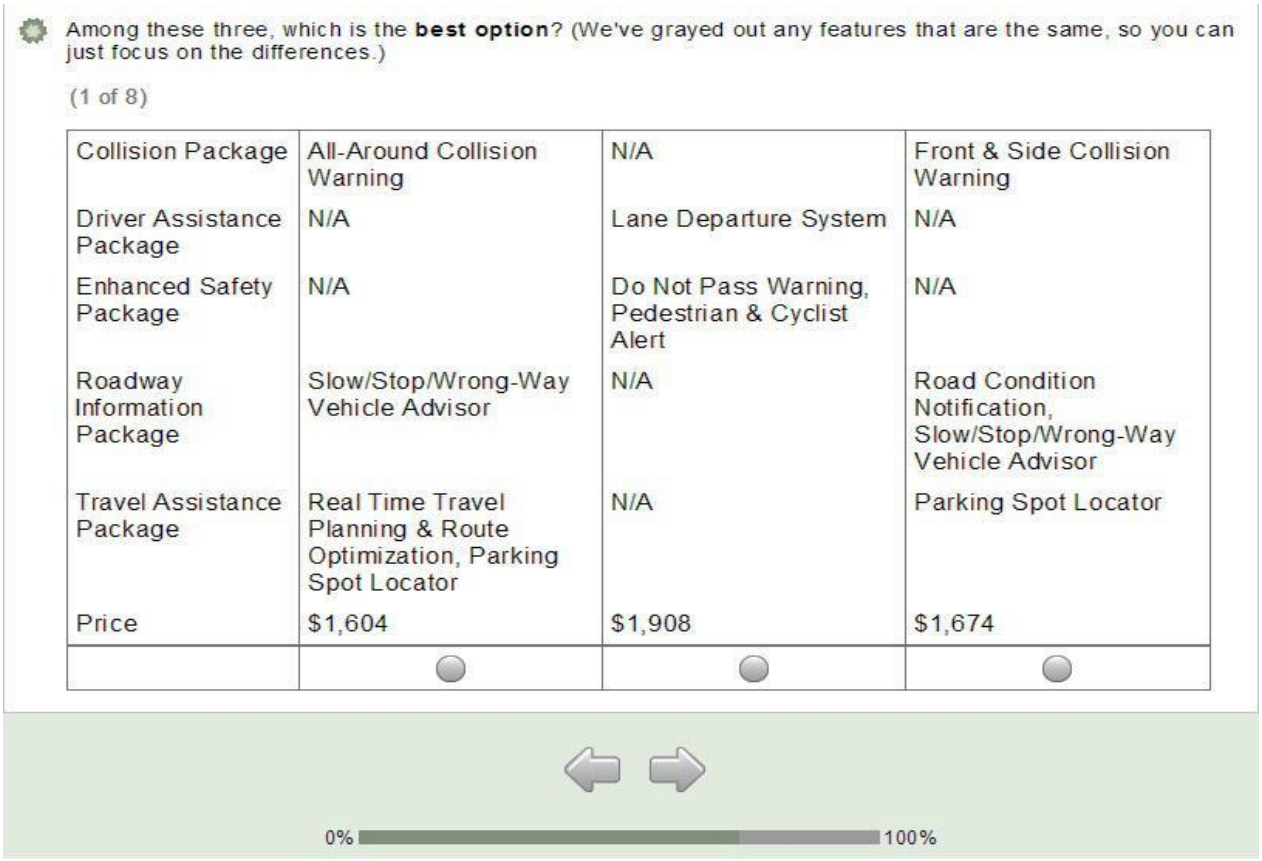
The second section focused on drivers' stated preferences for CV technology relating to safety and mobility. Drivers were first provided with a description of the different technology features. There were five attributes (collision package, driver assistance package, enhanced safety package, roadway information package, and travel assistance package) that included nine safety features and two mobility features (Table 1). Drivers were first asked to configure their own preferred bundle of attributes at the "build your own" (BYO) section. They were then given screening questions to answer; respondents were shown four products at a time and were asked to consider whether each one was "a possibility" or not "a possibility."

Table 1. Connected Vehicle Technology Choice Attributes

Attributes	Levels	CV Technologies
Collision Package	1	None
	2	Front Collision Warning
	3	Side Collision Warning
	4	Front & Side Collision Warning
	5	All-Around Collision Warning
Driver Assistance Package	1	None
	2	Lane Departure System
	3	Intersection & Left Turn Assist
	4	Lane Departure System, Intersection & Left Turn Assist
Enhanced Safety Package	1	None
	2	Do Not Pass Warning
	3	Pedestrian & Cyclist Alert
	4	Do Not Pass Warning, Pedestrian & Cyclist Alert
Roadway Information Package	1	None
	2	Road Condition Notification
	3	Slow/Stop/Wrong-way Vehicle Advisor
	4	Road Condition Notification, Slow/Stop/Wrong-way Vehicle Advisor
Travel Assistance Package	1	None
	2	Real Time Travel Planning & Route Optimization
	3	Parking Spot Locator
	4	Real Time Travel Planning & Route Optimization, Parking Spot Locator

During different stages of the screening rounds, based on non-compensatory screening rules, drivers were asked to identify levels that were “totally unacceptable." In addition, drivers were asked whether there was a particular level of one attribute that would be a “must have.” There were seven screening tasks, four “unacceptable” questions, and three “must have” questions. This information was then used to develop potentially desirable products for each respondent. These product bundles were shown three at a time, and respondents were asked to identify the most appealing product bundle in each instance (Figure 2). The winning concept from each round moved on to subsequent rounds, until a preferred concept was identified. The third section asked additional demographic questions, including income and education.

Figure 2. Example of a Choice Set



DATA COLLECTION

The authors' survey questionnaire was reviewed by a technical advisory committee, then revised and administered to a small group for testing. The test showed that respondents focused on CV's safety benefits, costs and convenience. There was concern by some respondents over the questionnaire's length; women were more inclined to complete the questionnaire. After further revision, the survey was applied on-line and promoted to various groups, including personal contacts, mailing lists, and social media, such as Facebook, Craigslist, and Backpage. Recruiting through social media attracted the majority of participants. Even though the participants would not make up a random sample, the authors expected that the intense focus of the survey, as with a focus group, would yield meaningful results.

ANALYSES AND FINDINGS

Participant characteristics

In total, 865 people participated in the survey. Roughly 52 percent (450 participants) completed all three sections (socio-economic, CV choice, and additional socio-

economic questions) of the survey. After the data quality assessment, 65 completed surveys were removed from the data set, leaving 385 surveys in the analysis data set.

Men made up a larger proportion of the total number of participants than women, 54 percent and 46 percent, respectively. The largest grouping of both men and women was between 30 and 59 (Figure 3). In general the female sample was relatively younger than the male sample. About 65 percent of both men and women participants had bachelors' or higher degrees, which is much higher than the national average of 29% in 2013 (31). Such a skewed population distribution is probably due to the nature of the sample method – online based survey and use of personal contacts and organization email lists. Also, the large draw from social media could be a contributing factor, because there is a positive association between educational attainment and internet use (32). Women were generally over-represented in the lower income cohorts but well represented in the higher income groupings (Figure 4). About 37 percent of men and 29 percent of women said their annual household income is $100,000 or higher, which is also higher than the national average of 22 percent in 2012 (33). A higher proportion of participants with post-secondary education seems to be a contributing factor. While survey participants were better educated and higher income than the population as a whole that should not be an issue, because early adopters of technology tend to have higher incomes and education than imitators.

Figure 3. Participants Age by Gender (n=385)

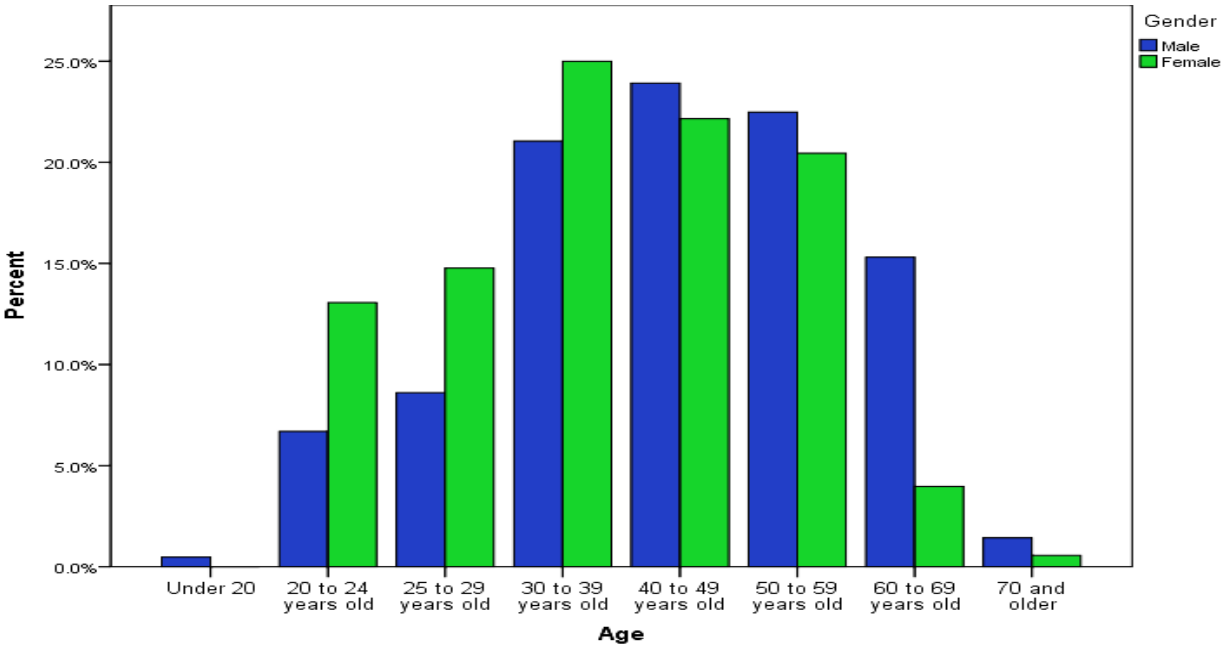
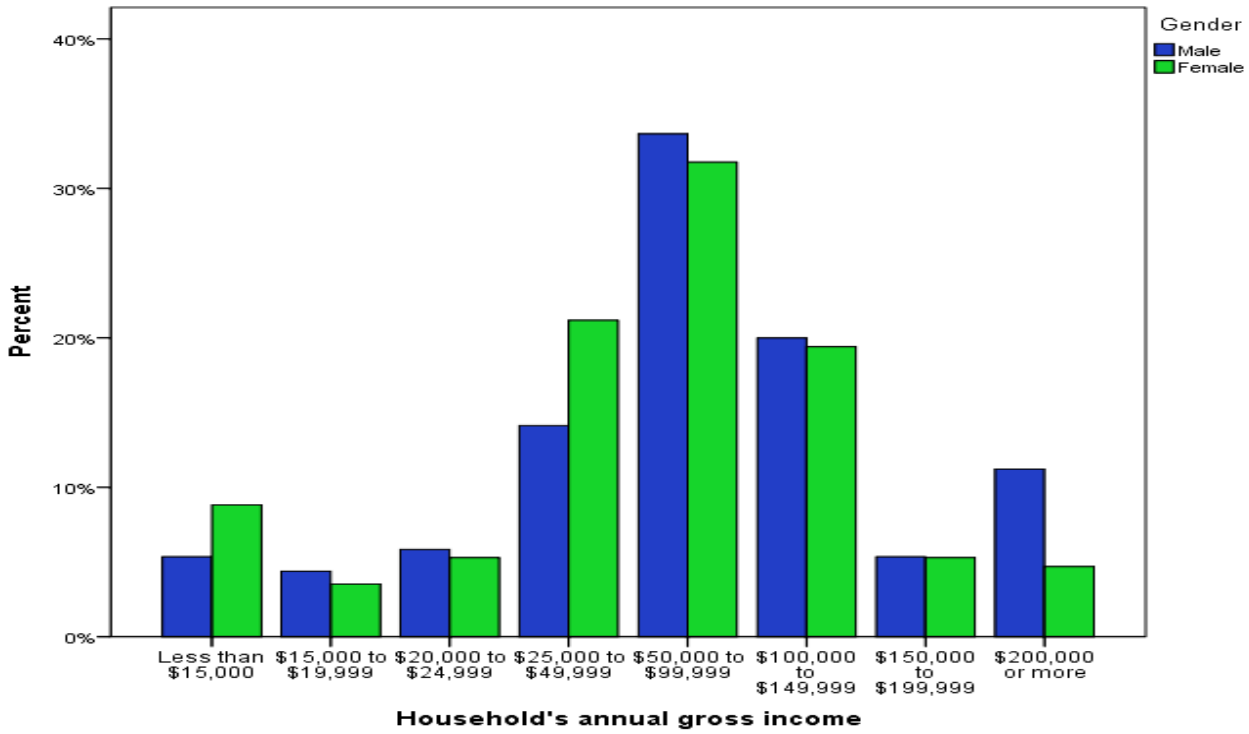


Figure 4. Household Annual Income by Gender (n=375)



To identify participants purchase/lease experience (especially differences between genders), questions regarding the level of involvement and level of confidence in purchasing vehicles were asked. Men were more involved ($t(372) = 3.03$, $p=0.003$) and confident ($t(372) = 7.24$, $p<0.01$) than women. In other words men acted more independently in making purchases, while women acted more collaboratively and sought the input of others.

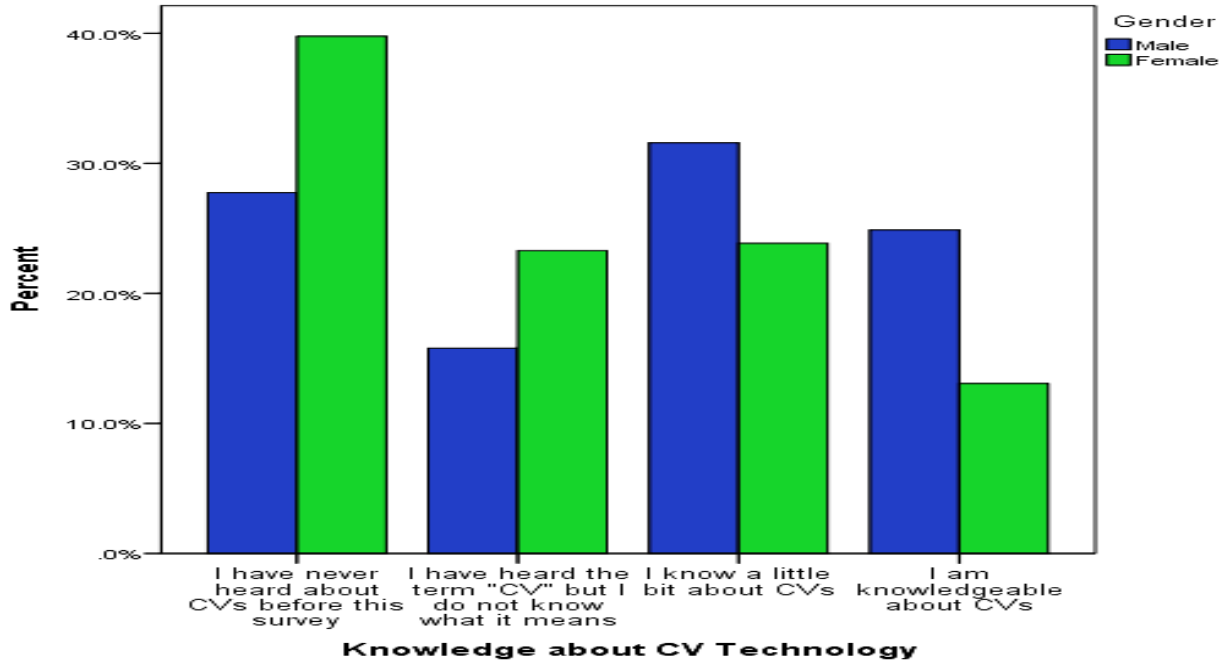
Potential differences in car purchasing budget levels and preferred vehicle features were evaluated. First, women set aside smaller budgets for purchasing a vehicle than men. Roughly 53 percent of women answered that their minimum budget for vehicle purchase is $10,000, while 32 percent of men said so. When it comes to a maximum budget level, women again want to spend less than men. Approximately 40 percent of women may spend $20,000 to $25,000 as a maximum, whereas a similar proportion of men want to spend $30,000 to $35,000. For both minimum and maximum budgets, the gender difference was statistically significant at the 95% confidence level (minimum budget: $t(368.9) = 4.76$, $p<0.01$; maximum budget: $t(365.5) = 3.58$, $p<0.01$). In other words, men want and can afford more expensive cars. This result conforms to past studies (11, 13); that is, women are more price sensitive in economic decision making.

Second, participants were asked to rate (on a 4 point scale) the importance of nine vehicle features when they purchase a vehicle. The features were safety, exterior design, engine power, status, driving comfort, interior space, fuel consumption, reliability, and environmental impacts. As expected, women were more interested in safety, fuel consumption, and environmental impacts than men. T-test indicates women's preferences are significantly different from men: safety ($t(313.6) = 5.28$, $p<0.01$), fuel

consumption (t (370.8) = 3.54, p<0.01), and environmental impact (t (372) = 3.73, p<0.01). However, gender differences for the other features were statistically insignificant, which differs from Mohammadian's findings (12).

In general men claimed to be more knowledgeable about CV technologies. Approximately 63 percent of men said that they were knowledgeable or knew something about CV (Figure 5). On the other hand, less than half (44%) of women said they were knowledgeable about CV. This difference was statistically significant (t (383) = 3.81, p<0.01).

Figure 5. Connected Vehicle Knowledge by Gender (n=385)



Driver's Preferences for CV Technologies

After participants completed the BYO question, a series of screening choice questions were provided to determine the participants' preferences. Using the built-in ACBC analysis tool of the survey software, individual and aggregated preferences (utilities) for CV technology packages were computed. Regardless of gender, participants seemed to prefer to have some amount of CV technology; i.e., for all attributes the response "None" shows negative utility values (Table 2).

Comparing utilities by attributes reveals that the most important factor for technology adoption is price (Table 2). For both men and women, as prices[1] increased,

[1] Price-estimates were made based on modifying the existing technology prices of leader auto manufacturers such as Audi, BMW, Cadillac, Chevrolet, Lexus, Mercedes-Benz, Porsche, Toyota, and Volvo with V2V (Vehicle-to-Vehicle) and V2I (Vehicle-to-Infrastructure) features, requirements and enhancements with sensors. At BYO section, prices varied depending on the choice level of the participants ($0 to $1,100 for Collision package, $0 to $1,200 for Driver Assistance package, $0 to $1,000 for Enhanced Safety package, $0 to $500 for Roadway Information package, $0 to $700 for Travel Assistance package, and finally $0 to $4,500 for total price). However, ±30% change in BYO prices applied during the ACBC screening choice questions to represent the actual willingness to pay of participants. Due to

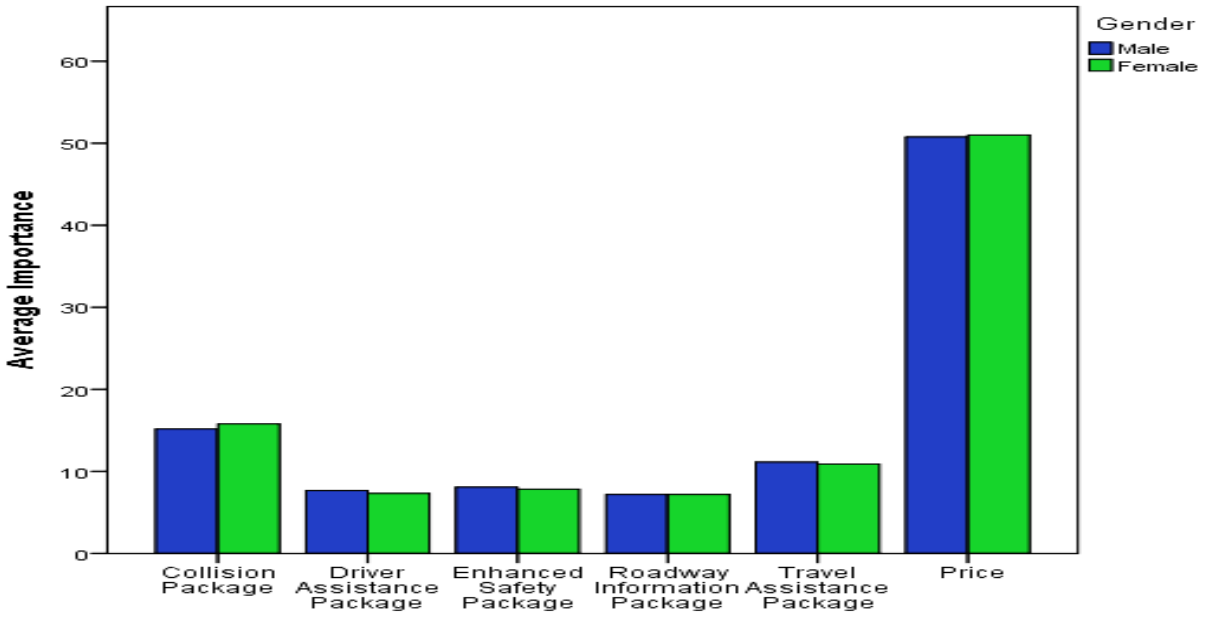
utilities decreased significantly. Overall, regardless of gender, participants favored the most comprehensive bundles of technologies for each attribute, but that decision is largely constrained by price. The relative differences between men and women for different levels of CV technologies were tested using ANOVA. Except for the "Slow/stop/wrong-way vehicle advisor" ($F(1,383) = 5.04$, $p = 0.025$)), there were no gender differences in choosing CV technology. Since there was no gender difference in preferences at the levels of technology, the comparison was made at the attribute level by computing the average importance (Figure 6). Of all the CV technology attributes, participants considered the collision package the most important. T-test shows no difference between men and women.

Table 2. Mean Utility Values by Gender

Attributes	Levels	CV Technologies	Male	Female	Total
Collision Package	1	None	-44.07	-46.01	-44.96
	2	Front collision warning	-2.19	-0.65	-1.48
	3	Side collision warning	-8.28	-8.89	-8.56
	4	Front & side collision warning	13.68	13.09	13.41
	5	All collision package	40.86	42.46	41.59
Driver Assistance Package	1	None	-17.27	-16.17	-16.77
	2	Lane departure system	8.26	8.55	8.39
	3	Intersection & left turn assist]	-4.09	-3.82	-3.97
	4	All driver assistance package	13.11	11.44	12.35
Enhanced Safety Package	1	None	-17.08	-16.61	-16.87
	2	Do not pass warning	-1.58	-1.68	-1.63
	3	Pedestrian & cyclist alert	3.68	3.25	3.49
	4	All enhanced safety package	14.98	15.04	15.01
Roadway Information Package	1	None	-11.70	-9.68	-10.78
	2	Road condition notification	2.92	4.01	3.42
	3	Slow/stop/wrong-way vehicle advisor	-4.97	-7.80	-6.26
	4	All roadway information package	13.75	13.47	13.62
Travel Assistance Package	1	None	-9.28	-7.80	-8.60
	2	Real time travel planning & route optimization	9.22	6.51	7.98
	3	Parking spot locator	-10.43	-9.71	-10.10
	4	All travel assistance package	10.49	11.00	10.72
Summed Price	Price: $ 0		129.46	132.17	130.70
	Price: $ 1,572		34.64	37.44	35.92
	Price: $ 2,433		3.14	7.62	5.19
	Price: $ 3,381		-38.76	-40.28	-39.45
	Price: $ 5,850		-128.47	-136.95	-132.35
Mean Utility			82.55	91.72	86.74

the +30% increment, the possible maximum total price could be $5,850 which was considered as the highest price for calculating utilities (see Table 2).

Figure 6. Average Importance of Attributes by Gender (n=385)



Willingness to Pay by Gender

Mean WTP was then estimated and compared by gender. Figure 7 shows comparison of the average amount that men and women were willing-to-pay at the BYO selection question and the winning price (actual WTP) at the end of the choice tournament. Both genders had slightly lower WTP in comparison with the BYO selection. Average price level of men for the BYO question was $2,298. After comparing different bundles, men's average WTP was decreased by 5 percent (to $2,185). Similarly, the decrease in WTP for women was 5 percent (from $2,257 to $2,143). The same figure also shows that men's BYO and WTP is about 2 percent higher than women's. Although women had lower absolute BYO and WTP values than men, no statistical difference between the genders was found.

The following figures show WTP by gender compared with various factors. Figure 8 compares WTP by gender and household's annual income. Interestingly, middle-income women have the highest WTP for all women participants and the same is true for men. While this seems counterintuitive, higher WTP among middle income households may be associated with education and exposure to technology. As observed, WTP of women is lower than that of men for lower- and higher-income brackets, but WTP of middle-income women is the highest of all ($2,383). From the perspective of gender and education, men and women with bachelor's degrees had the highest WTP, followed by associate's degree and lower, master's, and doctoral or higher (Figure 9). Because one expects that income and education would be highly correlated, this trend confirms the findings in Figure 8, an association among high education attainment, high income, and low WTP. The answer to this conundrum may be the survey participants' ages.

Figure 7. Mean Build Your Own (BYO) and Willingness-To-Pay (WTP) by Gender (n=385)

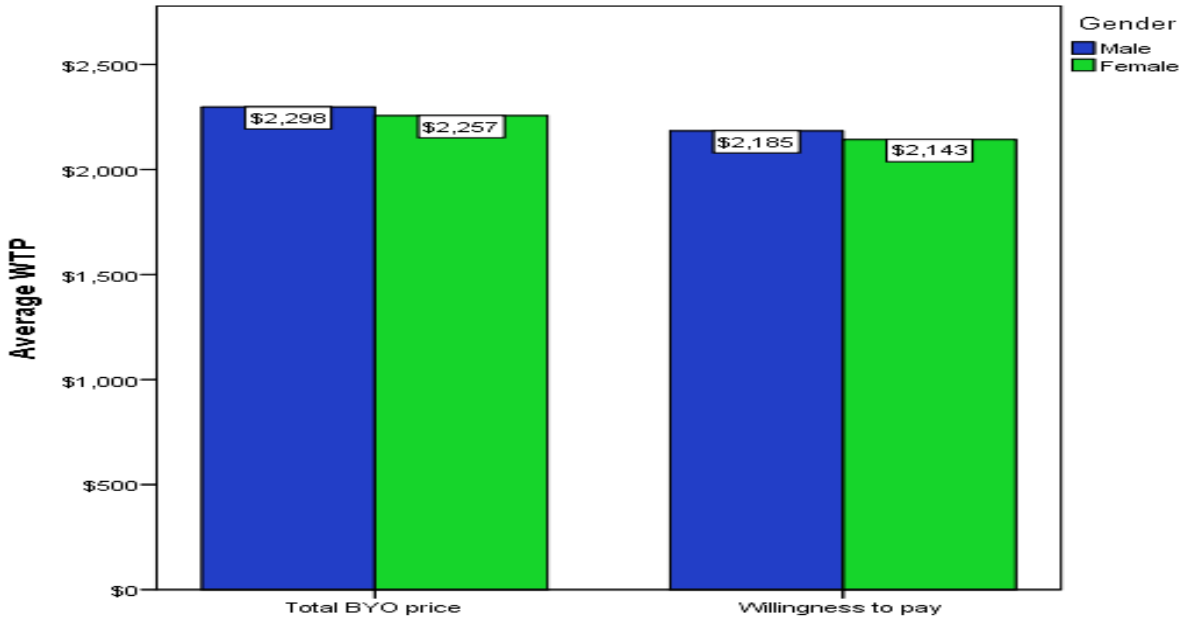


Figure 8. Mean WTP by Household's Annual Income and Gender (n=375)

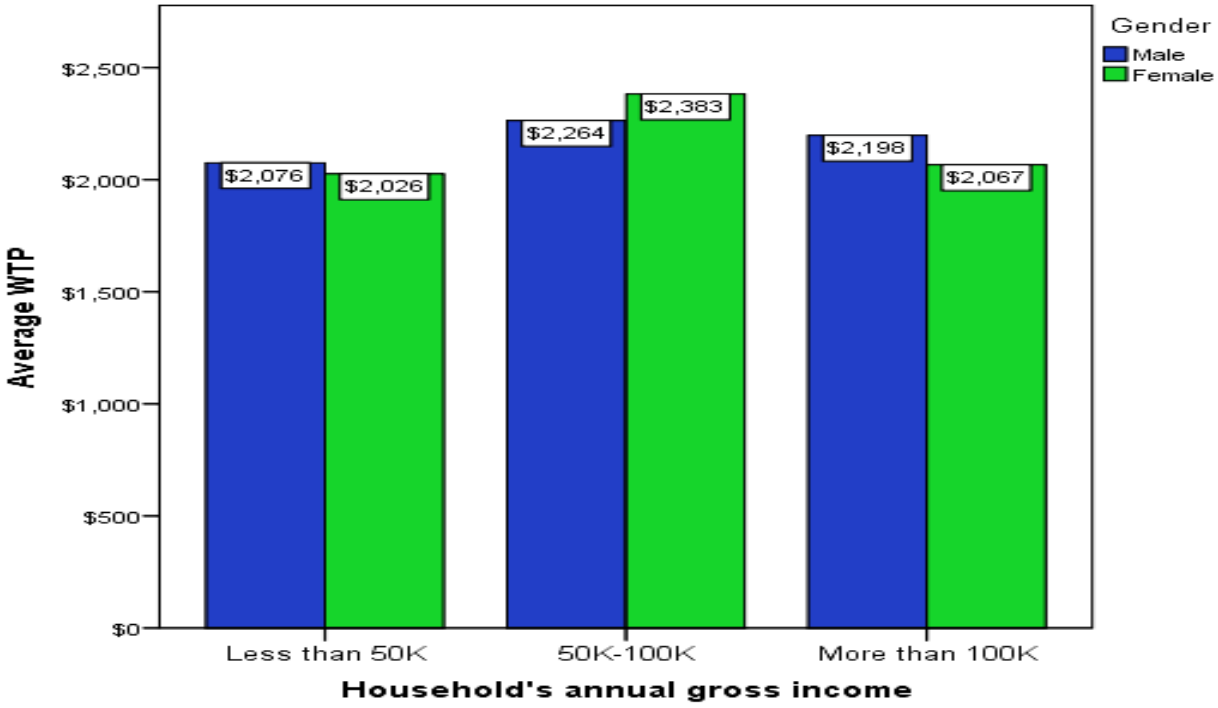
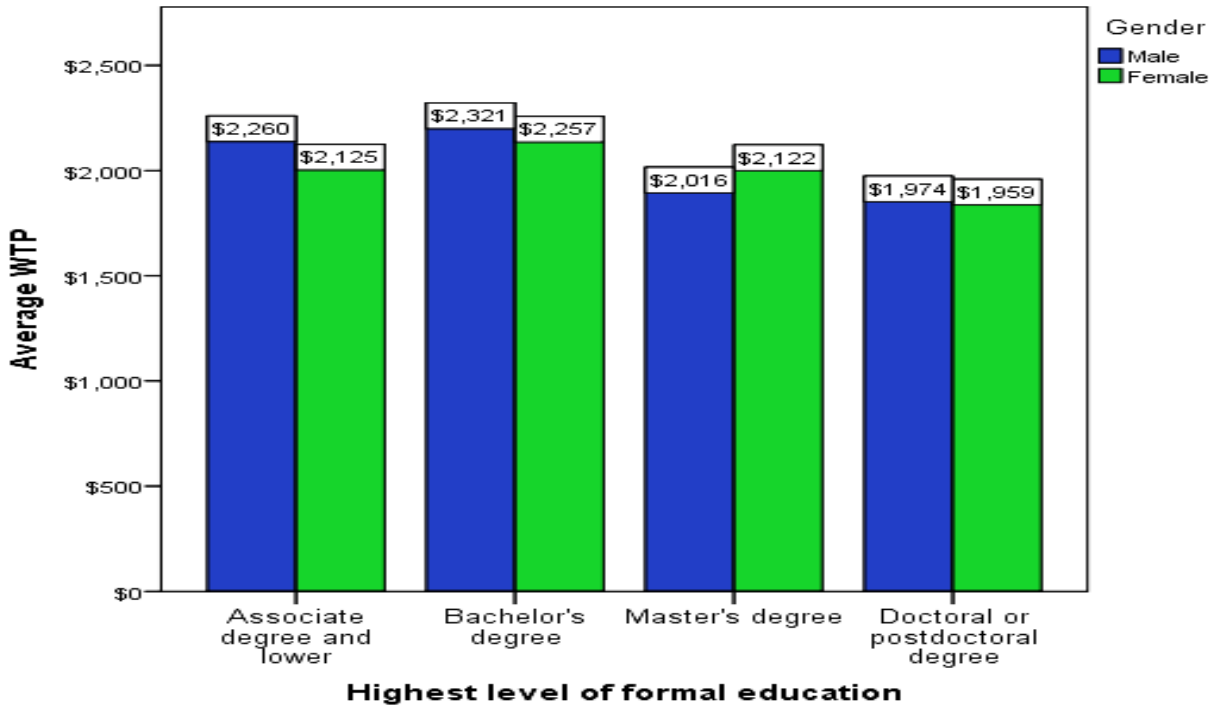


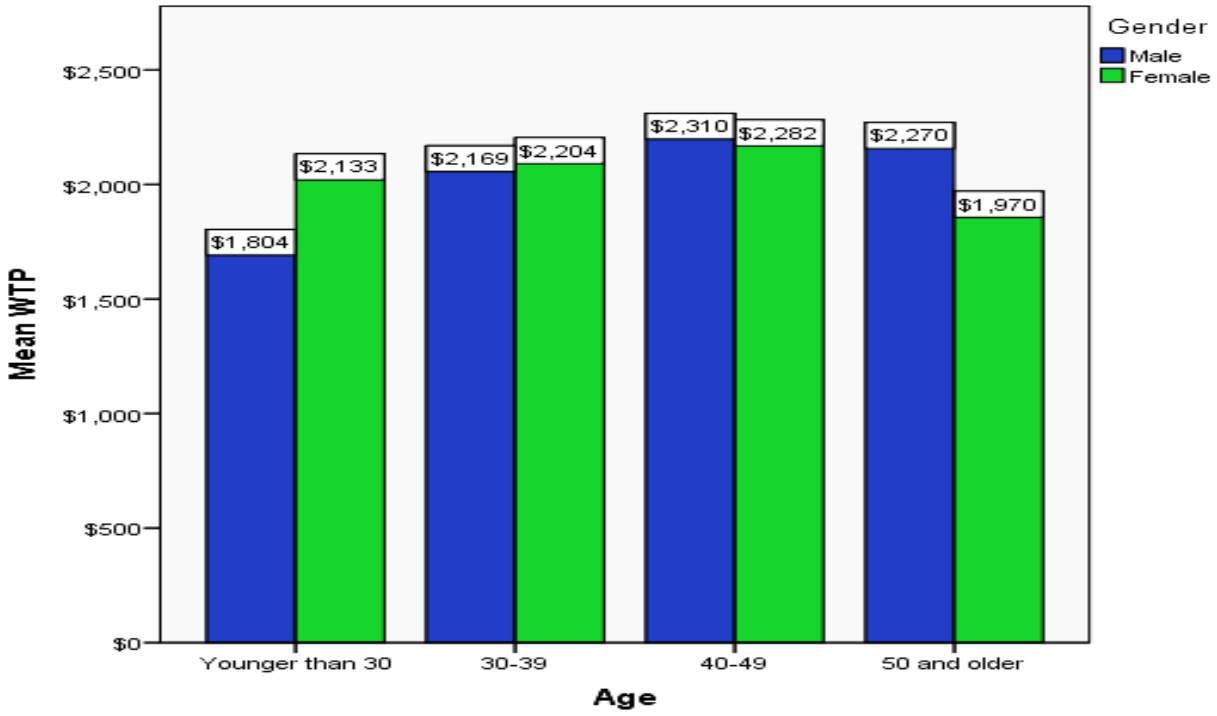
Figure 9. Mean WTP by Education and Gender (n=382)



WTP by gender and age is shown in Figure 10. While WTP values are fairly similar for both men and women at middle ages (30-39 and 40-49 groups), women younger than 30 have higher WTP than men in the same age group. By contrast, women at 50 and older have lower WTP than men in the same age group. Women in their 30's have a WTP of $2,133, and WTP stays fairly constantly until age 50 and older. At 50 and older WTP is only $1,970. By contrast WTP for men increases as they get older until age 50 and older. The youngest men (younger than 30) are willing to pay only $1,804, older men are willing to pay more: $2,169 for ages between 30 and 39, $2,310 for 40 to 49, and slightly less, $2,270 for 50 years old and older.

Figures 8, 9 and 10 seem to suggest gender differences in WTP by cohort; yet, even after considering gender and other variables, education, income, and age, no statistically significant differences could be found. Even so, the WTP difference between young men and women and WTP decline for mature women (50 and over) are vividly suggestive.

Figure 10. Mean WTP by Age and Gender (n=385)



CONCLUSIONS

The research literature indicated that women are more risk averse and have different social preferences when making economic decisions, are more sensitive to price of automobiles, and rate safety significantly more important among all age groups than men. Women tend to rate safety similarly at every age, while the importance of safety for male drivers increases with age. This current research is supportive of these findings. When purchasing vehicles, women are more concerned about automobile safety, fuel consumption, and environmental impacts than other vehicle features (e.g., status and engine power).

Statistical tests rejected the hypothesis that women have higher WTP in absolute terms than men for CV technologies. WTP by gender and its comparisons with income, education, and age show no statistical differences either, although mature women and young men appear less enamored of CV technology. That is, women at every age are more concerned about safety than men, but they are willing to pay only as much as men pay. However, women's budgets for vehicle purchases were lower than men's and the difference was statistically significant at the 95 percent confidence level. Also, women reported significantly less prior knowledge of CV than men. Thus, women have higher WTP than men relative to women's budgets and lesser knowledge.

The findings and conclusions have implications regarding promotion and diffusion of CV technologies to a diverse population. Price is a serious barrier to CV technology diffusion, but one would expect prices to come down with innovation, production, and governmental promotion. Women and men considered the collision package (front, side, all-around collision warning) the most important CV technology.

The automobile industry should make low-cost options and common standards a priority for diffusing collision warning technology.

Women have different social preferences than men when purchasing automobile technology, and mature women in general are less technology oriented. Government safety agencies should showcase CV technologies' safety benefits to media that cater to mature women and at family-oriented public events. In addition safety agencies may want to incorporate showcasing of CV within the various safety programs targeted toward young male drivers.

ACKNOWLEDGEMENTS

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Gendered Mobility and Work in Berlin's Post-Socialist Suburbia

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ABSTRACT

Using the example of the Berlin hinterland, this paper examines whether residence in a mono-structured suburban area imposes constraints on women's day-to-day life despite the social impact of post-Fordism and post-Socialism. The assumption of gender-specific differences stems from an "anti-woman" image that has been associated with the suburbs for decades.

The way in which the residents of ten selected study areas are constrained regarding their work and related daily mobility will be highlighted. In addition, the question is examined of whether, and to what extent, there are resources available in terms of social capital which may compensate for these potential restrictions.

By analysing employment statistics, I have looked at the study area's job provision. Moreover, a mixture of qualitative and quantitative survey methods has been used in order to collect data on labour context, mobility patterns and the local social capital available to suburban residents. The results of the analysis show a low provision of employment opportunities that are both close to home and suitable for women. When combined with the traditional division of labour also frequently encountered in the households of couples in the study, this leads to the majority of female suburban residents facing some form of restrictions. Considerable significance for work and mobility can be ascribed to the distinguishing feature of socialisation, as those persons socialised in East and West Germany still appear to be rooted in the respective formative societal models of marriage of both German states. A further finding is that female suburban dwellers are only to a limited extent able to compensate for the constraints with the resource of social capital.

1. INTRODUCTION

The question of whether the dichotomy of "mobile men" and "immobile women" is seen in suburbia is closely connected with the hypothesis that living in a suburban area restricts women's day-to-day life.

The latter assumption is rooted in a model of housing and living characterised by Fordist values, which was the case for the classic phase of suburbanisation in many industrial western countries in the 1960s. This model is based on a prospering economy with "permanently assured income, low biographical pressure to be mobile and clearly structured patterns of everyday life, both in terms of the separation of productive and reproductive labour and the gender-specific distribution of roles" *(1)*, (p. 409), (tr.). Standardized privately-owned homes, with their accompanying arrangement of everyday life – a productive, mobile husband working in the city centre and a wife working at home, who is thus relatively immobile – were now made possible at the urban fringes through mass motorization.

In the Berlin environs, the question whether these ideas of daily life still correspond to reality is of great relevance. Germany remains in a post-Fordist phase, although individual Fordist societal characteristics still exist in parallel. Post-Fordism is used here not only in the sense of replacing large-scale mass-production by small flexible manufacturing units, but also in the sense of a new gender order contrasting with the "traditional" Fordist gender roles *(2)*. Taking gender-roles as an example, it does not mean that the post-Fordist generation has substantially different gender roles to previous generations.

Alongside post-Fordist influences that affect society as a whole, the Berlin hinterland's specific course of development must also be taken into account. On the one hand, therefore, it is a post-socialist city region that has simultaneously undergone processes of transformation and contraction, and whose development cannot therefore be viewed in the light of the Fordist background of a thriving economy. On the other, East German socialisation instils a different understanding of gender roles in large parts of the population – above all regarding female labour participation. For the Berlin hinterland, the question thus arises: do typical suburban implications that applied under Fordist conditions still obtain today? In light of a post-Fordist and post-socialist framework, the following article establishes in concrete terms whether, and how, suburban residence restricts women's day-to-day lives.

This question is pursued by taking the pivotal factors determining everyday activity patterns: work, mobility and social capital. Work is generally considered to determine gender roles significantly, both in terms of productive and reproductive labour *(3)*. The differing mobility of the genders also affects suburban life in connection to work. Geographical features, particularly workplace provision, influence access to work and its distribution between men and women – and thus also mobility in terms of journey length and duration. In addition to the restrictions arising from work and mobility, I will establish how individually and collectively available social capital can alleviate everyday constraints.

In addressing female restrictions regarding work and mobility, this study follows a tradition within gender research. However, this paper, which is based on my doctoral thesis *(3)*, will stress not only restrictions, but also opportunities to overcome gender-specific limitations. These have previously only been referred to sporadically in similarly undertaken research.

2. CONCEPTUAL BACKGROUND

This article defines work, mobility and social capital as the three primary parameters of daily activity patterns. Whilst the analyses of work and mobility patterns emphasize the extent to which women are restricted in day-to-day life, the concept of social capital helps identify resources which can offset everyday constraints.

2.1. Work

Work is understood as "purposeful, planned and deliberate human activity that takes place using physical and mental (intellectual) capacities" *(4)*, (p. 86), (tr.). Despite this generally held definition, work is mostly equated with paid work and unpaid reproductive labour is often ignored. Paid work is thus defined as "activity that is performed as market-determined, organised work for the acquisition of a monetary return in order to provide a livelihood" *(5)*, (p. 54), (tr,). Additionally, an important characteristic of paid labour is that, alongside its income gains, it is distinguished by working times that can be isolated *(6)*. Reproductive labour, in contrast, is characterised thus: "without pay, without societal recognition and without end: this work is never finished and always starts again afresh with the same tasks" *(5)*, (p. 59), (tr,).

Alongside actual housework (shopping, laundry, cleaning etc.) and skilled manual work (gardening, building work etc.), this study also examines child care and accompaniment (taking children to school etc.) and the care of other household members and third parties outside the household. Reproductive labour thus encompasses various forms of work, namely "mental, manual, and emotional – aimed at providing the historically and socially, as well as biologically, defined care necessary to maintain life and to reproduce the next generation" *(7)*, (p. 13). The statistics indicate non-perception of a large proportion of overall work: only paid work is commonly recorded, whilst unpaid reproductive labour (still primarily performed by women) remains mostly invisible in statistical terms *(4)*. There are (at best) some time budget studies that give some data on reproductive labour. So necessary does the temporal recording of reproductive labour appear, however, and also so problematic, that the "recording technique of particular contents and structures of reproductive labour [has become] unsuitable" *(5)*, (p. 65), (tr,). The activities of reproductive labour often do not take place – as is necessary for survey design – in succession, but rather in parallel. Furthermore, reproductive labour is characterised by frequent underappreciation of its extent, due to a perception of it being carried out in passing, whilst doing other things.

This paper is based on a study that views work holistically and includes both productive and reproductive labour in the term.

2.2. Work Mobility

Work patterns influence daily mobility decisively. As with the general understanding of work, work mobility is mostly seen as productive labour mobility, in effect commuting. As stated above, this study sees work holistically, which is why accompanying trips and those for care purposes, undertaken in the performance of reproductive labour, are understood as part of work mobility.

The analysis of paid work mobility records the time spent and distance covered to an external place of employment. I have classified those who accomplish this type of work mobility as commuters and taken the following as their definition: "Workers, pupils and students whose place of work or education is not at their place of residence are classed as commuters" *(8)*, (p. 11), (tr.).

In Germany the number of commuters working and living in different municipalities is growing continually, while the number of "intra-commuters" (commuters within a municipality) and home workers is in steep decline. Some gender-specific differences stand out: men generally cover longer distances to work than women – this difference increases further out of town. The differences between the lengths of journeys to work are thus the greatest in rural areas *(9)*. Differences in commuting times also arise depending on the productive labour hours. Other studies show that, for women especially, commuting times vary strongly according to employment mode – the shorter the working hours, the shorter the trip to work *(10)*.

In contrast to precisely recorded paid work commuting, travel connected with reproductive labour is hardly surveyed in transport statistics. There is a problem here of distinguishing reproductive labour mobility and reproductive labour itself, as trips related to reproductive labour are often classified as work rather than mobility. As opposed to paid work mobility, most reproductive labour trips do not constitute a journey to defined places of work. Due to its different structure, the definition of reproductive labour mobility is not analogous to that of productive labour mobility: "Reproductive

labour mobility as a whole encompasses trips undertaken in the context of taking care of oneself, the family and other closely associated persons" *(11)*, (p. 3), (tr.).

2.3. Social Capital

Social capital is the third essential parameter that structures daily life and can be used to offset constraints. With the use of social capital, women living in suburban areas can counter restrictive structures with resources that mitigate the disadvantages. In practice this means employing interpersonal relationships to ease everyday life through mutual support, e.g. in child care.

My application of the concept of local social capital *(12)* in identifying (female) social resources in suburban districts is based on the constructs of Coleman and Putnam.

Though Coleman distinguishes between human and social capital, he stresses the "interaction effects" of both: his starting point is a network of individuals, in which the individual nodes constitute human capital and social capital resides in relationships between at least two individuals *(13)*. Every individual is embedded in social relationships – Coleman denotes social capital as the utilisation of these relationships. It is here, through their social relationships, that individuals access the human capital of others. In order for this network to be equally profitable for all involved, two conditions apply: trust between individuals and the availability of certain norms of reciprocity, which assure a service being returned. Beyond that, Coleman highlights social capital's quality as a public good i.e. that "no individual ownership [can] be granted [to it] or made effective [on it]" *(12)*; (p. 69),. While Coleman considers social capital to be an "instrumentally applicable, individual resource, though not independent on others", Putnam views it as a "resource of societies" *(14)*, (p. 62). Putnam's definition of social capital seems suitable for identifying and formulating collective problems, and the activation of community engagement with the aim of their eventual elimination: "Social Capital here refers to features of social organization, such as trust, norms, and networks, that can improve the efficiency of society by facilitating coordinated actions" *(15)*, (p. 167). Social capital is a precondition for collective action, as there is only a preparedness for such actions in communities with a high level of social capital.

Both Putnam's collective effects and Coleman's individual use are examined using the concept of local social capital, as "both perspectives are of interest in the neighbourhood related context [...] as the sum of individual effects in the neighbourhood also produces contextual effects" *(16)*, (p. 491). It is the residents of a given area, here the suburbs, who can use this localised form of capital.

3. METHODS AND STUDY AREA

A mix of methods comprising quantitative and qualitative procedures was used.The data used in the analysis were collected in the scope of the project "(Post-)Suburban Daily Mobility in the Berlin Hinterland", supported by the German Research Foundation. This project was carried out at the Geography Department of the Humboldt University of Berlin in 2006 - 2010. A quantitative survey gave an overview of Berlin's suburban residents' gender-specific work and commuting. To that end, residents were surveyed in 2007 by means of a standardised questionnaire (n=1,135). In addition, households received trip diaries (n=2,527) in which one day's trips were noted two days a week (one workday and one Saturday). The qualitative study helped in learning about the motives and subjective background conditions of these patterns. Guided interviews were conducted in summer 2008 with selected residents who had already taken part in the quantitative study. In addition to our own survey, I also evaluated employment statistics from the Institute for Employment Research (IAB). The aim pursued was to assess the regional facilities of the study area in terms of the differing gender-specific employment opportunities, as these have an influence on women's opportunities to earn.

The empirical survey took place in residential areas in the Berlin hinterland, which is part of the federal state of Brandenburg. Here, ten different study areas were selected, three of which were situated west of Berlin, three to the east and the remaining four to the south. Various criteria were used to choose the research areas: Besides the distance to the city centre, I tried to get a more or less

equal amount of people who are originally from West and East Germany. The second criterion refers to the presence of work, shopping and leisure facilities in potential research areas, as these might be of great importance for mobility. Therefore, three different suburban settlement types were chosen. First, isolated dormitory suburbs where there is hardly any access to facilities. Second, grown centres, which are suburban residential areas in proximity to an old town with some facilities nearby. And last, suburban residential areas close to a new centre i.e. a location with so-called "post-suburban" facilities. Due to the specific suburban development path, the average occupancy of the residents ranged between three and eight years for the various settlements as of 2007. Most of the respondents had lived in Berlin before they moved to the suburbs − the exact places of origin of the new suburban residents were the following: 35.8% had lived in suburbia before, 64.2% moved there from the outside. Of this 64.2%, 76.3% had lived in Berlin previously. The main causes for moving to the suburbs were lower rents, being able to buy a home, larger residential spaces and the desire to live in a green and quiet environment.

The study areas were built in the mid-1990s – no spread into the environs had been possible previously, due to the division of Germany. In 1992, residential suburbanisation around Berlin got underway and peaked in 1998 before declining due to reduced state support for the building of new housing *(17; 18)*. In terms of building structure, large regional differences arose, so that both apartment blocks characteristic of the East German suburbanisation process and detached homes and terraced housing typical of the construction of West German suburbs can be found.

4. RESULTS

This chapter examines the secondary statistics analysis findings on the provision of workplaces and then also the quantitative and qualitative survey results on work, labour mobility and social capital.

4.1. Employment structure in the Berlin hinterland

Analyses regarding gender-specific employment show that typically female employment sectors are underrepresented in the Berlin hinterland.

The situation regarding workplaces in Berlin and its hinterland is as follows: Whilst there are 3,375,200 registered residents in Berlin, of which 1,754,100 are in employment, Brandenburg has a population of 2,449,500, of which 1,073,900 are in work *(19)*. The number of jobs per head of population in Brandenburg is almost 10% lower than in Berlin. Even greater differences arise when looking at the sectors people are employed in: Berlin is a service sector centre, which employs 87.5% of all workers, with only 12.5% in the industrial sector. In Brandenburg, no less than 23% of the workforce are employed in the industrial sector, 74% in the service sector and just under 3% work in agriculture and forestry. Of those employed in industry in Brandenburg, most can be found in manufacturing (57.5%) and construction (32.6%).

We may assume that even with the provision of jobs close to the place of residence, they would not in the main be taken up by local residents, as spatial proximity is only one of several central factors in job selection *(20, 21)*. I essentially share the assumptions of the proponents of the jobs-housing imbalance hypothesis, that proximity of places of works and workers will rarely be achieved, as decisions concerning the location of home and work are made independently of each other *(21, 22)*. Nevertheless, employment near where people live influences the division of productive and reproductive labour within households. For each study area, the available jobs according to occupation were analysed to see if they are undertaken predominantly by men or women.

Occupations were classified as being female or male if one gender held at least 70% of those jobs *(3)*, (p. 109). This study asks what the proportion of jobs for women in the Berlin hinterland is compared to that in Berlin itself.

TABLE 1 Women's occupations in study area in comparison to Berlin
Source: *(3)*, (p. 109).

Female occupations	Study area	Berlin
Textile workers	x	x
Sales personnel		
Communications		
Office workers	x	x
Other healthcare workers	x	x
Social care	x	x
Personal hygiene	x	x
Hospitality	x	
Domestic services	x	x
Bank and insurance sales	x	
Writers, interpreters, librarians	x	
Total women's occupations	9	6

Comparing the number of female professions in the study area as defined by statistical criteria with those of Berlin, we see that Berlin as a whole evidences fewer women-dominated occupations.

The total of all persons employed in female occupations within a 30-minute radius of the study areas amounts to 35.7% of the total employed there. Those in female-classified occupations in the study areas amount to 47% of all employed in Berlin. It seems that in the metropolitan region of Berlin, typically female employment sectors are concentrated in the inner city. In other German cities, the central districts also display the highest proportion of women's productive occupations. *(9)*

The gender specifics of work, mobility and social capital are viewed in the following in light of this labour provision.

4.2. Gender specifics of work

Alongside the characteristics of regional employment provision, other factors also influence Berlin hinterland residents' gender roles. The division of labour within households is fundamental here, as the "allocation of work along gender lines [is] one of the most striking forms of the division of labour in our society" *(23)*, (p. 67), (tr.) and "one of the fundamental causes of the economic and social inequality between the genders" *(24)*, (p. 89), (tr.).

4.2.1. Paid work

Regarding productive labour working times, it is clear that having children influences women's time utilisation greatly, but not most men's. On average, women from the sample (n=434) work 34.9 hours and men (n=316) 41.3 hours per week. Among men and women with no children at home, a relatively balanced ratio of productive labour working hours can be seen, with this group of women involved in productive labour for 38.4 hours/week – on average only 2.6 hours less than men at 41 hours. Mothers, on the other hand, pursue productive labour for 32.9 hours/week, on average almost ten hours less than fathers at 42.6 hours. The difference between mothers and childless women is highly significant (T-Test result $p=<0.001$, $\alpha=0.05$), whilst that between fathers in reproductive labour and childless men likewise employed is insignificant. We also see a positive correlation among women

between the presence of children and time spent in paid work. Among men, in contrast, there is only a negligible correlation which can thus be disregarded (Women: C=0,3, α=0.01, Men: C=0.08). This establishes that the difference paid work hours is not due to sex per se but rather the distribution of gender roles amongst couples.

Concerning the influence of socialisation, we see that fathers who grew up in the old East Germany ("East-socialised" from here on), at 41.5 hours, pursue reproductive labour for negligibly less time than those from the West, who average 43.5 hours. The difference (as expected) becomes clearer amongst mothers – women of West German origin work on average 29.7 hours/week and thus a good five less than the 35 hours worked by mothers who grew up in East Germany. Mothers socialised in both East and West significantly differ from childless women with the same background, who respectively work 38.7 and 38.1 hours in productive labour. Therefore there is a very significant difference among women of Eastern origin, and a highly significant one among those from the West (T-Test result Eastern-socialized women: $p<0.01$, $\alpha=0.05$. T-Test result Western-socialized women: $p<0.001$, $\alpha=0.05$.).

Because children significantly influence women's time utilisation and reinforce gender role-specific differences, the following focuses on parents.

Alongside shorter working hours, we see another "female" characteristic of productive labour: jobs in "substandard employment" *(25)*, (p. 25), (tr.). Gender role-specific differences are stark among parents: in our sample, 52.4% of mothers have some level of qualification, but only 26.2% work in the field for which they qualified, whilst fathers show negligible discrepancy between qualifications and current field. (cf. Figure 1 and Figure 2).

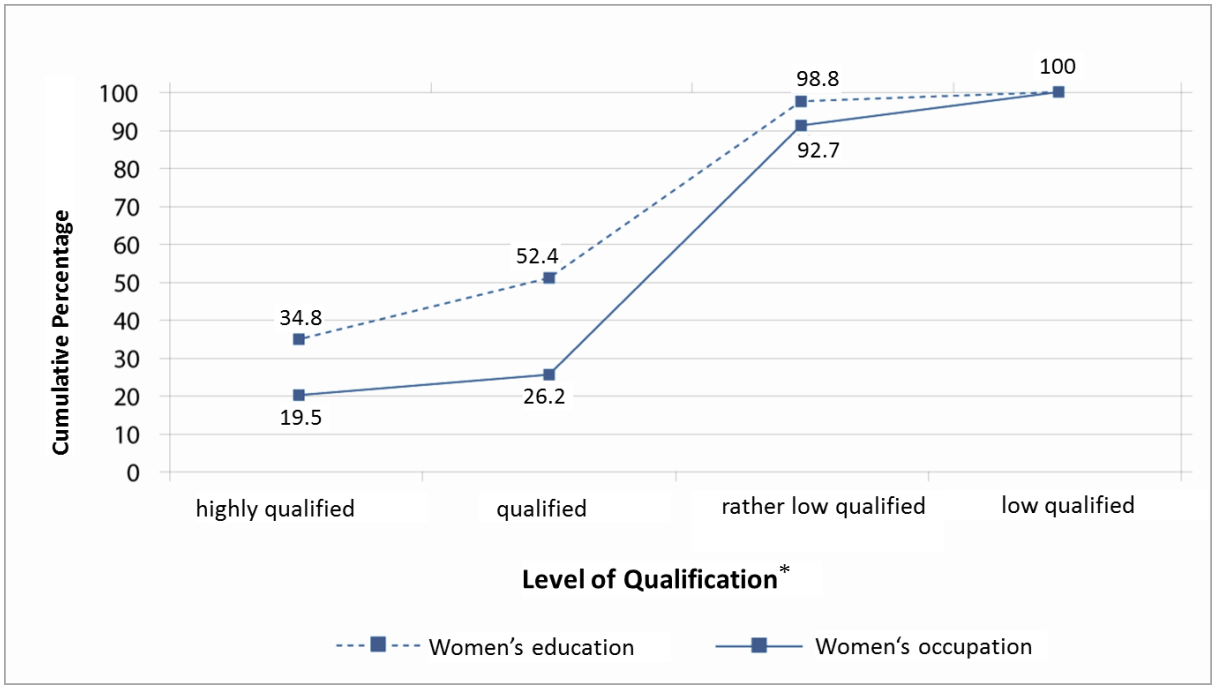


FIGURE 1 Qualification discrepancies among mothers [n=164] with children under 18. Source: *(3)*, (p. 125).

* The following classification was used to identify qualification levels:
a) Qualification levels in education: low qualified: no school exams, left school 14-16, in lower categories of German system; rather low qualified: school exams at 16 in middle categories of German schools; qualified: secondary school leaving exams for higher education; highly qualified: degree level.
b) Current productive labour qualification levels: low qualified: untrained, in lower grades of civil service or low grade work; rather low qualified: skilled worker/junior tradesperson/middle grade civil servant/qualified employee; qualified: master craftsman or foreman/upper level civil service grades/other professionally qualified work; highly qualified: the professions/high level civil service/highly qualified employees.

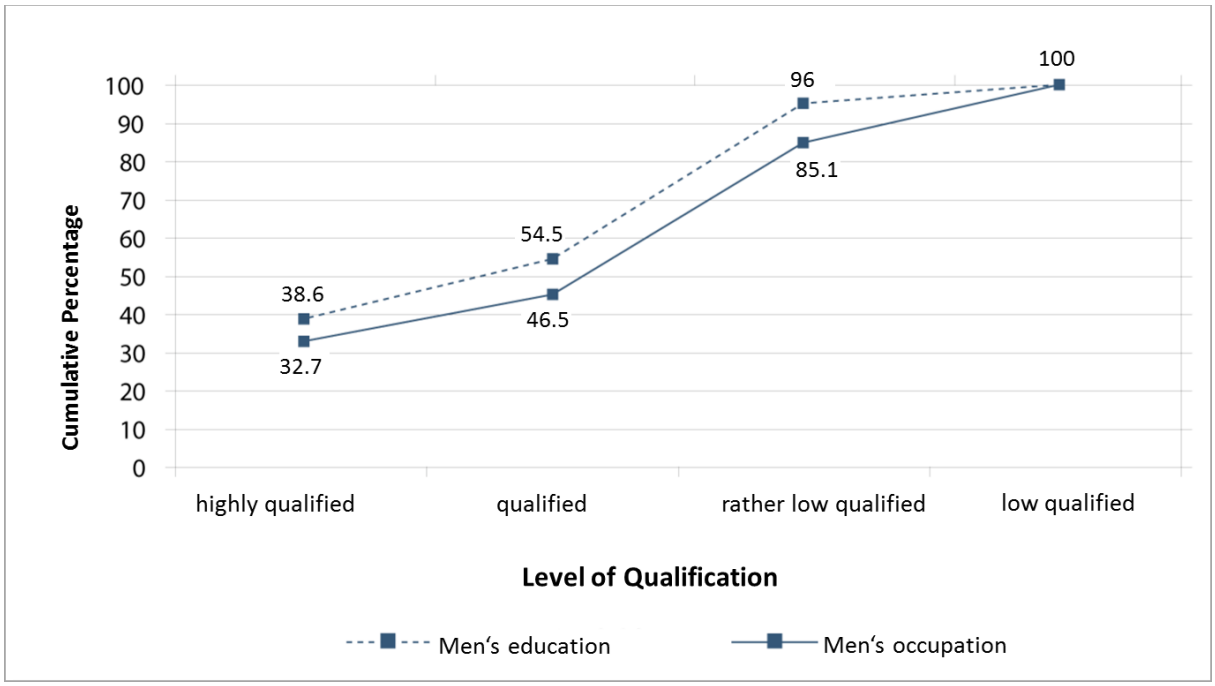
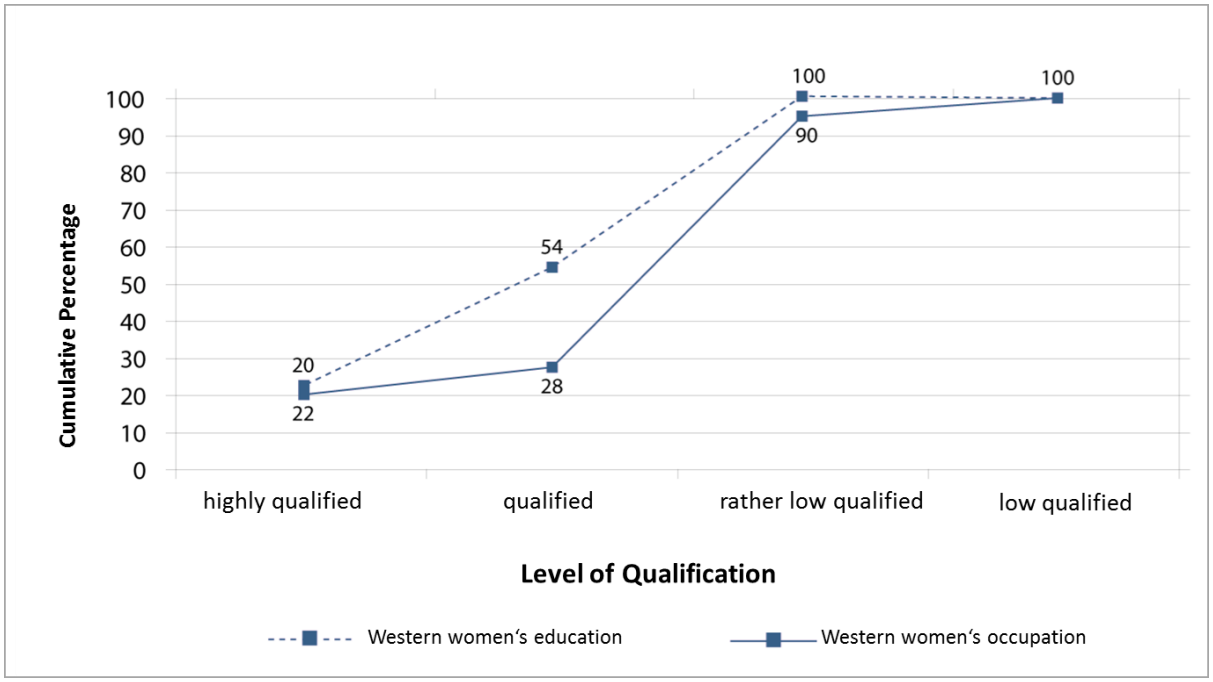


FIGURE 2 Qualification discrepancies among fathers [n=101] with children under 18. Source: *(3)*, (p. 124).

Figures 3 and 4 show differences according to the surveyed women's socialisation. West German-socialised women's work corresponds to their education, especially at the highly qualified level, contrasting with that of East-socialised women.



FIGURES 3 Qualification discrepancies among West-socialised women [n=50] with children under 18. Source: *(3)*, (p. 126).

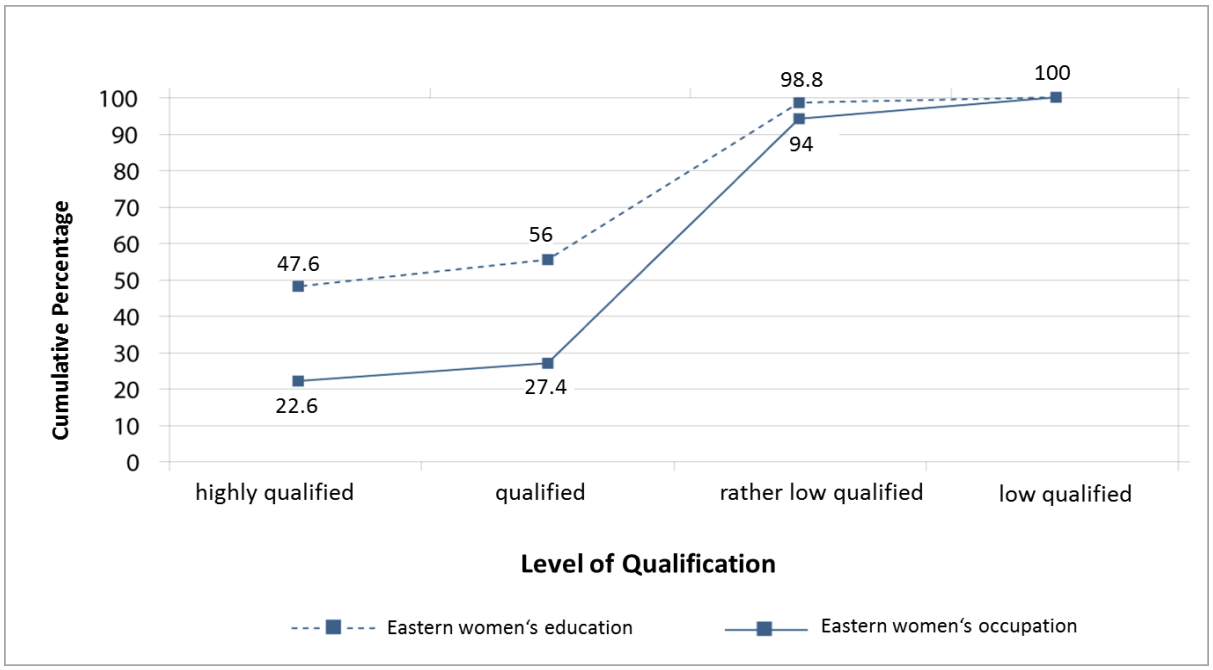


FIGURE 4 Qualifications discrepancies among East-socialised women [n=84] with children under 18. Source: *(3)*, (p. 125).

While West-socialised women more frequently shorten their working hours, East-socialised women tend to work below their qualifications and close to home. Both strategies save time in order to better deal with suburban life.

The differing job locations of East and West-socialised women confirm these results. Whilst, at 58.5%, comparatively few East-socialised women in the research area are in paid employment in urban areas, at 83.1%, most West-socialised women are. Analogously, women from West Germany also commute longer than those from the East (cf. Chapter 4.3.1). West-socialised women thus react to the low provision of suburban part-time jobs by accepting long commutes to get part-time work.

4.2.2. Reproductive work

It is (still) women who primarily do reproductive work. Analogously to men and women's productive labour hours, gender roles influence who does reproductive labour greatly. Based on all surveyed, women (n=573) perform on average 23.8 hours/week of reproductive labour, whilst men (n=409) do 13.3 hours, a significant difference (T-Test result: $p<0.001$, $\alpha=0.05$).

As expected, hours spent performing reproductive labour rises with children at home. Whilst childless women (n=157) perform on average 14.1 hours of reproductive labour, childless men (n=152) do 12.5 hours. By contrast, the surveyed women with children at home (n=328) spend 30.8 hours on reproductive labour, whilst fathers (n=180) do 15.2 hours.

The differences between mothers and childless women are enormous (T-Test result: $p<0.001$, $\alpha=0.05$), those between fathers and non-fathers are insignificant. There is a clearly significant correlation between women's reproductive work hours and the presence of children, though nothing similar among men (Women: $C = 0.4$ ($\alpha = 0.01$), Men $C = 0.1$).

This correlation between reproductive working time and children applies to women socialised in both East and West. The difference in time doing reproductive labour among East-socialised mothers (25.6 hours) compared with the childless (14.3 hours) is correspondingly high (T-Test result: $p<0.001$, $\alpha=0.05$). There is likewise significant differences among West-socialised women: childless (15.8 hours) and mothers (35.6 hours) (T-Test result: $p<0.001$, $\alpha=0.05$). Among West-socialised men, the childless perform on average 14.4 hours of reproductive labour and fathers 16.2 hours, whilst childless East German men do 12.0 hours, fathers 14.0 hours.

Consequently, we see that the presence of children has no influence on men's reproductive labour hours, regardless of socialisation. Regarding reproductive labour hours, there is no prevailing equality between the genders from East or West.

4.3. Gender specifics of work mobility

The previous section discussed if gender roles and regional job environments influence the work of the suburbanites. This section discusses the characteristics influencing work mobility.

4.3.1. Paid work mobility

Work mobility is closely connected to the times and form of paid work. Again, the difference in men and women's commute times is due to gender roles.

The majority of the suburbanites surveyed work in Berlin (62%). The average commute time confirms that most jobs in Berlin entail long commutes: 70 minutes/day for the journey to work, whilst in rural eastern Germany – which includes the Berlin hinterland according to the Federal Office for Building and Regional Planning's (BBR) – the average commute time comes to 51.1 minutes/day *(9)*. That the difference in men and women's commute times is not due to sex per se is shown by the comparison of couples with and without children at home. In childless households, the difference is negligible: men commute 72.7 minutes/day (n=74) and women 73.3 minutes/day (n=100) – women take marginally longer. Among parents, however, we see gender-specific differences. Mothers in productive work (n=244) commute only 65.4 minutes daily, almost eight minutes less than childless women (n=100) and fathers (n=74) likewise employed. This confirms the often-quoted hypothesis

that children indeed have an influence on women's productive labour and commuting patterns, to which fathers are relatively immune *(10)*.

The differences in journey times between differently socialised women, particularly among mothers, are larger than those between gender, employment mode and presence of children. East-socialised mothers (n=135) thus commute on average 61.8 minutes and Western mothers (n=74) 71.8 minutes daily; among childless women commuting times hardly differ between Western (n=31), 74 minutes, and Eastern women (n=56), 73.6 minutes. These differences between women with and without children are significant among Easterners (T-Test result: $p<0.05$, $\alpha=0.05$), but not Westerners. These commuting times, varying between East and West-socialised women, correspond with the finding from chapter 4.2.1: that East-socialised mothers tend to work below their qualifications, mostly full-time and close to home (only 58% work in Berlin), whilst West German-socialised mothers prefer part-time work in Berlin (82%), and further afield.

4.3.2. Reproductive work mobility

We can trace the higher number of trips made by women back to their primary responsibility for reproductive labour and its associated mobility. For instance, men (total trips n=442) make on average 3.7 journeys/workday, and women (total trips n=516) 4.4. The gender-specific divergence becomes clearer when looking at persons in paid work with children, who, as previously mentioned, are under greatest time pressure, with fathers averaging 3.9 trips/day (n=131), and mothers (n=166) 5.1.

The distribution of daily journey times in carrying out individual activities confirms that the proportion of reproductive labour journeys made by mothers in paid work (n=564) turns out to be much higher than those made by fathers (n=321) (Figure 5).

Whilst commuting forms the lion's share of fathers' daily trips, the figure drops among women in paid work, whose commutes form 24.6% of daily trips, whilst almost half are reproductive labour-related trips at 48.8. The proportion of trips for leisure, small errands and other purposes is relatively equal.

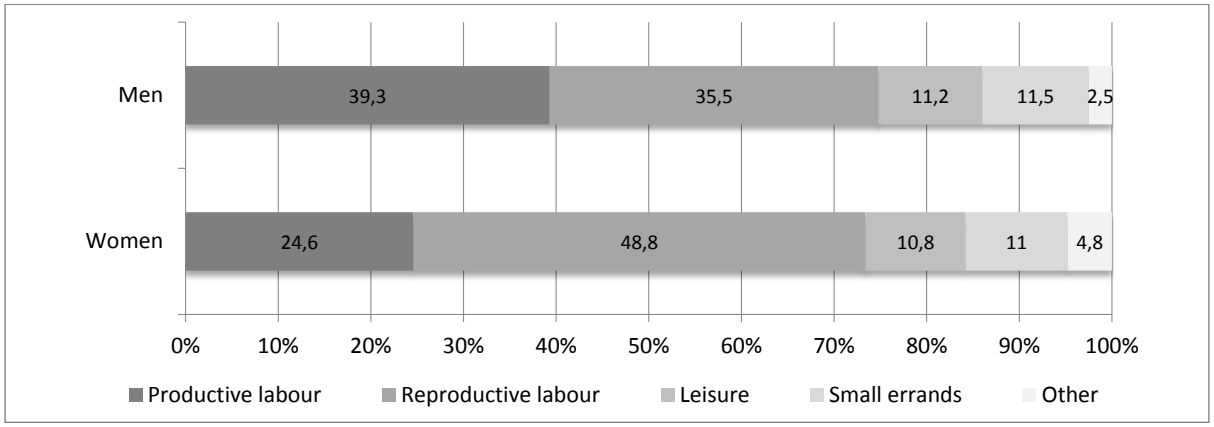


FIGURE 5 Parents in paid work's workday trip purposes. Source: *(3)*, (p. 53).

The time spent by men and women on journeys relating to reproductive labour correspond to the percentages of trips made, men (n=202) spending on average 26.1 minutes/workday, and women (n=333) 31.5 minutes. In line with the higher number of trips, men in paid work with children spend only negligibly more time, 27.5 minutes. The difference becomes clearer between mothers in paid work compared to childless women, with mothers spending 37.9 minutes.

4.4. Gender-specific resources via local social capital

The empirical findings concerning mobility, work and workplace availability confirm the hypothesis that deficient job provision and services in suburbia creates restrictions in work and mobility, particularly among women. I have also therefore examined whether the resources of social capital can offset this, and whether women thereby succeed in compensating for, or at least in alleviating, the restrictions affecting them. The corollary is whether gender-specific differences may be seen in the forming and use of social capital. Because social capital forms in interpersonal relationships, one may assume that the frequency of neighbourly contacts influences local social capital's development and strength. Precisely in the area of intensive local contact, i.e. getting together with neighbours at least once a week, the differences between mothers and childless women – and between mothers and men, both with or without children – are very striking.

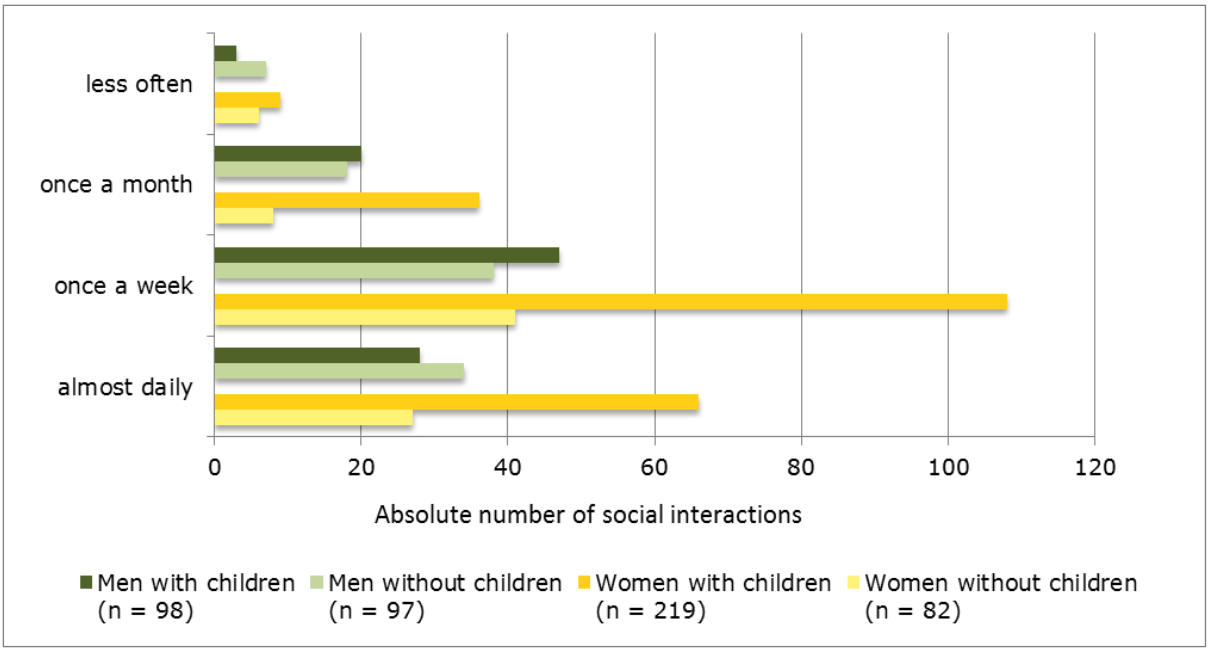


FIGURE 6 Men's and women's local social contact. Source: Own survey 2007. Author's own chart.

Based on contact frequency, the prerequisites of forming neighbourly networks, particularly of mothers, are present. The following examines whether they use this contact as local social capital, thus easing their daily lives, and mitigating work and mobility constraints. This was pursued using interview statements analysis.

It was first examined whether mothers, in terms of local social capital, use their social interactions not only for bilateral exchanges, but rather whether they also interact in their environment in a way that may benefit the collective. I then asked how the available local social capital affects individuals, and what alleviation this represents for women.

Interviews show that mothers' willingness to engage in their local area and campaign for local issues is middling. I found significant engagement in children's welfare among most mothers, with them often being involved in kindergarten associations. There is, however, very little visible readiness to get involved in the local area with the aim of benefitting all residents. Ms Schulte's stated views are typical:

> CR: "Is there anything like an initiative which says, 'we have so many children here, we now demand better transport connections?'"

FS: “There have been some attempts, yes, but it all fizzled out, because nothing really comes from that kind of thing.”

Ms Schulte (pseudonym), 40, Mittenwalde, West German, self-employed dietician, spends 20hrs/week in paid work, 2 children

As to whether social contact eases daily life, two forms of benefits that freed up mothers everyday life were seen: reciprocal child care arrangements and car-pooling.

The respondents frequently arrange reciprocal child care, especially drawing on neighbourly support in emergencies. In contrast, when car-pooling, they primarily draw on bilateral friendships. Daily assistance depends on individual social skills.

In conclusion, mothers have greater potential for social capital at their disposal through their local social contact than men and childless women. This is, however, to a large extent not used in relieving daily conditions.

5. DISCUSSION AND CONCLUSION

Does living in suburban areas restrict women’s daily lives? My answer has various aspects.

The provision of “women’s jobs” in the Berlin hinterland demonstrates that suburbia is (still) relatively manufacturing-based. Since the total of all persons employed in female occupations in the study areas is almost 11% less than in Berlin it becomes obvious that “typical” female jobs are underrepresented.

Due to this lack of jobs and resulting longer commutes, we see that women, particularly those with children, often reduce their working hours or work below their qualifications. Significantly, West German-socialised women, in line with the “housewife model of marriage with a male breadwinner” prevalent in the FRG, more often reduce their hours, whilst East German-socialised women, following the “double-provider model” of the GDR, more frequently work in substandard employment nearer home.

Having children tends to have the opposite effect on men than on women, with fathers doing marginally more productive labour. Other studies had already confirmed this correlation, reasoning that founding a family noticeably displaces productive labour hours within the household, with men increasingly in the role of “family breadwinner”, often associated with “retraditionalisating” gender roles *(25)*, (p. 36), (tr).

We also see gender-specific differences in the division of reproductive labour. Both the original West German “housewife model” and the original East German “double-provider model” have marked gender roles so that women still overridingly perform this unpaid work. As with productive labour, there is a significant correlation in reproductive labour between the number of reproductive work hours and the presence of children.

As with productive labour hours, children impact women’s but not fathers’ commute times. With the majority of their jobs located near home, East-socialised mothers have considerably shorter commutes than those from West Germany. In step with their prime reproductive labour responsibilities, women also make more trips in connection with it. Mothers therefore make more reproductive labour trips than to productive work.

Amongst women, children not only impact work and mobility but also their embedding in social networks. Correspondingly, mothers establish and maintain far greater neighbourly social contact. In this, children play an important role as a “binding factor” to the place of residence. We again see women do not network better by virtue of their sex, but that children reinforce traditional gender roles. But mothers do not use this social capital to its full extent to overcome restrictions and alleviate everyday conditions.

Based on the presented results, we see that suburban residence impacts women’s daily lives, even under post-Fordist and post-socialist conditions. It became clear that differences cited here in work and associated mobility have not arisen due to sex per se, but have rather been formed by gender roles. Fundamentally, we see the cause of persisting traditional gender roles in men and women’s still

starkly differing income levels in Germany and elsewhere, so that household budgeting and finance decisions lead to traditional division of labour. The classic gender-specific division of labour with its accompanying manifestation of traditional gender roles are thus influenced at the social, not the regional, level. In the Berlin hinterland it is nonetheless clear that structural context can further reinforce pre-existing traditional gender roles. Alongside the poor provision of workplaces close to home, mothers' prime responsibility for journeys accompanying children can be considered to be a fundamentally restrictive factor in most female suburban dwellers' daily lives, so that the majority of women clearly encounter constraints in this regard due to their gender role. The widespread (feminist) assumption that suburban living often involves the role of "female chauffeur" is thus borne out around Berlin.

The prerequisites for creating local social capital are good but not optimal. Women spend more time on a daily basis in their neighbourhood, which explains their higher amount of social contact. Of interest here is whether they can mitigate daily life constraints with this contact, using it as a social capital resource. I found only a modicum of civil engagement in local issues. It is clear, however, that neighbourly help is often employed, although primarily based on bilateral relationships. Women's local social capital is thus greater than men's, but overall poorly developed., Social capital can therefore only in low measure compensated for constraints stemming from suburban residence that increasingly affect women, particularly mothers.

In order to build local social capital, everyone needs to take part in its production and utilisation. For this to happen, the affected persons need firstly to be aware of their restrictions in terms of location, and should try to develop appropriate strategies that can combat these restrictions. Until now, their (typically suburban) family and privacy-oriented way of life has hindered the development of feelings of solidarity and community with other women. A certain type of institutionalisation in support services would be necessary to make this accessible for all, independently of individual social connections.

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Explanatory note:

Quotes in the above text marked "(tr.)" have been newly translated, for ease of understanding, and are to be viewed in this light and not as existing translations of the originals.

Examining Employees' Preference toward Telecommuting with an Emphasis on Women Employees

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The increasing role of women in social and economical activities expands their contributions to urban traffic. Telecommuting as an approach in Transportation Demand Management (TDM) can play an important role in lessening or redistributing peak hour trips. In this study, telecommuting by focusing on women employees' characteristics is examined. The sample used in this research has been obtained from the survey at seven organizations in Tehran, Iran. Three discrete choice models are generated based on collected data. Using binary logit and ordered probit models, women employees' preferences towards telecommuting and their preferences of working from home or local offices as well as the frequency of doing telecommuting are modelled. Moreover, marginal effects are discussed for each model. Results indicate the significance of the effects of telecommuting for women. More attention should be given to women's profession characteristics, their commuting specifications, and their personal and social characteristics.

Key Words: Transportation Demand Management, Women, Telecommuting, Binary Logit, Ordered Probit

1- Introduction

Gender is an important factor and should be explicitly integrated into transport research, practice and policy. A better understanding and definition of gender equity in transportation are needed to determine what gender equity means and how equity can be accomplished. Although men and women travel patterns have been converging at an aggregate level, there are still significant differences between their travel behaviours. This divergence has been increased on the basis of societal patterns such as *Employment Disparities*, which can be seen as results of differences in income, occupation, part-time and flexible labour force employment, *Household Roles* as a caused of changes in lifestyle which urge women to have trip chain and also *Changing Household Structures* which in single-parent households that women are substantially more likely to be headed than men [1].

Since late 1970, transport study towards gender issues has been started [2].The initial researches were in women's mobility needs in two different areas: constraints on women's mobility [3] and also women's shorter commute distances and duration [4].Interests in women's transportation issues and gender differences have been increased and women's travel behaviour has been investigated from different points of views [5]. It is also indicated that women are more likely than men to change their travel behaviour and adopt work schedule changes [6].Travel distance, age, holding driving license, household structure, having children, number of private cars, number of family members and income were influenced in women's travel behaviour and trip choices [7]. They make more trips and linked trips than men yet their trip length and time are less. Picking up or dropping one, personal and family affairs and shopping were the most frequent reasons for women to have trip chain [8-10]. Women are more willing than men to use their own car less and more fancy of ridesharing, walking is favourable as well [11-13].

Approaches in Transportation Demand Management (TDM), as a new strategy in management and modification of commuting pattern, can be classified in four different groups: Incentive-Based Methods, Land use Management, Improvement of Transportation Options, and Policies and Programs. Telecommuting is a valuable policy based on telecommunication advancements in the recent decades and could be an approach in lessening the work purpose trips and redistributing them to off peak hours [14].Telecommuting has been consistently important factor in shaping travel patterns, not only workers' one-way commute trip but also their total work trips and non-work trips [15]. Adopting telecommuting is a multidimensional decision and different aspects such as work, life, leisure, travel and ideology should be considered [16].Considering the increasing role of women in societies as work force and also their unique responsibilities in households highlight the necessity of addressing women's drives, constraints and preferences towards telecommuting.

2- Literature Review

Telecommuting as a policy and strategy in TDM has been studied from different aspects. Mokhtarian has played an important role in introducing telecommuting. Through her vast studies, she defined telecommuting as the use of telecommunications technology to partially or completely replaces the commute to and from work to alleviate the massive twice-daily peak commuting loads imposed upon most major cities. According to her findings, telecommuting is sometimes equated with teleworking, which is simply the use of telecommunications-related technology to conduct work, but not all teleworking (e.g., teleconferencing) replaces a commute trip. In fact, teleworking may or may not replace travel at all. Telecommuting can also be considered as one type of remote work, which has been defined: work done by an individual while at a different location than the person(s) directly supervising and/or paying for it. Telecommuting, of course, is both Telework and remote work and can be categorized into two types: home-based and non- home-based [17].

Internal decision making process is initiated by some threshold level of dissatisfaction with one or more aspects of life. Such a search for solution is motivated by drives, and in case of dissatisfaction, it is the drives which activate a search for adjustment to reduce it. On the other hand, constraints are factors that inhibit the formation of preference. Understandings the effect of constraints, in addition to the role of drives, is important for forecasting purposes. Constraints are those which, when they active, essentially preclude telecommuting from being chosen. Drives are categorized into work, family, leisure, independence, ideology, travel and the constraints can be external (based in work environment) awareness, also organization and job or internal (arising from psychological considerations) psycho-social variables [16]. In addition, a preference may express a long-term priority that may not always be exercised. The main reason for mismatch between preference and action is assumed to be presence of constraints. The preference model estimates the trade-offs between advantages and disadvantages of telecommuting that an individual must consider in forming his or her preference [18].

In terms of propensity to telecommuting, Mokhtarian and Salmon examined men and women employees' preferences through explanatory variables and binary logit models. Results indicated that by highlighting disability, stress, personal benefits as well as commute stress and time, preferences toward telecommuting would increase. On the other hand, workplace interaction, household interaction and commuting benefit would decrease employee's preferences on telecommuting [18].

Through several studies the influence of gender on adopting telecommuting has been discussed. Popuri and Bhat in their research presented a joint discrete model of home-based telecommuting adaption and home-based frequency using revealed preference. The results underscored the importance of socioeconomic and occupational characteristics of employees in explaining telecommuting behaviour. It was also mentioned that women with children are more likely to telecommute [19]. Mannering and Mokhtarian also mentioned in their study that being a mother of small children had a positive influence on adopting telecommuting [20]. In a case study in Minnesota, the results pointed out that telecommuters are more likely to be women, married and have children [21].

Bailey and Kurland surveyed the literature on teleworking and telecommuting. In terms of differences linked to gender, they indicated that full-time employees who telework are more likely to be male, slightly younger and making higher income, while part-time telecommuters are doing that more informally, being predominantly female, older and earning less [22]. Mokhtarian and her colleague in another study and through binary logit models on choosing telecommuting mentioned that women have got more preferences than men and also telecommute more [23]. In a case study in India, the effect of telecommuting on travel behaviour examined and indicated that telecommuting should be considered more for women [24].

In terms of benefits of telecommuting for women in quality of work life (QWL), Olorunfemi found out that promoting telecommuting policies could reduce pressure from women and bring productivity and increase the QWL[25]. Mokhtarian et al, in their research examined the impact of gender, occupation and presence of children on adopting telecommuting. Through statistical analysis, nearly the entire specific hypothesis formulated from literature and judgments were corroborated: women are more likely than men to cite family, personal reasons and stress reduction as advantages of telecommuting and more likely to see the lack of visibility of management as a disadvantage. Moreover, they highlighted that women are more likely to see keeping same job after relocation as a benefit of telecommuting and men are more likely to see the lack of professional interaction as a cost [26].

Theriault et al examined telecommuting from home using the data from the sample of more than 30000 workers in Quebec metropolitan area (Canada). In a binomial logistic model of propensity to telecommuting they found out that women are far less likely to telecommute than men and among

women those who were under 24 were less enthusiastic to adopt telecommuting. In a cross-effect of gender and professional status they indicated that self-employed women and women of those powerless categories are far more prone to adopt telecommuting [27].

Khattak et al showed that education, age, presence of children in the household, gender, and certain measures of location and accessibility are important in explaining the tendency to work from home. In terms of gender they found that men have got more tendencies to work from home than females [28]. Walls et al. analyzed the survey of Southern California residents and found out that there is no difference between male and female workers in the propensity to telecommuting and also statistically significant effect of gender is not found in the telecommuting frequency model [29].
Jin and Wu, based on the data from1995 Nationwide Personal Transportation Survey (NPTS) and 2001 and 2009 National Household Travel Survey (NHTS) in United State, explored a wide range of individual, household and land use characteristics relevant to individuals' telecommuting behaviour. It was indicated that male workers are more likely to work from home than are female workers. They also mentioned that out that 14 percent of male workers had the option of work from home whereas only 10 percent of female workers had that option [30].

In most of reviewed studies, telecommuting adoption by women were mainly discussed. Whether women or men are more likely to choose telecommuting widely depends on the context and the population from which the sample is taken. By the way, based on women's unique role in societies and households, in addition to examining women's characteristics on adopting telecommuting, their preferences towards location and frequency of doing telecommuting need to be addressed.

3- Methodology

In this study, women employees' preferences towards telecommuting from different aspects are modelled. Women's preferences to adopt telecommuting, their preference to do telecommuting from local offices or home and finally the frequency of doing telecommuting are examined. In terms of decision making, choice and random utility models are applicable [31]. In random utility model it is assumed that U_{in} the utility of alternative i for individual n, is given by: $U_{in}=V_{in} + \varepsilon_{in}$. Where V_{in} is the systematic component corresponding to some functional form of attributes that effect utility, and ε_{in} is the random error corresponding to unobserved attributes and taste variations, measurement error, imperfect information, and instrumental variables. It is assumed that each individual attempts to maximize his/her utility. Thus the probability that individual n will choose alternative i is given by:

$$Prob_n(i)= Prob(V_{in} + \varepsilon_{in} \geq V_{jn} + \varepsilon_{jn}) \qquad \text{for all } j \neq i$$

Depending on the assumptions made about the functional form of V, and the distribution of the disturbance ε, various discrete choice models such as Logit and Probit models may be formulated. In first two models, Binary Logit models will be developed to identify women's preferences on adopting telecommuting as well as the location where they prefer to do. In the third one, women's preference in terms of frequency and number of days doing telecommuting is examined. Preferences are defined in three categories in forms of weak (0 or 1 days a week), medium (2 or 3 days a week) and high (4 or 5 days a week). As this approach deals with ordered independent variable, by considering latent variables and thresholds and also specifications of error term, ordered probit model is developed [32].

To discriminate women's information, two approaches are selected: first model is developed by using only women's data (70 individuals). In the two others, considering the low amounts of women's respondents and in order to highlight their important characteristics in relation with independent variables, by using gender dummy variable (*Sex*=1 for women and 0 for men) explanatory variable *x* is inputted as follows:

$$\beta\,(1+\alpha.Sex)\,x = \begin{cases} For\ men:\ \beta\,x \\ For\ Women:\ \beta\,x + \alpha\,\beta\,x \quad \Rightarrow \beta\,x + \gamma\,x \end{cases}$$

where γ is behavioural difference between men and women. If γ is statistically significant then the behaviour of women and men will vary in terms of explanatory variable *x*. Otherwise the behavioural differences will be neglect.

4- Data discretion

The data has been obtained from a two pages questionnaire distributed at seven governmental and semi-governmental organizations in a Central Business District of Tehran, the capital city of Iran. As telecommuting is almost a new approach in terms of working in Iran, initially employees and their managers were given some information. The data consist of 245 individuals (70 women and 175 men) and through a comprehensive interview socioeconomic and demographic factors, travel and commuting issues, ideology, preferences and suitability of adopting telecommuting have been asked from employees and their supervisors. In terms of job categories and wide range of job titles, the concept of abstract job has been applied [33].

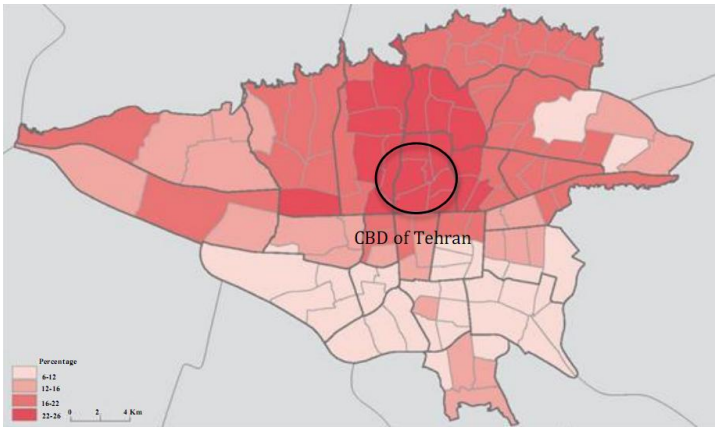

Figure 1- Employment rate in Tehran
Ref: Tehran Municipality official statistic website: www.atlas.tehran.ir

Employment rate in Tehran during the period of data collection was about 6-26 percent (Fig 1). As it is clear from the figure, in the CBD of this metropolitan, employment rate is in maximum range and by considering the increasing role of women in the society and job market, 70 women (about 28 percent) have been interviewed to represent the population.

5- Models and results

In this section, mentioned models and related results are calibrated and discussed respectively.

5-1- Women employees' preferences towards telecommuting

In the first step women's preferences toward telecommuting is modelled using binary Logit and it is calibrated based on *only* women's information. Results and marginal effects are illustrated in tables 1 and 2.

Variables	Coefficient	t-Value	P Value
Constant	9.373	2.02	0.043
Importance of reports, correspondent etc.	-3.739	-1.88	0.06
Number of children	-0.831	-2.03	0.042
Ideology about the impact of telecommuting on work efficiency	4.017	2.12	0.033
Travel time from home to work	0.084	1.88	0.059
Using organization's car	-6.341	-2.66	0.007
Age group (20-29)	-3.806	-1.83	0.066
N	70		
Log-Likelihood at 0	-45.52		
Log-Likelihood at constant	-30.443		
Log-Likelihood at convergence	-12.491		
Pseudo-R square	0.7425		
Adjusted pseudo-R square	0.589		

Table 1- Binary Logit model for women's preferences toward telecommuting

It can be concluded from above table that women's dependence on reports and correspondences is an important factor that decreases their preferences towards telecommuting. Increasing the number of children causes lower tendency on adopting telecommuting, which can be related to their loads of duties as mothers at home. In addition, those women employees who use their organisations' car for commuting and also younger women employees, who are experiencing new work environment, prefer to work from primary offices. An expected result appears in variable of travel time from home to work that by increasing travel time, telecommuting is more preferable. Those women employees, who consider telecommuting as motivation for more productivity, have got more tendencies to do telecommuting.

Marginal effects of above model are in Table 2. Marginal effect of an independent variable demonstrates the changes in probability of choosing an alternative when it increases 1 unit[32]. Women employees' preference towards telecommuting will decrease about 1.6 percent when the importance of reports and correspondents increases about 1 unit respect to the average. Tendency of adopting telecommuting when a child is added to a family, using organization's car and being younger than 30 will decrease about 0.3, 19.1 and 3.8 percent respectively. It is worth mentioning that marginal effect for dummy variable explains the situation corresponding to 1 against 0.

Variables	Marginal Effect
Importance of reports, correspondent etc.	-0.016
Number of children	-0.003
Ideology about the impact of telecommuting on work efficiency	0.017
Travel time from home to work	0.0003
Using organization's car	-0.191
Age group (20-29)	-0.038

Table 2- Marginal effects of Binary Logit model for women's preferences toward telecommuting

5-2- Women employees' preferences towards the location of doing telecommuting

In the second model, the women employees' preference towards location of doing telecommuting is studied. Preferred location of doing telecommuting has been inferred through the stated differences between number of days of working between local office and home, thus the information of those who

had equal preferences is omitted. Because of few numbers of women employees' respondents, the model is calibrated by the whole sample and the women's information is extracted through gender dummy variable approach discussed in the previous section. With regards to the available data, a binary Logit model is developed. Table 3 and 4 illustrates the results and the marginal effects.

Based on this model, total work experience by negative coefficient appears that means when employees' work experience increase, they prefer to work from local office and they do not consider home as a suitable working place. This can be interpreted that telecommuting is almost a new approach and this could be accounted as a paradigm shift by employees against traditional state of work from home and eventually it is not acceptable. The mentioned reason could be approved by the effect of education variable as well: those employees who hold undergraduate degrees do not prefer to telecommute from home. In addition, employees consider telecommuting as an approach that could have impacts on work efficiency when it is done from local office rather than home. Walking to work in the morning has got a utility for employees and it brings more tendencies to telecommute from local office rather than home. However, in the return trip, which usually is in the afternoon pick hours, those who use bus prefer to telecommute from home and not to take waste their time in public transportation.

Average daily time spent on phone or fax machine appeared in the model in two ways: by spending more time on it, whole employees tend to adopt telecommuting more from home, yet women employees behave in opposite direction and when they have to talk more with phones or use fax machine as part of their job, they prefer to do telecommuting from local office. It can be implied that when phone or fax machine plays important role in men's job, home is the preferable place to telecommute. Women who are involved in advertisement, marketing, sales or customer service sectors, prefer to work more from local offices, which highlight the nature of their work that should be in touch more with clients and customers. Finally, when the importance of reports, correspondents increases, women are more likely to telecommute from home. However based on previous model, their tendency of doing telecommuting would decrease.

Table 4 shows the marginal effects of second model. Mode choice in commuting and changes in education and employees' ideology towards productivity lead to significant differences in preferences of employees towards location of doing telecommuting.

5-3- Amount of women employees' preference towards telecommuting

In the last model, the frequency and number of days of doing telecommuting by employees and women is examined. The preferences have been defined through three alternatives: Weak (0 or 1 day a week), Medium (2 or 3 days a week) and High (4 or 5 days a week) and there is no difference between tendency of working from local office or home. Based on characteristics of error term in the utility function, an ordered probit model is developed and employees and women's specifications are highlighted. Results and marginal effects are shown in tables 5 and 6.

The results indicate that the importance of reports, correspondents etc and dependence to special places such as Lab, studio etc would cause lower preference towards telecommuting. Those employees who hold driving license also tend to commute and use their car. Work experience in current job and also belief to the impact of telecommuting on lessening traffic congestion and work efficiency would encourage employees to do telecommuting more. Using car as a mode of travel to get to work is a factor that increases employees' preferences to do more days of telecommuting.

Women's specifications in terms of frequency of adopting telecommuting are examined in this model as well. Women managers or supervisors as well as those who women work in research and consultation area prefer to telecommute less as they need to turn up in their primary work place more. The ideology of women on family wellbeing is another important issue and related variable appeared

by positive coefficient in the model which means women as mothers or wives consider telecommuting as an approach that they could spend more time with their family. However, by increasing the number of children, women employees prefer to do few days of telecommuting that might relate to high amount of responsibilities which can prohibit them from doing their jobs' duties. Women employees who walk to work in the morning prefer to do telecommuting less, it can be interpreted that they probably live near their primary work offices and telecommuting can be meaningless in this case.

Threshold is 2.6 and it shows that whenever the value of independent variable is less than zero the preference is weak, between 0 and 2.6 is medium and more than 2.6 the preference will be high. Table 6 shows the marginal effects and clarify the changes in probability of weak, medium and high preferences when the value of independent variables increase 1 unit

Variables	Coefficient	t-Value	P Value
Constant	3.08	2.34	0.019
Total work Experience	-0.30	-4.08	0.000
Average time spent daily on Phone/Fax machine	0.88	2.85	0.004
Education : Diploma or less	-1.59	-2.05	0.041
Ideology about the impact of telecommuting on work efficiency	-0.87	-1.95	0.052
Home to work trip mode choice : Walking	-1.50	-1.82	0.069
Work to home trip mode choice : Bus	3.19	1.69	0.092
(*Women*) Importance of reports, correspondent etc.	4.29	3.70	0.001
(*Women*) Job categories: Advertisement/Marketing/Sales/Customer Service	-4.33	-1.99	0.046
(*Women*) Average time spent daily on Phone/Fax machine	-1.73	-3.52	0.001
N	90		
Log-Likelihood at 0	-62.383		
Log-Likelihood at constant	-62.027		
Log-Likelihood at convergence	-37.409		
Pseudo-R square	0.4		
Adjusted pseudo-R square	0.397		

Table 3- Binary Logit model for employees and women's preferences toward telecommuting from local office/home

Variables	Marginal Effect
Total work Experience	-0.072
Average time spent daily on Phone/Fax machine	0.213
Education : Diploma or less	-0.376
Ideology about the impact of telecommuting on work efficiency	-0.211
Home to work trip mode choice : Walking	-0.357
Work to home trip mode choice : Bus	0.408
(*Women*) Importance of reports, correspondent etc.	0.078
(*Women*) Job categories: Advertisement/Marketing/Sales/Customer Service	-0.070
(*Women*) Average time spent daily on Phone/Fax machine	-0.041

Table 4- Marginal effects of Binary Logit model for employees and women's preferences toward telecommuting from local office/home

Variables	Coefficient	t-Value	P Value
Constant	0.129	0.29	0.82
Importance of reports, correspondent etc.	-0.217	-1.73	0.08
Holding driving license	-0.597	-2.37	0.02
Ideology about the impact of telecommuting on reducing traffic congestion	0.462	3.38	0.01
Ideology about the impact of telecommuting on work efficiency	0.305	2.81	0.00
Home to work trip mode choice : Car	0.538	2.45	0.01
Work experience in current job	0.033	1.64	0.10
Importance of special places (Lab/Studio...)	-0.165	-1.42	0.15
(*Women*) Job categories: Management/Supervision	-1.076	-1.63	0.10
(*Women*) Number of children	-0.316	-3.22	0.00
(*Women*) Ideology about the impact of telecommuting on family wellbeing	0.033	-2.05	0.04
(*Women*) Home to work trip mode choice : Walking	-0.820	-1.20	0.23
(*Women*) Job categories: Research/Consultation/Expertise	-0.377	-1.15	0.25
Threshold	2.600	15.17	0.00
N	245		
Log-Likelihood at 0	-269.160		
Log-Likelihood at constant	-190.596		
Log-Likelihood at convergence	-160.167		
Pseudo-R square	0.405		
Adjusted pseudo-R square	0.296		

Table 5- Ordered probit model for employees and women's preferences towards frequency of doing telecommuting

Variables	Marginal Effect Alternative 0	Marginal Effect Alternative 1	Marginal Effe Alternative 2
Importance of reports, correspondent etc.	0.052	-0.029	-0.023
Holding driving license	0.117	-0.027	-0.089
Ideology about the impact of telecommuting on reducing traffic congestion	-0.112	0.062	0.05
Ideology about the impact of telecommuting on work efficiency	-0.076	0.041	0.033
Home to work trip mode choice : Car	-0.110	-0.059	0.048
Work experience in current job	0.008	0.004	-0.004
Importance of special places (Lab/Studio...)	0.040	-0.022	-0.018
(*Women*) Job categories: Management/Supervision	0.370	-0.318	-0.051
(*Women*) Number of children	0.077	-0.042	-0.037
(*Women*) Ideology about the impact of telecommuting on family wellbeing	-0.108	0.400	0.062
(*Women*) Home to work trip mode choice : Walking	0.269	-0.222	-0.047
(*Women*) Job categories: Research/Consultation/Expertise	0.078	-0.027	-0.052

Table 6- Marginal effects of ordered probit model for amount of employees and women's preferences towards telecommuting

6- Conclusion

Regarding to technological advances, telecommuting as a new approach in Transportation Demand Management can play an important role in eliminating or redistributing work purpose trips to off peak hours in order to lessen traffic congestion and may help achieve sustainable transportation systems. This approach could be improved by considering gender differences and focusing on travel behaviours. This study tends to examine women employees' behavioural characteristics in context of telecommuting. Three models have been developed and through binary Logit and also ordered probit models, women's preferences towards telecommuting, its location and the frequency of adopting telecommuting discussed. Moreover, the marginal effects of models presented.

Based on results, it can be concluded that by increasing the number of children in a household, women's preference towards telecommuting decreases. However, the family wellbeing and spending more time with family, preferably small size ones, is important for women and encourage them to do more telecommuting. Women's ideology about impact of telecommuting on productivity could be motivations for involving more in teleworking. Age is another important factor in their decision making and young women have got more tendencies to adopt telecommuting.

In terms of job specifications, women who are involved in management/supervision, advertisement/marketing/sales/customer service and also research/consultation/expertise are less likely of doing telecommuting. Women tend to telecommute from local office where can be in touch with more clients or colleagues. Those women who are more involved with reports and correspondents, phone and fax machine prefer to telecommute more from home. Travel time plays an important role in this context, and by increasing spent time in commuting, women's preference toward telecommuting increase. However, those women who walk to work or using organization's car from commuting prefer primary offices to work.

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Work in progress!

Left holding the baby or increased career opportunities? The gendered consequences of regional enlargement and increased commuting

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ABSTRACT

Greater urbanization has meant that the growth of city-regions is an increasingly common development in many countries. This trend has advantages for economic growth in terms of expanding the labour market, widening job opportunities, increasing choices and facilitating specialization. Improved communication systems, with better public transport, as a result of the development of city regions could be expected to benefit women as well as men - facilitating journeys between home and work and broadening labour market opportunities. However, even in a supposedly gender-equal country like Sweden, women have typically been regarded as less mobile than men and the female body is often constructed as more spatially circumscribed and place bound. A "masculine" construction of commuting as a necessary evil for male career advancement (reinforcing the male bread-winner model) seems to predominate. In this scenario, men commute further/longer in pursuit of their careers. Women, on the other hand, are left "holding the baby", taking the main responsibility for the home and the family, often while also engaged in paid (part-time) employment which is restricted to close-to-home opportunities because of their caring responsibilities. An alternative scenario is, nevertheless, possible – a more gender equal alternative - in which unpaid caring work is shared more equally by partners/couples. In this scenario commuting becomes something positive opening up increased possibilities also for women in the labour market and greater career opportunities. Drawing on theories concerning gender and mobility and using the findings from a questionnaire survey and interviews carried out in two Swedish city-regions, this paper explores the gendered consequences of increased mobility in city-regions in terms of these two scenarios, and considers their implications for transportation policies.

INTRODUCTION

In Sweden, as in many other countries, regional enlargement has been seen as involving many economic advantages and has become an important goal in regional growth policy (Friberg, 2008; Scholten & Jönsson, 2010). In the current government strategy, *A national strategy for regional competitiveness, entrepreneurship and employment 2007-2013* (Ministry of Enterprise, Energy and Communications, 2007), both regions and citizens are seen as benefiting from the process of regional enlargement and the development of city-regions. Not only is the region's labour market and its competitiveness expected to be strengthened but also the range of job opportunities available and the individual's career prospects are considered likely to improve (Ministry of Enterprise, Energy and Communications, 2007). Greater investment in infrastructure is expected to facilitate commuting (both by car and public transport) enabling citizens to travel more rapidly and easily to work across municipal boundaries and contribute to the development of expanded more differentiated labour markets and to increased job opportunities. The aim is that:

> "Regional enlargement should occur with the least possible environmental impact and on equal terms for *both women and men*" and that it is important to "take into account the different commuting patterns of women and men and the differences which may exist in lifestyle and travel patterns within different professional groups and between people with different educational backgrounds" (Ministry of Enterprise, Energy and Communications, 2007: 23, my emphasis).

It is seen as important, if regions are to continue to develop and prosper in the competitive global economy that good communications are available to facilitate commuting between municipalities. This is considered to both enable citizens to find employment that matches their skills and employers to obtain the labour power that meets their requirements. However, the strategy does not discuss the gendered consequences of regional enlargement and increased commuting to work for everyday life. To be able to take advantage of widening labour markets and increased job opportunities, it is necessary to have the time and resources to commute. Women are generally viewed as less mobile, tend to earn less and take greater responsibility for the household and the family which may limit their ability to benefit from larger labour markets and increased job opportunities.

Two possible scenarios arise – one negative and one more positive. In the first, regional enlargement has negative consequences reinforcing the gendered division of household/family responsibilities and emphasizing the male breadwinner role and the female role as care giver and mother. In the more positive scenario, regional enlargement offers potential to break the gendered divisions of paid and unpaid labour. In this view, widening labour market opportunities for both women and men would be accompanied by a more equal division of responsibility for the household and the family, and by improved conditions for commuting by public transport. Drawing on theories concerning gender and mobility, this paper explores these two scenarios in two Swedish city regions using the findings from a questionnaire survey and interviews carried out in the two regions. The paper is structured as follows: it begins with a short presentation of the two city-regions, followed by a brief discussion of

gender and mobility. Next the two scenarios are presented and analysed and finally some conclusions are drawn.

SWEDISH CITY-REGIONS: GÖTEBORG AND UMEÅ

This paper is based on a study of two rapidly growing Swedish city-regions[1]. Göteborg city-region is an expansive local labour market and is the third largest city-region with a population of 950, 000. It is comprised of the central municipality of Goteborg and 12 peripheral municipalities[2]. Umeå city-region is much smaller in population terms but is one of Sweden's fastest growing city regions and is a key city region in the far north of Sweden. It has a population of 202, 000 and comprises the central municipality of Umeå and 6 peripheral municipalities[3]. These regions coincide roughly with the commuting area around both cities and in both cases the main direction of travel to work is into the regional centre. In Umeå's case, the city region matches the local labour market region. In Göteborg's case, the local labour market comprises an additional 5 municipalities. These were not included in the survey as they were not part of the regional co-operation known as *Göteborgsregion*. A questionnaire survey of 6000 citizens[4] aged 16-85, with a 60% response rate[5], was carried out in the two city-regions in 2010[6]. In addition, 24 interviews (12 in each region) were carried out in order to get a deeper understanding of the consequences of commuting for the division of household responsibilities and on leisure activities. The regional growth programmes covering both city-regions (*Region Västerbotten* 2011; *Göteborgsregionen* 2006, 2010) prioritize regional enlargement and focus on investment in infrastructure and city development. However, there is no analysis of the gendered consequences of regional enlargement and gender equality is not problematized, but is simply included as part of the goal of sustainable development.

GENDER AND MOBILITY

Hjorthol (2008) suggests that men and women's daily mobility can be seen as a "barometer" of the state of equality between women and men in society. The power relations relating to gender, class, ethnicity and education embedded in mobility cannot be ignored when focusing on commuting (Uteng 2009). Accordingly, drawing on Uteng & Cresswell (2008), we locate

[1] These were chosen as part of a larger study of the importance of size for regional identity and engagement in politics. Göteborg region is one of Sweden's major city regions and Umeå region is one of the smaller city regions.

[2] Ale, Alingsås, Härryda, Kungsbacka, Kungälv, Lerum, Lilla Edet, Mölndal, Partille, Stenungsund, Tjörn och Öckerö. Area 3 695 km²

[3] Bjurholm, Nordmaling, Robertsfors, Vindeln, Vännäs and Örnsköldsvik. N.B. Örnsköldsvik municipality was not included in the survey as this only became part of the Umeå region 2013. Area without Örnsköldsvik 9 312 km² (with Örnsköldsvik 15 688 km²).

[4] 2000 in Göteborg municipality and 2000 in its peripheral municipalities; 1000 in Umeå municipality and 1000 in its peripheral municipalities.

[5] Similar response rates were obtained in both city-regions, however, women and older people were overrepresented in the replies, accordingly weighting variables were used to compensate.

[6] Umeå city region, particularly the peripheral municipalities, were over represented in relation to population size, accordingly a weighting variable was used to compensate.

commuting within a larger framework concerning the social, cultural, technological, infrastructural and political aspects of mobility. Thus

> "Understanding motility ... means understanding the observable physical movement, the meanings that such movements are encoded with, the experience of practicing these movements and the potential for undertaking these movements" (Uteng & Cresswell 2008: 2)

We see mobility as gendered, producing and reproducing gendered power relationships in society. Masculinity tends to be coded as mobile and active and femininity as stationary and passive, thus opening and constraining possibilities for subjectivities and who can be the active citizen. The female body is often constructed as more spatially circumscribed (Sheller 2008; Hanson 2010). Girls and boys tend to be socialized into different capabilities for mobility with girls associated with more sedentary activities, more limited uses of space and greater risk aversion (Young 1990). In drawing attention to the different ways in which girls and boys move, Young is not suggesting that women should simply be seen as static and men as mobile, but rather that mobility is embodied and enacted different ways. This difference "acts to reaffirm and reproduce the power relations that produced these differences in the first place" (Cresswell & Uteng 2008:3), which has implications for women's mobility in relation to the labour market and commuting, to where and how much women work. In Sweden, for example, women are economically active to almost the same extent as men, but the labour market is highly gender segregated with women working in the caring services, frequently in low paid occupations with very "local" labour markets. Thus women tend to work "close to home" more often than men.

THE TWO SCENARIOS

Turning to Sweden, and in particular our study of two city regions, we now examine two scenarios – one more negative and one more positive.

Scenario 1: Left Holding the Baby

Even in a supposedly gender-equal country like Sweden, women have typically been regarded as less mobile than men and the female body is often constructed as more spatially circumscribed and place bound. A "masculine" construction of commuting as a necessary evil for male career advancement (reinforcing the male bread-winner model) seems to predominate. In this scenario, men commute further/longer in pursuit of their careers. Women, on the other hand, are left "holding the baby", taking the main responsibility for the home and the family, often while also engaged in paid (part-time) employment which is restricted to close-to-home opportunities because of their caring responsibilities. As Forsberg (2005) points out, many regional political actors have an overly positive view of the benefits of regional enlargement and fail to see the gendered consequences of increased commuting for individuals and households in their everyday living (Gil Solá, 2013).

Compared to many other countries, Sweden has a large proportion of women in the workforce and the female economic activity rate is nearly as high as the male. In 2011, the economic activity rate was 82 % for women aged 20–64 and 89% for men, but women work part-time to a much greater extent (32% compared with 10% for men) (Statistics Sweden 2012). However,

as the official government report SOU 2005:66 points out women's increased participation in paid work outside home has not been matched by men's engagement in child care and household labour. In other words, women still tend to take the main responsibility for the home and for childcare (Scholten & Jönsson 2010) and thus may face a double burden (Bergström Casinowsky 2010). Indeed recent research from Sweden, on the gendered aspects of commuting, suggests that regional enlargement may serve to reinforce traditional gender roles (see Friberg 2004, 2008; Scholten & Jönsson 2010) and, in effect, essentialize women as 'mother' and 'care giver'. Further, the construction of women's place as in the home i.e. the private sphere and men's as in the public and where the public space is portrayed as fearful and dangerous for women can also have consequences for their mobility. The threat of violence often serves to make women more risk-averse and limit their mobility and hence their commuting patterns (Andersson 2005). A number of studies (e.g. Friberg 2004, Hanson 2010, Sandow 2011) point out that there are variations in commuting between different groups in society and women have been shown to be less likely to commute than men and if they do, more likely to commute only shorter distances (NUTEK 2002).

A further explanation may lie in the highly gender segregated Swedish labour market and differences in labour markets[7] for women and men, with those for men being geographically larger and fewer. Although the number of labour market areas for both women and men more than halved during the period 1970 to 2005, they have reduced faster for men, particularly highly educated men. Larger local labour markets are seen as facilitating specialization, especially for men (Västra Götalandsregionen 2003). Women, on average, commute less than men regardless of income level, thus their labour market regions are smaller and greater in number (Vägverket 2005) and in 2005 were 98 for women compared with 68 for men (Gil Solá 2009). There is also a difference in the number of labour markets according to the level of education with both higher educated[8] women and men having larger and few labour markets (see Table 1 below).

Table 1: Number of Labour market regions in Sweden 1998/99 by sex & level of education

Level of education	Women	Men	All
High	81	47	71
Low	142	98	124
All	107	79	100

Source: Reworked from Västra Götalandsregionen 2003, based on Statistics Sweden

In 2010, 53% of gainfully employed women worked in the private sector and 47 % in the public sector whereas the figures for men were 84% and 16% respectively (Statistics Sweden

[7] The labour market areas (LMAs) are constructed by Statistics Sweden (a government agency) using statistics on commuting between municipalities. Changes in the number of LMAs have been used as a measure of regional enlargement. This has been rapid during the last 20 years when the number of labour market areas has decreased by almost 30 percent (SCB 2010).

[8] Above secondary level schooling.

2012). In the past, women have tended to work predominantly in the public sector where much of this employment has been in local government in schools, nurseries, and health centres and these are found in every municipality which means that their employment is more local in nature (Friberg 2008), making it possible for most women employed in these categories to work in the municipality where they live. Further, a nurse, a nursery school teacher or a primary school teacher is unlikely to increase her/his pay by increased commuting (Vägverket 2005). In 2010, only 24 % of women working in the public sector commuted to another municipality (Håkansson, 2010). There are, however, suggestions that this is changing and Statistics Sweden reports that the numbers commuting daily to work in another municipality increased by 44% for women and 28% for men between 1988 and 2008. Wages are more differentiated in the private sector than the public which favours increased commuting even for women (Vägverket 2005). In the case of those employed in the private sector, women's commuting has come much closer to men's - 33% for women compared with 35% men in 2010 (Håkansson, 2010).

However, despite the faster rate of increase for women, men still account for almost 60% of those commuting over municipal boundaries (Håkansson, 2010). Further, although women's commuting has increased in recent years, their "action space" is still considered to be much more limited than men's as they continue to take greater responsibility for the home and family. This can reduce their labour market choices and reinforce gender differences (Hjorthol 2008), thus men are considered to have benefited most in terms of career opportunities from regional enlargement (Gil Solá, 2009). In other words, some individuals are more mobile than others and have greater choice and opportunities when it comes to deciding where they want to live and work. This suggests that not everyone will be advantaged to the same extent by regional enlargement or have equal possibilities to take advantage of expanded labour markets (Adolfsson Jörby 2005). Our study of Umeå and Göteborg city regions showed that, in keeping with the rest of the country, men are still more likely to commute than women (see Table 2). The difference between women and men is less in the Umeå region than the Göteborg region, possibly because most of those who commute within the Umeå region work within the public sector. The universities and regional hospital are major employers for both women and men. Those commuting outside the region are mainly employed in the private sector which accords with the general tendency for those working in the private sector to commute further than those employed in the public sector. Interestingly, in the Göteborg region, it is almost as common for both partners to commute as it is for the man to be the sole commuter. This may well relate the fact that Göteborg region is a more densely populated urban region with better a developed public transport system which facilitates women's commuting as our survey also showed that women tended to use public transport to a greater extent than men.

Table 2: Commuting over municipal boundaries[9]: Commuting patterns in pair relationships in Umeå and Göteborg city-regions (percentages)

	All respondents	Umeå city-region	Göteborg city-region
Only the woman commutes	12.7	7.7	13.4
Only the man commutes	20.9	10.0	22.6
Both commute	18.9	5.0	21.1
Neither commutes (over the city boundary)	47.5	77.3	42.5
Sum	100.0	100.0	100.0
N	1585	860	725

Note: It has been assumed that the pair relationships are between a man and a woman

There are also differences in both attitudes to and modes of transport used between women and men (SIKA 2002). Men generally have greater access to motorized transport and more frequently commute by car whereas women are more positive towards public transport and use it to a greater extent. Women's journeys to work are often more complex and multipurpose reflecting the need to co-ordinate dual roles as mothers and wage-earners – for example, taking children to day care/school then on to work, later collecting children, shopping and home (Friberg et al., 2009). A number of studies indicate that having small children under school age may also reduce the tendency to commute (see Sandow 2011). As mentioned above, women are still mainly employed in low-income occupations and/or work part-time to a much greater extent than men (Statistics Sweden 2012), which make long-distance commuting less economically worthwhile and attractive than it is for men with their normally higher-income occupations (Gil Solá, 2009) and fulltime employment. The more even distribution of employment in "typically" female employment such as retail, education, and health care can enable women as a group to work closer to home and commute shorter distances.

Further, there are still differences in norms between women and men concerning good parenting (Bergström Casinowsky 2010) making it easier for men to combine a career and family life and thus to commute to work. As Sandow (2011) shows, long-distance commuters are most likely to be men, have a high level of education and work in the private sector. There tend to be fewer socio-economic gender differences among long-distance commuters compared with women and men commuting short distances. She also points out that long-distance commuting tends to be associated with higher earnings; but, because men dominate this category, they benefit economically correspondingly more than do women. Although

[9]This is the definition of commuting used by Statistics Sweden. The municipalities in the Umeå region are much larger in area than those in the Göteborg region. E.g. Umeå municipality has a population of nearly 120 000 and an area of 2 317km^2 while Göteborg has a population of over 500 000 and an area of only 451 km^2. This can help to understand why fewer "commute" in the Umeå region. However in both cities over 40% of commuters are women (SCB Kommunfakta 2013).

commuting to work can be advantageous in terms of income and career opportunities, it can also mean less time for family and friends and can lead to stress and health problems. It can also lead to relationship problems and, according to Sandow (2011), the risk of separation is 40 percent higher among long-distance commuters than among other couples.

As mentioned earlier, local labour markets have enlarged to a greater extent for men than women leading to a greater tendency for men to commute longer distances. As long-distance commuting reduces available family time, the non-commuting spouse often takes on a larger share of household commitments. Sandow (2011) shows that men's long-distance commuting may, therefore, serve to reproduce and reinforce traditional gender roles on the labour market and within households. She suggests, on the other hand, if more women commute long-distances, this might lead to more gender equal relationships in the labour market and within households (Sandow 2011). However, the findings from Bergström Casinowsky's (2010) study of work related travel and the gendered division of domestic responsibility do not support this. She found that when the work traveller was a man, there was a reduction in his relative share of responsibility for the home and the family, but when the work traveller was a woman, the allocation of home-based responsibility remained largely unchanged. We have found a similar pattern in our study as the following quote and Table 3 illustrate:

> "It's mainly my wife who takes care of household matters. Partly because she's home much more than I am and partly because … well I'm out often in the evenings. She usually complains that I don't help … I mean I can do all that cooking, cleaning, washing and all that. But I'm away much more ... and she's home alone so she takes care of all that." Interview 2012, man aged 57, married, 4 grown up children, long distance commuter.

> "During the week my husband cooks and shops … but at the weekends I do most of the rest (housework) … and the fourteen year old (daughter) helps a little." Interview 2012, woman 49, 3 children 20, 14, 10 (eldest left home), long distance commuter.

Table 3: Division of household responsibilities, according to men and women (percent) in Umeå and Göteborg Regions, 2010

Household responsibility	I have the main responsibility, according to:		We share the responsibility, according to:		My partner has the main responsibility, according to:	
	Women	Men	Women	Men	Women	Men
Buying groceries	40.6	14.5	48.3	54.2	8.5	20.0
Cooking	50.0	11.5	38.0	43.3	9.7	42.4
Laundry	66.5	8.4	25.3	32.7	5.6	55.8
Cleaning	44.3	8.9	47.0	57.4	5.5	30.2
Repairs/maintenance	5.4	69.7	30.0	22.0	58.1	1.7
N	1267	1107	1267	1107	1267	1107

Note: The wording in the question was "Which one of you – yourself or your husband/wife/cohabitant/partner has the main responsibility for the following". The response alternatives were I; we share; my partner; not relevant.

The above table shows that the division of tasks in the household follows a traditional pattern in the sense that women have the main responsibility for most household activities, apart from those that concern repairs or maintenance. There is general agreement among men and women about this. Nevertheless, there are clear differences in how this is assessed by men and women. Both tend to overestimate their own contribution in the opinion of the opposite sex i.e. men's estimation of their contribution to the household is greater than women's estimation of men's contribution and vice versa. However, men are more likely than women to claim that household responsibilities are shared. Repairs/maintenance and laundry are the tasks that are the most unequally distributed, followed by (in this order) cooking, cleaning and buying groceries. Shared responsibility for cleaning and buying groceries is fairly common whereas it is less common that cooking and laundry are shared.

However, if we look at responsibility for household tasks and commuting (Table 4), it brings into question our argument that commuting reinforces the traditional gender roles. It appears to make little difference whether the man or woman commutes or not i.e. there continues to be a very traditional division of labour for unpaid work regardless of commuting. The only difference is when it comes to activities concerning children. Here there is a much greater propensity to share the task regardless of whether it is the man or the woman who commutes. The tendency is particularly noticeable when it comes to men who commute. This may be a necessity to enable both parents to commute and/or a way of compensating for being away from the children through travel to work.

Table 4: Commuting and household responsibilities Umeå & Göteborg Regions 2010

	Woman Commutes						**Man Commutes**					
	Yes			**No**			**Yes**			**No**		
Activity	Does self %	Part. does %	Share %	Does self %	Part. does %	Share %	Does self %	Part. does %	Share %	Does self %	Part does %	Share %
Food shopping	43	7	46	40	9	49	13	28	55	15	28	54
Cooking	45	11	41	52	9	37	12	38	47	12	44	43
Laundry	65	5	26	67	6	25	9	53	33	8	57	33
Cleaning	45	6	45	44	5	48	9.	32	53	9	29	59
Repairs	4	63	28	6	56	31	71	1	23	69	3	22
Leave/fetch child day care/school	8	6	24	8	2	15	4	6	31	2	4	15
Leave/fetch child from activities	7	5	33	8	3	15	7	3	37	4	3	18
Help child with homework	12	4	26	9	2	14	3	8	30	3	5	19

To try to understand the variation in responsibility an "I have the main responsibility-index" was constructed (explained in appendix) see Table 5 below

Table 5: Explaining variation in having the main responsibility for the household

OLS regressions, dependent variable: I have the main responsibility-index

	All respondents		According to female respondents		According to male respondents	
Constant	2.544***	1.869***	1.554***	0.552	0.987***	0.653*
Gender	-0.859***	-0.956***	-	-	-	-
Own commuting	0.012	0.014	0.049	-0.103	-0.027	0.072
Partner's commuting	0.214***	0.081	0.271**	0.015	0.131	0.075
Age	-	0.013***	-	0.024***	-	0.001
Have children age 0-16	-	0.151*	-	0.223*	-	0.009
Level of education	-	-0.087	-	-0.215**	-	0.018
Household annual income	-	0.051**	-	0.050	-	0.058**
Left-right position	-	0.030	-	0.078	-	-0.040
City-region	-	-0.066	-	-0.154	-	0.068
Centre-periphery	-	0.095	-	0.359**	-	-0.137
R Square	0.134	0.167	0.011	0.094	0.004	0.024
Adjusted R Square	0.132	0.161	0.009	0.082	0.001	0.009
N	1548	1301	843	692	704	609

Note: The coefficients are B values of OLS regressions. Levels of significance: *p < 0.05; **p < 0.01; ***p < 0.001. See appendix for explanations of the variables.

This table shows that women are consistently more likely to have the main responsibility for the household, even when controlling for other possible explanatory factors. If a woman commutes it does not make it more or less likely that she will have the main responsibility for the household. However if her partner commutes it becomes more likely that she will have the main responsibility. However, the impact of the partner commuting disappears when account is taken of other explanatory factors. For women, the likelihood of having the main responsibility for the household is reinforced by age, having young children, and level of education i.e. women who have the main responsibility for the household are mainly elderly or have young children or a low level of education. Men, on the other hand, are more likely to regard themselves as taking the main responsibility when the household income is high.

Further, living in the suburbs seems to be a "gender trap" for women. When all other explanations have been taken into account, women take the main responsibility for household matters if the family live in the suburbs. This coincides with findings from a study of the Copenhagen region. Naess (2008) showed that differences between women's and men's access both to job opportunities and leisure activities were considerably greater in the municipalities in regional periphery than in the central area. The smaller range of employment opportunities in the suburban municipalities meant that women's options in the labour market were considerably more limited than men's who had access to a much larger labour market.

Table 6: Commuting over municipal boundaries: Commuting patterns in pair relationships in core city and suburban municipalities (percentages)

	All respondents	Core city	Suburban municipalities
Only the woman commutes	12.7	10.8	15.2
Only the man commutes	20.9	16.7	26.5
Both commute	18.9	3.6	38.7
Neither commutes over municipal boundary	47.5	68.9	19.6
Sum	100.0	100.0	100.0
N	1585	860	725

Note: It has been assumed that the pair relationships are between a man and a woman

It is interesting to note from Table 6 that all types of combinations of commuting are more common among couples living in the suburbs than in city core. It is also decidedly more common that both the man and the woman in a couple commute in the suburbs than in the city. This seems to be part of an urban lifestyle particularly in Göteborg suburban municipalities, but is very unusual among those living in the central city municipality, particularly in Umeå.

Scenario 2: increased career opportunities

Having found that commuting does not necessarily affect the gendered distribution of household responsibilities, an another scenario is explored – a more gender equal alternative - in which unpaid caring work is shared more equally by partners/couples. In this scenario commuting becomes something positive opening up increased possibilities also for women in the labour market and improved career opportunities.

Associated with the development of city regions is investment in infrastructure to facilitate commuting by public transport as well as by car. The implications of this could be especially important for women as a group, particularly if improvements in bus and rail networks lead to greater opportunities to commute to work thus expanding women's labour market. As the number of women in the workforce has increased, women's overall travel patterns have begun to change and have begun to look more like men's (Scholten & Jönsson 2010). Increased possibilities for women to commute could have a positive effect in terms of opening up employment opportunities and challenging existing gender inequalities on the labour market (Sandow 2011). Indeed, there are signs that the gender gap in commuting is slowly reducing. Gil Solá (2013) looking at commuting generally in Sweden, shows how between 1994/95 and

2005/06, the different in the distance commuted by women and men has decreased in both absolute and relative terms (see Table 7).

Table 7: Journey to work: average distance and time 1994/95 och 2005/06, Sweden

		1994/95 %	2005/06 %	Absolute change over time, km	Relative change over time %
Journey length km	**Woman**	11.3	13.7	+2.4*	+21*
	Man	16.1	18.2	+2.1*	+13*
	Difference	4.8*	4.5*		
	Gender[10] Index	42 %	33 %		
Travel time, minutes	**Woman**	23	27		
	Man	24	27	+4*	+18*
	Difference	0.6	0.1	+4*	+15*
	Gender Index	3%	0%		

Source: Adapted from Gil Solá (2013: 104). Women 1994/95 n=4840, men 1994/95 n=5750, women 2005/06 n= 6780, men 2005/06 n=7550.
* Statistically significant difference, $p < 0.05$

A general trend in Sweden is that families with small children tend to move from the central city to the suburban areas. This is the case in both the Göteborg and Umeå Regions and has led to increased commuting in both regions. It is above all women who have increased their commuting in the last decade which has placed greater demands on public transport as women choose to commute by bus, train or tram to a larger extent than men (Fredberg 2012). Both the Göteborg and Umeå Regions are working to encourage commuting by public transport. Göteborg Region is a more densely populated region and has a well developed network of commuter trains and fast bus traffic that comprise the framework that link the various parts of the region (Göteborgsregionens kommunalförbund 2009). However, although more sparsely populated, even the Umeå region is working to encourage commuting by public transport through, for example, its *Be Green Umeå* project. In 2012, commuting by public transport reached an all-time high (Umeå Kommun 2013). An important contributory factor has been the development of a new railway line *Botniabanan* which has opened up rail connections

[10] Gil Solá (2013) uses the relative measure *gender index* to compare women's and men's journey times and distances. It is calculated as follows:

$$\frac{\text{Value for man} - \text{value for woman}}{\text{Value for woman}}$$

A positive value should be read as men commute X percent longer than women A negative value means that women commute further than men (Gil Solá ,2013: 82)

between Umeå, Nordmaling and Örnsköldsvik. This has expanded the Umeå Region labour market, particularly for women who account for the greatest increase in commuting between Örnsköldsvik and Umeå (Umeå Kommun 2013).

Other changes in society such as cutbacks in the public sector and privatization of welfare services may also have consequences for women's propensity to commute over the municipal boundary i.e. their work places may become less "local". In Sweden, prior to the 1990s, woman worked more in the public than the private sector. However, cutbacks in staff in both national and local government and the transformation of public utilities (such as the Post Office, and the National Telecommunications Administration) into commercial enterprises have meant that in 2010 women worked slightly more in the private sector than the public (Statistics Sweden 2012). In 1999, 53 % of women in employment worked in the public sector and 47% in the private. By 2010 the situation had been reversed and 53 % work in the private sector and 47% in the public. Men work mainly in the private sector, 80% in 1999 and 84% in 2010 (Statistics Sweden 2000 and 2010). The increase in women's employment in the private sector appears to be accompanied by a greater propensity to commute. In 2010, only 24% of women working in the public sector commuted over the municipal boundary compared with 33% in the private sector. This latter figure is approaching that for men i.e. 35% of men working in the private sector commuted in 2010 (Håkansson 2010). Indeed it has been shown that those women who commute longer distances are largely employed in the private sector and have a higher level education, compared to other gainfully employed women (Bengtsson 2008).

The belief that women tend to stop commuting when they start a family is also being brought into question. According to Bengtsson (2008), the commonly held view that it is only men who are long-distance commuters under a longer period and that women will stop when they start a family and have small children is challenged by the statistics on commuting. His study of Statistic Sweden's regional register of labour markets and employment shows that this is not the case. He found surprisingly many similarities between female and male long distance commuters. Indeed slightly more women (18%) than men (17%) had children aged 0-6 years, (although it should be noted that women only account for about 30% of long distance commuters). This seems to suggest that, contrary to the commonly held view, having children does not necessarily make it harder for women than men to commute long-distances to work.

Our study of the Umeå and Göteborg regions shows that while more women than men commute less than 5 kilometres and more men commute over 50 kilometres, there are very small differences between men and women who commute between 5 and 50 kilometres (see Table 8 below).

Table 8: Gender and Journey Distance (kilometres) Umeå and Göteborg			
Distance	**Women (% of total)**	**Men (% of total)**	**Total**
Under 5 km	31.8% (59%)	22.4% (41%)	27.2%
5-10 km	17.3% (50%)	18% (50%)	17.6%
10-30 km	33.2% (46%)	39.4% (54%)	36.3%
30-50 km	11.6% (51%)	11.4% (49%)	11.5%
Over 50 km	6.1% (41%)	8.8% (59%)	7.5%
Total	100%	100%	100%
N	2156		

When it comes to the length of time spent commuting, we found surprisingly few differences between women and men (see Table 9). One explanation may be that although women tend to commute slightly shorter distances than men, they choose slower methods of transport. Our study shows that it is more common, for example, for women to walk, take the bus or tram to work and that it is slightly more common for them to cycle. Although men and women take the train to roughly the same extent, it is decidedly more usual for men to drive to work (this is the predominant mode of transport for men) and it is more usual for women to be a passenger.

Table 9: Gender and Journey Time (minutes) Umeå and Göteborg			
Time	**Women (% of total)**	**Men (% of Total)**	**Total**
Less than 10 minutes	14.7%	14.5%	14.7%
10-20 minutes	29.4%	28.5%	29.0%
20-30 minutes	21.5%	22.5%	22.0%
30-40 minutes	14.9%	13.2%	14.1%
40-60 minutes	13.7%	14.1%	13.9%
Over 60 minutes	5.8%	7.2%	6.5%
Total	100%	100%	100%
Pearson Chi-Square	.237 (not statistically significant)		
Likelihood Ratio	.236		
N	2310		

These tendencies match the overall picture for commuting in Sweden. As Fredberg's (2012) analysis of Statistics Sweden's commuting statistics shows, taking the car is the dominant way of for commuting to work particularly for men in all types of municipalities. Commuters in the 3 major cities (Stockholm, Malmö and Göteborg) travel least by car, 50% of men and 25% of women (Fredberg 2012). Whereas the car is the dominant mode of transport in smaller,

more rural municipalities, where 80 % of men and 60% of women travelled to work by car. In total, 57 %of women and 72 % of men travelled by car for at least part of their journey to work, while the corresponding figures for using public transport were 28 % for women and only 13 % for men (Fredberg 2012).

Our study shows as do the statistical studies of labour market enlargement and commuting in Sweden in general, that women are increasingly economically active and increasingly commute (Bengtsson 2008, Håkansson, 2010Fredberg 2012). This would seem, at least on the face of it, to be enabling them to develop their career opportunities. However, if they still continue take the main responsibility for the home then there is a risk that commuting becomes a double burden. Turning to the latest time-use study carried out by Statistics Sweden (2012), this shows that women aged 20–64 have increased their gainful employment over the last 20 years by, on average, 3 hours per week from 27 hours in 1990/91 to 30 hours per week in 2010/11. Men have, on the other hand, decreased their gainful employment during the same period from, on average, 41 hours per week in 1990/91 to about 37 hours per week in 2010/11. Has this led to a decrease in women's and an increase in men's unpaid labour in the home? The overall figures for Sweden suggest that this has not happened. Women continue to spend more time on unpaid housework than men – although the hours spent have reduced from an average of 33 hours per week in 1990/91 to 26 hours in 2010/11. Despite working less in paid employment than 20 years ago, men have not increased their share of unpaid labour in the home which remains the same as in 1990/91 i.e. on average 21 hours per week.

Turning to the Umeå and Göteborg region, questions concerning responsibility for household tasks were used to construct a "we share-index" (see Appendix) (see Table 10). Five household tasks were included: food shopping; cooking; laundry; cleaning; and repairs/maintenance in the home. If all these tasks were shared the score was 5, if 4 were shared the score was 4 and so on.

Table 10: Explaining variation in sharing responsibility for the household

OLS regressions, dependent variable: We share-index

	All respondents		According to female respondents		According to male respondents	
Constant	2.242***	3.423***	2.636***	4.011***	2.553***	4.088***
Gender	0.246***	0.445***	-	-	-	-
Own commuting	-0.112	-0.110	-0.161	-0.018	-0.059	-0.200
Partner's commuting	-0.211**	-0.029	-0.269**	-0.091	-0.127	0.056
Age	-	-0.029***	-	-0.030***	-	-0.029***
Have children age 0-16	-	-0.227**	-	-0.246*	-	-0.196
Level of education	-	0.184**	-	0.203*	-	0.168
Household annual income	-	-0.018	-	-0.038	-	0.004
Left-right position	-	-0.072	-	-0.089*	-	-0.048
City-region	-	0.142	-	0.193	-	0.081
Centre-periphery	-	-0.299**	-	-0.352**	-	-0.238
R Square	0.017	0.110	0.015	0.121	0.002	0.086
Adjusted R Square	0.015	0.103	0.012	0.109	0.000	0.072
N	1548	1301	843	692	704	609

Note: The coefficients are B values of OLS regressions. Levels of significance: *p < 0.05; **p < 0.01; ***p < 0.001. See appendix for explanations of the variables.

Table 10 shows that own commuting does not make it more or less likely to share the main responsibility for the household, but if the partner commutes it becomes less likely that functions are shared. However, the impact of the partners' commuting disappears when account is taken of other explanatory factors. It is more likely that the responsibility for the household will be shared if you are young, have no young children, are highly educated or live in the city, rather than the suburbs. Interestingly, women on the left of the political scale more frequently state that the household functions are shared (whereas men are consistently more likely to claim that the household responsibilities are shared). This remains when controlling for other possible explanatory factors. This may reflect a more collectivist ideology in the family with the expectation that responsibilities should be shared rather than individualized. In the case of men, only young age significantly explains why they share the household functions. This perhaps gives some hope for changes in the future.

CONCLUSIONS

Neither scenario holds completely. It is still more common that men commute than women. Nevertheless, there are some signs that women are able to take advantage of regional enlargement and where there are good public transport systems, expand their job market. However, class plays a role here and those women who seem to be best able to take advantage are those with a higher education, working in well paid jobs in the private sector. A "commuting lifestyle" where both man and women commute is more common in Göteborg than in Umeå; and in the suburbs rather than in the city. This is possibly facilitated by the well-developed fast-bus/commuter train network, particularly given women's preference for commuting by public transport. These findings have implications for transport policy.

Surprisingly, our study shows that, while the division of tasks between men and women mainly follows traditional paths, this is not primarily related to commuting i.e. the gendered division remains regardless of commuting. Other factors appear to be more important - in particular, age, whether one has young children, level of education and household income. Being elderly, having young children, a low level of education and low household income are associated with women taking the main responsibility for the household. Residing in a suburb also significantly explains how household functions are divided with women more likely to take the main responsibility if the couple lives in the suburbs rather than the city core. Hence, commuting disappears as an explanation when other factors are taken into account. Particularly striking is that suburban living, rather than commuting, ties women to a traditional role.

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Appendix

Variables in the OLS regression analyses

Variable	Question/variable construction	Variable values
	Indicators of the dependent variables	
I have the main responsibility-index	*The number of household activities for which the respondent has the main responsibility compared to partner:* Buying groceries, cooking, washing, cleaning and repairs/maintenance.	Index 0-5
We share-index	*The number of household activities for which the respondent shares the responsibility with partner:* Buying groceries, cooking, washing, cleaning and repairs/maintenance.	Index 0-5
	Indicators of the independent variables	
Gender	*Are you a woman or a man?*	1 Woman 2 Man
Own commuting	*Are you commuting at least once per week for work/studies to other municipality than you home municipality?*	1 No 2 Yes
Partner's commuting	*Where does your husband/wife/cohabitant/partner work/study?*	1 In home municipality 2 In other municipality
Age	Number of years	18-
Children age 0-16 years	Has children in the age 0-16 years	1 No 2 Yes
Level of education	*What is your highest level of education?* Seven response alternatives were reduced to three for the analysis	1 Compulsory school, etc. 2 Upper secondary school, etc. 3 University, college
Household annual income	Total income for all persons in your household before tax (SKR)	1 = 100 000 or less 2 = 101 000-200 000 3 = 201 000-300 000 4 = 301 000-400 000 5 = 401 000-500 000 6 = 501 000-600 000 7 = 601 000-700 000 8 = More than 700 000
Left-right position	Self-assessed position on a left-right scale	1 Clearly to the left 2 Leaning towards left 3 Neither/nor 4 Leaning towards right 5 Clearly to the right
City-region	The city-region of the resident	1 Umeå city-region 2 Göteborg city-region
Centre-periphery	Location of the resident's home municipality in the city-region	1 The city of Umeå or Göteborg 2 Other municipality in the city-region

Cover letter

On the occasion of the comments of the reviewers we have adjusted some sections in the paper.
- In Section 1 we have described the goal of the study in a better way.
- In section 2 Data and Methodology we have split up the section into two subsections in order to structure the section in a better way.
- In section 2.1 we have added a paragraph about the qualitative data we have used. This will improve the understanding of the various travel patterns and the type of days in paragraph 2.2.
- In order to get a better understanding of the assignment process of the households to a type of day, we have added figure 2.
- In section 5 (Conclusions and discussion)more attention is given to daily scheduling in relation to congestion reduction

Families on the run: how do Dutch households with young children organize their travel behaviour?

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ABSTRACT
In many families with young children, parents face coordination problems in scheduling household transportation tasks, such as bringing children to a day care centre, combined with work-related travel. The increasing labour participation of Dutch women over the past decades has affected their individual mobility. Most Dutch women work part-time and the weekly organisation of days at work and away from work are often related to the organisation of school days. This implies that allocation of activities between partners becomes more and more important on days at which both partners work and children also have to be taken care of. From a mobility and transport policy perspective it is important to get insight in how parents with young children organize their travel behavior on weekdays, what bottlenecks they encounter and how they solve them. Current policy issues such as congestion reduction can benefit from this information about the level of flexibility in daily schedules.
In this paper we examine how parents with young children organise their mobility in terms of school and preschool (childcare) related travel in combination with their work travel. By using quantitative data from the Dutch National Travel Survey from 2004 to 2009, we identified three main travel activity patterns: the so called 'Combination day', a 'Care day' and a 'Work day. By analysing these 'time-space paths' we describe how households with different background characteristics organise their weekday mobility in terms of trips, distance travelled and journey times, modes of transport used, and temporal aspects of their particular time-space paths. These quantitative data were supplemented with qualitative data from interviews with parents in 33 households. We discuss the kind of constraints parents say they encounter in their weekly scheduling and which strategies they apply to fulfil their mobility patterns. The results are discussed in relation to a number of transport policy issues.

1. Introduction

Each day the parents of young children face numerous logistical challenges, requiring extensive coordination. The children must be brought to school or day care, the parents commute to and from work, the grocery shopping must be done, and all this must occur daily in a short timeframe. At certain times of the day, these households regularly experience hectic situations; consequently, they are often called 'rush hour' families.

Due to various societal processes, such as women's increasing participation in the labour market, the Dutch population's activity patterns have changed. The structure of daily life is now under intense time pressure (Olde Kalter, Harms and Jorritsma 2009). Today, a large percentage of parents have paid jobs outside the home (Cloïn and Souren 2011). Approximately two million parents between the ages of 25 and 45 years old wrestle with busy time schedules and the combining of work and family responsibilities. Consequently, it has become increasingly difficult for parents to coordinate their family's various activity patterns. This usually requires household members to adhere to a strict organisation of daily activity patterns, which involves complicated travel patterns and continuous deliberation about the use of various transport modes. Because people usually have a limited amount of time in which to travel to the various activity locations (schools/day cares, places of employment, afterschool care centres, etc.), cars are often the transport mode used, and also at times when the roads are heavily congested. This is especially the case for families with young children under the age of 12 years old.

Although women's labour market participation has increased over recent decades, the division of paid employment and providing care for children remains unequal among fathers and mothers. On average, fathers work longer hours and for more days in the week, while mothers devote more time to caring for children and also dropping off/picking up children (Cloïn et al. 2010, Cloïn and Souren 2011, Molnàr 2005). Moreover, women generally feel more responsible for caring for children, while men traditionally feel more responsible for providing the family income (Van Wel and Knijn 2006, Portegijs and Keuzekamp 2008, De Meester 2010, Cloïn and Souren 2011). These factors have resulted in differences in activity and travel patterns between fathers and mothers in families with young children.

From a mobility perspective it can be very useful to study activity and travel patterns of these households with their increasingly busy schedules, as these patterns may reveal to what level people have the flexibility to change their mobility behaviour. This also goes for the ways in which parents with young children mutually negotiate their weekly mobility (e.g., their transport modes), the various problems/limitations they encounter and the ways in which they currently deal with these limitations (see also Ettema and Van der Lippe 2009, De Meester and Van Ham 2009, De Meester 2010, Karsten 2003, Schwanen 2007). Current policy issues such as congestion reduction can benefit from this information about the level of flexibility in daily schedules.

This paper focuses on the daily mobility of two-parent families with children under the age of 12 years old. We specifically focus on how men and women divide the travel required for work and care-providing among themselves. The comprehensive results of these analyses are found in Jorritsma and Schaap (2012). In this paper, we first examine the data used and ways in which we have compiled the various types of travel patterns of young families. We provide a general overview of the mobility of young families in the Netherlands, in which the focus is on describing the mobility differences between men and women in young families. We then present our findings pertaining to the various types of travel patterns of young families, which also include gender differences, when relevant. Finally, we reach a number of conclusions and indicate whether the findings are important for policymaking, in terms of how they pertain to mobility questions.

2. Data and methodology

2.1 Data

From 33 in-depth interviews conducted with Dutch, two-parents families with young children (Blom and De Kleuver 2010), it was shown that some families had divided responsibilities among each other, while in other families, one parent combined child care travel with work travel. These different ways of organization showed varying divisions of parental duties and associated mobility. By combining this information, four types of travel patterns could be distinguished that had a relationship with the organization of travel for work and childcare:

- A work trip is combined with dropping off/picking up children at the same day
- A day-care trip is undertaken by one of the parents and is not combined with a work trip.
- A work trip is undertaken by at least one of the parents. No care trips are undertaken.
- No relevant trips are undertaken for work or care-providing.

In order to analyse these travel patterns for the Dutch population we used quantitative data. Because we study interactions between parents in households, mobility data for complete households (or at least all adults in the household) is needed. The only data source with a large enough sample that contains Dutch travel data for complete households was the Dutch National Travel Survey (MON), which is an annual study of travel behaviour of residents in the Netherlands, including travel purposes, origin and destination of the trip, travel modes, time periods and trip distances. Household and personal characteristics are also reported. Based on the research, statements can be made about all trips that begin and/or end in the Netherlands. This paper used the records dating from the years 2004-2009 (RWS /AVV 2004-2009).

The MON data set consists of data at four levels: data at the household level, at the individual level, at the level of trips and at the level of trip stages. All members of the same household can be traced back to that household. Due to this set up, the interaction between household members can be studied, as well as personal mobility at the trip or trip stage level. The data for every household was registered for one single day, so it includes no information about the previous or following day for any specific household.

2.2. Methodology

A central question in this research study is how parents divide the responsibility of dropping off/picking up children among themselves, and how they combine this with their work-related mobility. Due to this particular focus, only a part of all possible households were included in the study, and of those households, only the trips related to child-care or professional activities were selected. The households selected were those with at least one child aged 12 years or younger. Furthermore, only trips undertaken during weekdays (before 19:00) were included, and specifically those between home, school/day care, places of employment, and combinations thereof. Moreover, national holidays and vacation days were excluded. The selection on which the analyses were based comprises the daily records of 34,730 parents.

These analyses differentiate between the parents' various types of travel patterns. Figure 1 shows an example of a travel pattern. This is a series of trips in which the point of departure is the home address, and one or more journeys are combined in order to carry out the various activities.

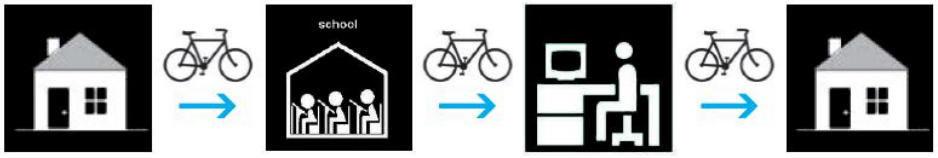

Figure 1. Travel pattern of one parent who brings his/her children to day care or school by bicycle, and then immediately continues on to work, before ultimately returning home

The first challenge in this study was to classify the different types of travel patterns of parents that were relevant for our study. The number of distinct travel patterns can be quite large, even with the limitation of destination types that was made. A classification is useful if it , on the one hand does not consist of too many segments, and if these segments are on the other hand meaningful and distinguishable. Two aspects of the organization of responsibilities are clearly related to our research question: whether a parent travels to work on a given day, and whether a parent brings the children to school or day-care and/or picks them up again. The division of responsibilities between parents and within the family on any given day determines how the type of day is classified.

As explained before, in some families one parent combined bringing the child(ren) to school or day-care facility with travelling to work, while in other families, these tasks were divided evenly among the parents. In other families, the children were either too young or too old to be brought to school (or were taken to school or day-care by a person from outside the family for another reason). A day-to-day variation could also be seen, so the responsibilities were not always the same on any given day.

Based on the organization of responsibilities we assigned the different types of travel patterns to households. First, if on the registration day at least one of the parents took the children to school, the whole household was classified into the group of families with child care travel (Figure 2). Next it was determined whether any of the parents travelled to work. By combining the information (occurrence of travel for child care, occurrence of travel for work), it could be determined whether a combination of responsibilities or a division occurred. This led to a classification of the whole household based on the travel patterns of individual parents within those families on the given day. As these classifications only contain information about one single day, the classifications were called "type of day". Figure 2 visualizes the classification process.

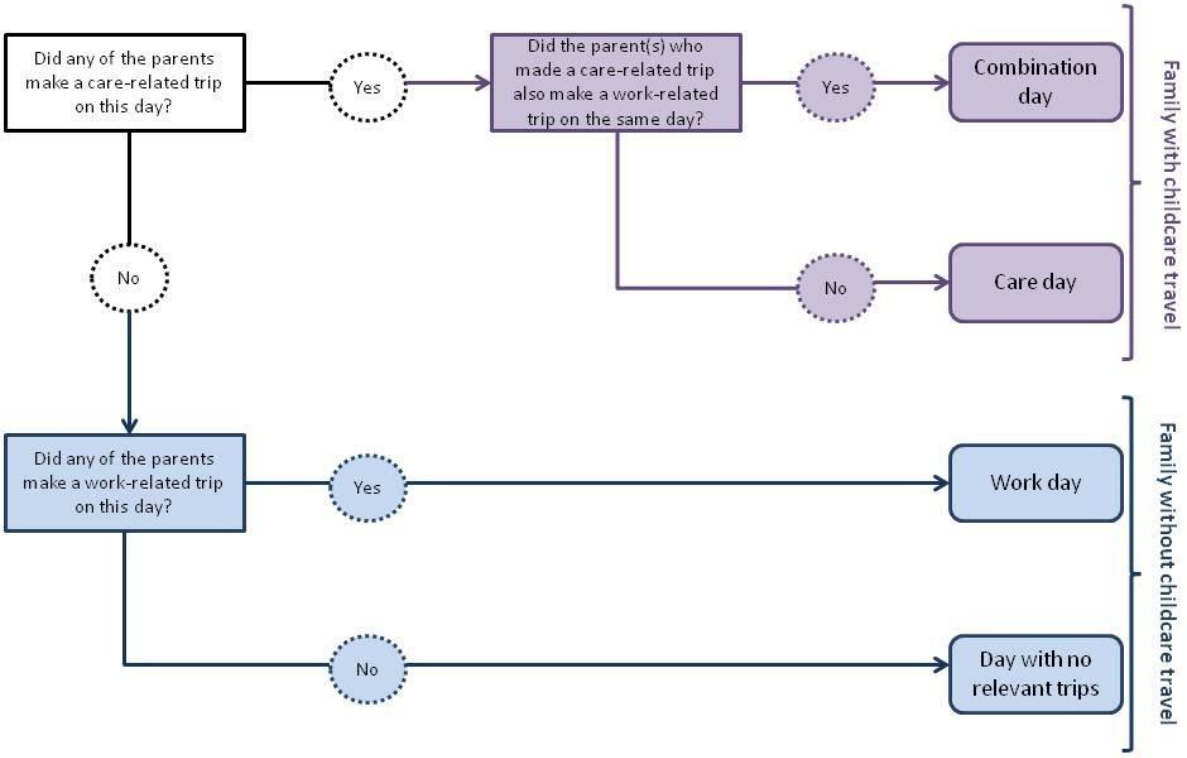

Figure 2. Classification process for households into combination day, Care day, Work day and day without relevant trips.

The four types of day are: [a] the Combination day, in which at least one parent combines travelling to/from work with dropping off/picking up children at the same day; [b] the Care day, in which the parents do not combine a work trip and a care-providing trip, but nonetheless a child is dropped off/picked up by one of the parents (the other parent might travel to work); [c] the Work day, in which a child is not dropped off/picked by a parent, but a home-to-work commute is undertaken by at least one of the parents; and [d] a day without relevant trips undertaken for work or care-providing.

So, when a combination of work and care-providing is performed by one and the same parent on the given day, the entire household is deemed to have had a Combination day on this day and it is therefore no longer classified in another category. The travel pattern of the other parent is no longer used for further classification. Subsequently, the Care day is classified, and a household in which no children are dropped off/picked up is assigned to one of the latter two categories.

The various types of travel days occur with varying frequencies in households with young children. By far the most days (42%) fall under the Work day category, in which at least one parent travels to work but no children are dropped off/picked up from school or day care. The days in which neither parent undertakes a work-related or care-providing trip only occur 12% of the time. Figure 3 shows the share of the various types of travel days.

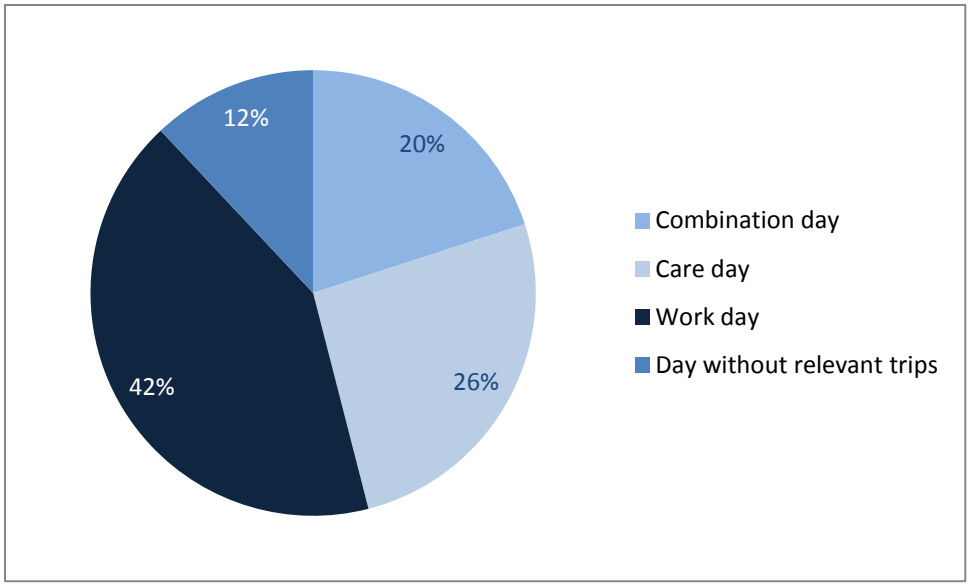

Figure 3. Types of travel days of Dutch households with young children.

In the following section we first examine the general differences between mothers and fathers of young children. How do their activity patterns differ, and what does this mean for their mobility? We then return to the types of travel days of Dutch families. After we have described the general characteristics of these families, we identify gender differences in terms of responsibilities and mobility characteristics.

3. Mobility of mothers and fathers in Dutch families with young children

Children live at home in one-third of all Dutch households. Two-parent families constitute 28% of all Dutch households, while 6% are one-parent families (Figure 4). Nearly three-quarters of all two-parent families include children aged 12 years or younger.

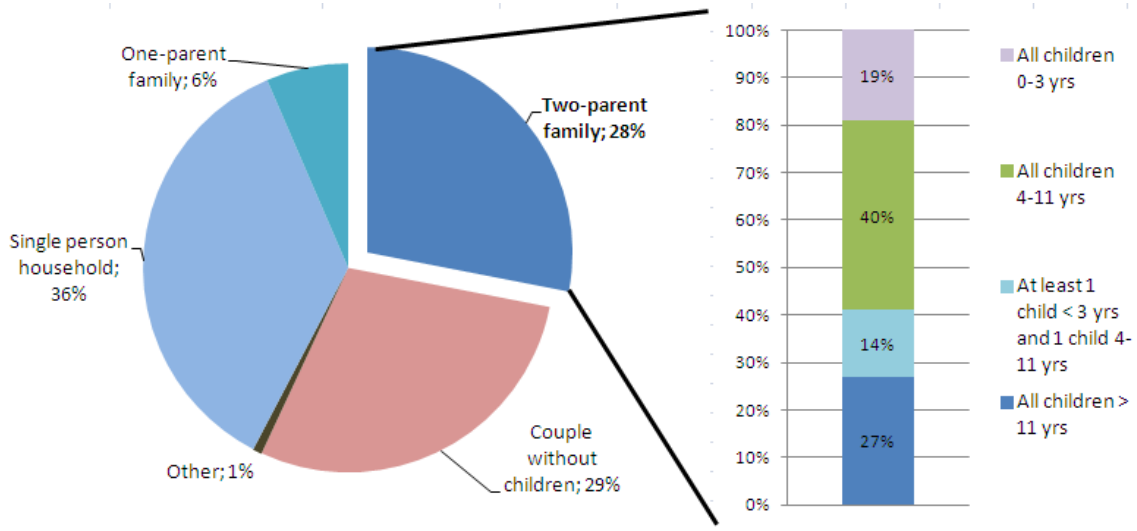

Figure 4. Composition of households in the Netherlands and the age categories of children in two-parent families, 2010 (in percentages)

Trips: number, distance and duration

Over the past decades, gender differences in mobility behaviour have decreased. For men, the average number of journeys undertaken decreased between 1985 and 2007, while for women this number increased slightly (Olde Kalter et al. 2009). The average distances travelled by women also increased, as did the amount of time they spent travelling. Men however continued to travel greater distances and for

longer amounts of time than women, but the difference became smaller (Gossen and Purvis 2004, Rosenbloom 1996). This development was primarily due to women's increasing labour market participation, increasing possession of drivers' licences and increasing levels of education in the Netherlands (Olde Kalter et al., 2009).

It is primarily single people and people without children who make the largest contribution toward narrowing the so-called 'gender gap'. For the fathers and mothers of young children, these developments occurred more slowly. Supported by Dutch travel data from the years 2004-2009, in the following section we provide a concise overview of the current mobility situation for Dutch parents and also denote any discernible gender differences.

There are indeed discernible differences between parents with young children and the average Dutch household, just as there are clear gender differences within these families. Mothers with young children for example undertake relatively much shorter trips. Although they undertake more trips per day than fathers, mothers with young children travel some 20 minutes less per day, and on average travel fewer kilometres than fathers. Comparatively, fathers work further away from home than mothers, with fathers having an average home-to-work travel distance of 22 kilometres, which is 9 kilometres more than that of mothers, and fathers also travel approximately 7 minutes more to and from their places of employment. The difference in home-to-work travel distances between fathers and mothers has not changed significantly since the late 1990s (CBS 1985-2003; RWS/AVV 2004-2009). Table 1 presents various figures pertaining to the mobility of Dutch mothers and fathers and compares these to the mobility of average Dutch adults.

Table 1. Mobility behaviour of parents with children younger than 12 years old as compared to all Dutch adults. Source MON 2004-2009

Mobility behaviour	**Fathers**	**Mothers**	**All men ≥ 18 yrs. Old**	**All women ≥ 18 yrs. old**
Average number of trips per person per day	3,5	4,4	2,9	2,9
Average distance travelled per person per day (km)	57	28	39	29
Average journey time per person per day (minutes)	82	60	84	72
Average home-to-work distance (km) (only working people)	22	13	22	9

Division of duties

Between 2001 and 2009 the labour market participation of mothers with young children increased from 56% to 71%, while over the same period the labour market participation of men remained virtually unchanged (Olde Kalter et al 2009). Consequently, in increasing numbers of families both parents worked during more days of the week (Cloïn and Souren 2011). Nevertheless, fewer mothers worked than fathers, and gender differences were discerned in the number of contractual hours, the home-to-work travel distances, and the division of other duties within the household (such as caring for children). It appears, for example, that fathers on average worked for more hours and days in the week, and that mothers spent more time caring for children and more often dropped off/picked up their children (Cloïn et al. 2010, Cloïn and Souren 2011, Molnàr 2005). On days in which both parents went to work, these parents would more equally divide the care-providing duties among themselves (Ettema and Van der Lippe 2009).

Table 2 shows the distribution of labour participation of parents in Dutch households with young children (0-12 years). Only 10% of these parents, both male and female, participate in full time jobs and only 2% of the women have full time jobs of 35 hours per week in combination with a partner working part time. The

majority of these women work in part time jobs. It is obvious that mothers in households with young children make less working hours than men, although the total amount working hours of women has doubled since 1996, from 10 hours a week to 20 hours a week on average (Statistics Netherlands 2013).

Table 2: distribution labour participation, parents in households with young children(0-12 years), Netherlands 2012. Hours per week. Source: Statistics Netherland 2013.

Both spouses working						
	Fulltime-parttime					
Total fulltime - fulltime	Male > 35 hours; female 20 to 35 hours/week	Male > 35 hours; female 12 to 20 hours/week	Female > 35 hours; Male20 tot 35 hours/week	Parttime parttime	One of the spouses working Part time	None of the spouses working
10%	52%	17%	2%	10%	6%	4%

The dropping off and picking up of children from school/day care was more often done by mothers than by fathers. Mothers dropped off/picked up children on average 3.5 times more often than fathers. There is a strong correlation between the mothers' shorter home-to-work travel distances and the fact that they more often combined work and care-providing duties. Moreover, mothers were also more often the ones who responded to emergencies, such as picking up their sick children from day care (Portegijs et al 2006).

Transport mode use

Gender differences also have an impact on the transport modes used by mothers and fathers with young children. Mothers have a larger role in dropping off/picking up children and in household duties, such as grocery shopping. For travel in the immediate residential area, the choice is often for slower transport modes, and this is indeed revealed in the statistics: fathers used cars for nearly two-thirds of their trips, while for mothers this percentage was markedly lower (see Table 1). Mothers clearly made more use of bicycles or walking for their trips.

For commutes to and from work, cars are the most frequently used transport mode, which is the case for both fathers and mothers (Figure 5). Mothers make relatively more use of bicycles. Given the large difference in average home-to-work travel distances between fathers and mothers, the difference in transport mode use is remarkably small.

Today, children are primarily dropped off at school or day care by car or bicycle (Figure 5). Mothers opted to use slower transport modes (bicycle or walking) 62% of the time for drop off/pick up trips. Fathers on average used cars just over half the time. Because mothers more often drop off/pick up children, children in the majority of cases either bicycle or walk to and from school.

There is however a development to be discerned in this, namely involving the mothers: since the mid- 1990s, the percentage of trips undertaken with mothers as car drivers increased from 28% to 38% (CBS 1985-2003; RWS/AVV 2004-2009). This increase comes mainly at the expense of trips undertaken as car passengers. For fathers the percentage as car drivers has remained relatively constant. That mothers increasingly travel as car drivers, and increasingly less often as car passengers, is related to women's increasing rates of driver license possession and car ownership, as well as to women's increasing labour market participation (Jorritsma et al. 2010).

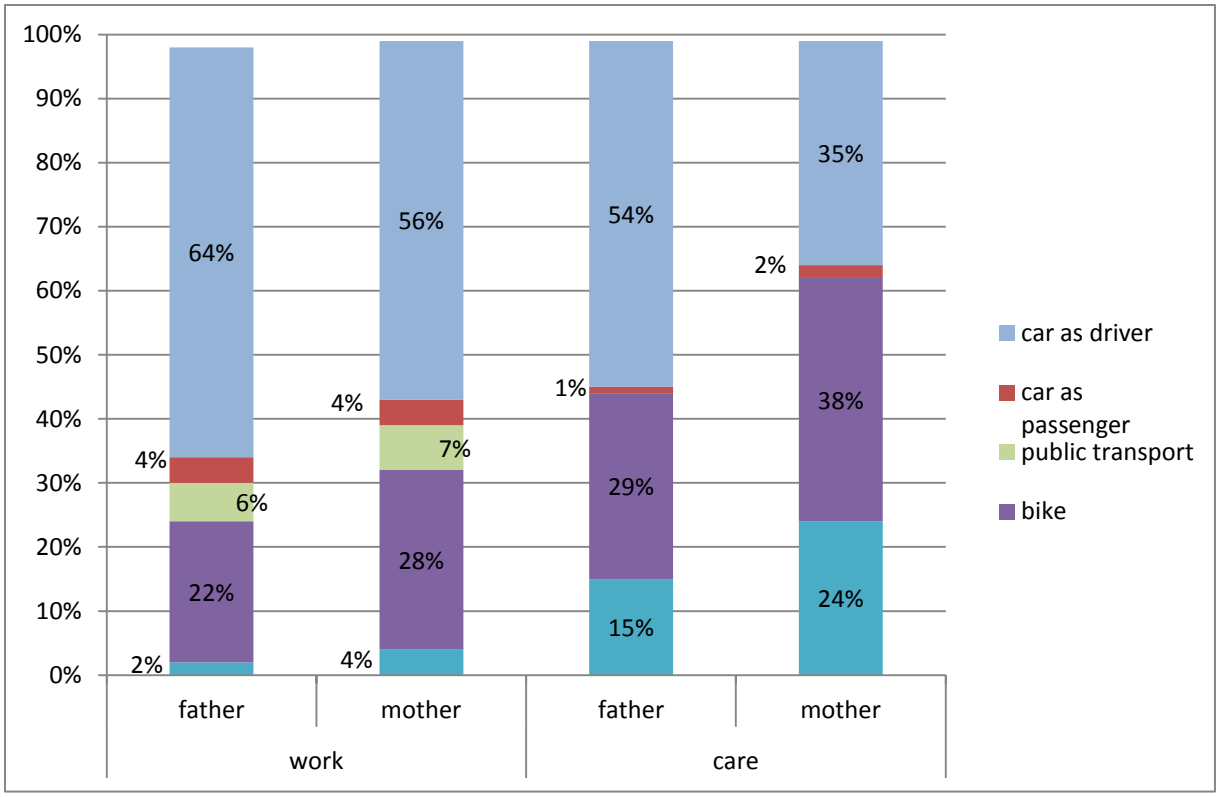

Figure 5. Share of transport modes for trips related to care-providing and employment for Dutch mothers and fathers with young children.

4. Types of travel days in Dutch families

Parents often travel to drop off/pick up their children, but do they also have to travel to their work place? How often do parents travel directly to work, and are they not responsible for their children's transportation? Are there differences depending on the day of week? Which transport modes in the various day types are most popular among parents? And, in conclusion: what are the discernible differences between men and women?

The Combination day

When at least one parent during the same day combines a drop off/pick up children trip with a commuting trip, this household is deemed to have had a Combination day. Notably, in most families that are classified in the Combination day on their day or travel registration, (62%) both the father and mother work outside the home and on the same day drop off/pick up their children. Although individual parents combine their responsibilities on one day, there is still a division of responsibilities within the family: one parent brings the children to school in the morning and consequently travels to work, while the other parent travels to work directly; on the way back, the other parent picks up the children, while the first parent can travel directly from work to home.

In 26% of cases only one parent combines the commute to/from work with the drop off/pick up of their children, while the other parent during the same day only engages in home-to-work mobility. The situation wherein one parent does not work outside the home while the other parent still combines his or her work commute with the drop off/pick up children, is rare (in 9% of families).

Combination days occurred most frequently on Mondays, Tuesdays and Thursdays, which corresponds to the days in the Netherlands when both parents are most often engaged in paid employment. An important difference between men and women was discernible on Combination days. In nine out of ten households in which both parents commute to their places of employment, mothers dropped off/picked up their children considerably more often than fathers. Three factors play a role in this: mothers more often work part-time and consequently are more flexible, they more often work closer to home and they more often feel themselves responsible for caring for their children.

Parents' average mobility levels on Combination days is higher than the average mobility levels of all two-parent families in the Netherlands, as they undertake more trips, travel more kilometres and spend more time travelling per day (Table 3). This greater mobility is a result of the larger number of activities that these households engage in during a single day. In addition, it is possible that the set opening and closing times of day care facilities and schools (precisely during rush hours) have an effect on travel times, whereby parents have less flexibility in the travel time they have for dropping off/picking up their children. Consequently, these parents are less likely to have the opportunity to avoid rush hours, and thus their travel times increase. Moreover, the average distance travelled to day cares and/or primary schools is approximately 2.9 kilometres, which is slightly more than the average of 2.5 km for Dutch families with young children. Children's out-of-school care facilities, such as day care and after-school centres, which parents often use on days that they (both) work, are situated slightly further from home than primary schools (Van der Klis et al. 2011).

We see significant differences in travel behaviour between the spouses on a Combination day especially concerning the distances travelled. Females in households with a Combination day travel only 13 km to their work location as for men this is 20 km. Since women make also more trips then men their average trip length is shorter.

Table 3: Mobility behaviour of parents on a Combination day

	Combination day			**NL families with children < 12yrs**		
Mobility behaviour	**House-hold**	**Male**	**Female**	**House-hold**	**Male**	**Female**
Trips per person per day	4.8	4.3	5.4	4.0	3.5	4.4
Distance per person per day (km)	49	60	37	43	57	28
Journey time per person per day (minutes)	83	89	76	71	82	60
Average distance to work (km)	17	20	13	18	22	13
Average distance to day care / school	2.9			2.5		
Modal share of parents dropping off/picking up children						
Car	57%	64%	54%	46%	55%	37%
Public transport	1%	0%	1%	0%	0%	0%
Walking/cycling	40%	35%	45%	53%	44%	62%

For families having a Combination day, cars are the most often used transport mode for dropping off/picking up children (57%) and approximately 40% of trips to and from day-care centres and schools however are undertaken by bicycle or walking. Public transport is seldom used (1%) for dropping off/picking up children (Table 2). Women are using active modes of transport for dropping off/picking up children more often than men do (45% versus 35%). Men on the other hand are using the car more often for this purpose (men: 64%, women: 54%). Cars are the most often used transport mode for commuting to work (65%); the percentage of parents who cycle or walk on Combination days is lower – approximately 25%

As many as 55% of these households own two cars. That number is relatively high compared to the average Dutch households with young children (48%).

The pattern of care-providing travel on a Combination day differs considerably from the transport mode use of the average Dutch household with children younger than 12 years old. In this second group of households, the car is less dominant for care-providing trips (46%), with the slower transport modes prevailing (53%).

A large percentage (60%) of the parents engaged in a Combination day travel directly to their workplaces after dropping off their children at day care or school. These parents primarily use cars for their commutes, with approximately 20% opting for bicycles. The other 40% of parents first return home after dropping off their children at day care/school, and more than half of these parents (57%) will then change their mode of transport before travelling on to their workplaces. The combination 'car and bicycle' and 'car and walking' are the most frequent (33%) combinations. The majority of parents use slower transport modes (bicycles and walking) to drop off/pick up their children, and cars for commuting to and from work. Parents that return home and do not change transport modes use bicycles proportionally more often (36%), while 10% opt to walk.

An interesting observation from our analysis is that women are more involved in combining day care trips and working trips then men. About 50% of the men in this type of day do not combine a day care trip with a working trip, whereas only 22% of the women do not combine both trips. From this observation it is likely that women have more responsibilities (or take more) for taking care of the children on a Combination day. An explanation for this observation could be that women are more involved in part time jobs than men or women have more opportunities to drop off/ pick up the children from school or day care centre because of the shorter distance to their work location.

The Care day

A household is deemed to have had a Care day when one of the two parents travel to drop off/pick up their children from day care and/or school, but does not combine this with a commute to work on that same day. In approximately half of the households (55%), both the father and mother do not commute to work on a Care day. That is a relatively large number, given that the employment rate of Dutch parents is higher than 55%. For 40% of households on a Care day, one parent travels to work, but without combining this with a drop off/pick up, while the other parent only travels to drop off/pick up the children. The Care day most often occurs on Wednesdays, and, to a somewhat lesser degree, on Fridays.. That is why parents, especially when they are working part time, choose the Wednesday to stay at home.

Compared to the combination day, the division between fathers and mothers in terms of dropping off/picking up children on Care days is skewed. Mothers on average undertake 85% of the care-providing trips on these days, compared to only 15% for fathers. This is also due to the fact that in households with one or more Care days, it is primarily the mothers who hold part-time jobs or do not work at all. An additional explanation for this is that children of primary schools have shorter school days (until 12 am) on Wednesdays in the Netherlands. Compared to all Dutch two-parent families with young children, the Care day is relatively common among one-income households (36% compared to 25%).

On days when they have a Care day, parents on average undertake more trips in a single day and spend a longer time travelling than two-parent families have on average days (Table 4). Especially mothers are very mobile on a Care day, they make almost twice as much trips as fathers. On the other hand the travelled distance for women on Care day is low 26 km), compared to men (60 km). This type of travel day encompasses a relatively large number of one-income families, in which the mothers specialise in the care-providing duties, including dropping off/picking up the children. Mothers make relatively much shorter household-related trips and care for the children. The breadwinners in one-income families do not have to take into account the temporal-spatial constraints associated with the need to drop off/pick up children at specific times and places. Consequently, it is easier for the breadwinners in one-income families to accept longer home-to-work travel distances (25 km on average) and corresponding travel times.

The distances travelled for dropping off/picking up children at school or day care are lower than the average. This is in part due to an overrepresentation of families with children in the school-going ages (4 years and older). On the days when one of the parents does not work, these children also do not go to after-school facilities when the school day ends. As we previously indicated, primary schools are on average situated closer to homes than day care centres (Baydar and Melser 2011; Van der Klis et al. 2011). It is precisely on the days when the parents' travel day is relatively uncomplicated, requiring no work-related coordination of mobility, that they can also stay closer to home when dropping off/picking up children, and spend proportionally less time performing this duty.

On a Care day, cycling and walking are the most frequently used transport modes for dropping off/picking up children (69%), yet within this group the car is still used by a considerable number of parents (30%). However, this is much less than on a combination day, where the car remains the dominant mode of transport. Parents having a Care day regularly combine the dropping off/picking up of children with other activities outside of the home, such as grocery shopping, for which cars are routinely used. Women use less frequently the car then men for dropping off/picking up children from school and they considerably use active modes more frequent then men (71% versus 59%).

Table 4: Mobility behaviour of parents on a Care day

	Care day			**NL families with children < 12 yrs.**		
Mobility behaviour	**House-hold**	**Male**	**Female**	**House-hold**	**Male**	**Female**
Trips per person per day	5.2	3.7	6.7	4.0	3.5	4.4
Distance travelled per person per day (km)	43	60	26	43	57	28
Journey time per person per day (minutes)	77	84	69	71	82	60
Average distance to work (km)	25	26	21	18	22	13
Average distance to day care /school	2.2			2.5		
Modal share parents dropping off/picking up children						
Car	30%	40%	28%	46%	55%	37%
Public transport	0%	0%	0%	0%	0%	0%
Walking/cycling	69%	59%	71%	53%	44%	62%

The Work day

On a day in which a household is having a Work day, neither of the parents bring their children to school or day care. However, on such days at least one of the parents does commute to work. This type of day gives insight into the flexibility families with young children would encounter in situations where they do not have to add travelling to a school or day care to their already existing responsibilities. For two-thirds (67%) of the households on a Work day, both the father and mother commute to work; in 33% of these families, one parent commutes to work without combining this with a trip to drop off/pick up children, and the other parent does not travel at all (that is to say, not for work and not to drop off/pick up children at school or day care). Households with only children under the age of 4 years old who do not attend day care or school relatively often undergo a Work day. The older children (from approximately age 9) in these households walk or bicycle to school on their own (CBS 2011), and thus this does not require the mother or father to undertake a care-providing trip.

In cases in which both parents only travel to their job and do not combine this with child-related travel, it is likely that the child care is arranged within the home or the children are picked up by a nanny at home. In the Netherlands, many parents prefer their children to be cared for as much as possible in the private sphere, which, for example, includes having nannies at home or bringing children to grandparents or other family members when both parents work (De Meester 2010; Cloïn et al. 2010).

On days when they have a Work day, parents on average undertake fewer trips than two-parent families on average days (Table 5). This is not so surprising, as such days do not include trips solely devoted to dropping off/picking up children. The number of kilometres travelled is approximately the same, while the amount of time people spend travelling is significantly lower (66 minutes compared to 71 minutes per person per day). The flexibility in scheduling the trips in time might also increase as a result.

For an average day for Dutch families with young children, there is a substantial difference with regard to the transport modes used for commuting to work. The car is dominant: cars are used for nearly two-thirds of all commutes to work. Men are using the car more frequently then women and walking and cycling are, compared to the combination day and Care day, relatively seldom used, while public transport is used approximately 5% of the time(Table 4).

Table 5: Mobility behaviour of parents on a Work day

	Work day			**NL families with children < 12 yrs**		
Mobility behaviour	House-hold	Male	Female	House-hold	Male	Female
Trips per person per day	3.2	3.2	3.1	4.0	3.5	4.4
Distance travelled per person per day (km)	41	57	24	43	57	28
Journey time per person per day (minutes)	66	81	50	71	82	60
Average distance to work (km)	20	24	16	18	22	13
Average distance to day care /school	19.6			20.4		
Modal share parents working trip						
Car	65%	68%	59%	46%	55%	37%
Public transport	5%	5%	7%	0%	0%	0%
Walking/cycling	25%	22%	33%	53%	44%	62%

5. Conclusions and discussion

The mobility of parents with children aged 12 years and younger clearly differs from that of the average Dutch person. These households have more responsibilities that require them to travel, and consequently have less flexibility in scheduling their activities and trips. There are also considerable differences between fathers and mothers. Fathers and mothers both make on average more trips per day than Dutch people who do not have children, but again mothers still make more trips than fathers. Fathers on average travel more kilometres per day than the average Dutch person, and mothers less. Both fathers and mothers spend above average amounts of time travelling per day. Mothers make more short trips and more often use bicycles for these trips than fathers. Their mobility is focussed mainly around the house and the location where their children receive care. Mothers drop off/pick up children at school and day care an average of 3.5 times more often than fathers. Although in recent years mothers have experienced increasingly higher rates of labour market participation, fathers still work for more hours and days per week.

On average, the higher educated a Dutch person is, the further he/she works from home, but even when educational levels are taken into account, fathers still work considerably further away from home than mothers. Regardless of their educational levels, Dutch mothers, more so than fathers, continue to attach importance to the close proximity of home, work, school and day care. Also in this respect, mothers on average have a smaller activity range than fathers. Fathers often use cars instead of more home-related transport modes such as bicycles.

The analyses of parents' travel patterns reveal that parents who combine dropping off/picking up children with commutes to work at the same day are also more likely to use cars for these drop off/pick up trips. However, some do prefer to use bicycles, even if they then subsequently commute to work by car, because they have difficulty parking at schools and because local traffic jams cause so much stress that they regard the changing of transport modes to be a more relaxed and efficient experience. Personal preferences seem to play a greater role than the actual differences in travel times, although the same

limitation in time and space lies at the base of the transport mode choice. On days when the home-to-work commute is not combined with the dropping off/picking up of children, more parents opt to accompany their children by bicycling or walking.

Many transport policy issues have a link with this reduced flexibility in scheduling. For instance, many unsafe traffic situations exist around schools, due to the high number of cars that have to share the same space with young children by foot and on bikes. The little flexibility in scheduling that parents experience often leaves them no choice but to commute to work by car during rush hours – and consequently also bring their children to school by car. This especially applies to parents who must combine work with accompanying their children to and from school. This is a problem from both the societal and policy perspectives. For such problems it is crucial that solutions are found on both the local and regional spatial levels. It is precisely this combination of these two scale levels that renders the mobility of parents so complex. Local traffic solutions, which contribute towards allowing both cars and slow transport modes (bicycles and walking) to reach schools in a safe and non-stressful manner, such as the 'Kiss and Ride' lanes for dropping off children at school, could be more widely applied. The concentration of various day care facilities and primary schools within the same building or in close proximity to one another may ensure that parents have to travel to fewer locations, but such concentrations might also lead to more traffic congestion in and around such sites. This is a distinct limitation to the concentration of childcare facilities.

Another topic closely related to the (limited) flexibility in daily scheduling is congestion reduction. New ways of working (independent of time and location), believed to increase the flexibility in this schedule, are widely introduced. However, if other parts of parents' activity schedules that are often combined with work-related travel, such as bringing children to child care, remain the same, the actual flexibility might only slightly increase. Women will probably have an even smaller increase in flexibility than men, as the mobility of mothers is more home- and child-oriented. Therefore, in order to create flexibility and stimulate other mobility choices, all constraints in the daily schedules should be considered.

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How different are barriers against out-of-home activity participation for women raising children?

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Abstract. Against the backdrop of an ageing Japan, and as a countermeasure against the low birthrate phenomenon, the promotion of an environment that allows children, pregnant women, and parents of babies and young children to participate in out-of-home activities in a safe and comfortable manner is increasingly becoming more important. This study focuses on barriers encountered by parents with young children when conducting out-of-home daily activities. We classified barriers in several categories: Transportation system, activity opportunities, household activity scheduling, childcare services, childcare information and public attitudes towards childcare. To examine the effect of these barriers on daily out-of-home activity participation, we conducted a web-based questionnaire survey on 1,000 women with young children living in the Kanto Region, including the Tokyo Metropolitan Area. Using the data collected from this survey, we analyzed the differences in travel mode by trip, segmented according to trip purpose on both rainy and fine weather days. Then, frequency of with/without children grocery shopping, strolls and outings to parks were modeled to further investigate important barriers. Finally, we examined differences in mothers' attitudes toward several kinds of barriers given different residential location, and the effect of personal and household characteristics on those attitudes. Findings suggest that difficulties encountered when conducting out-of-home activities differ given different living areas. In the Tokyo central area, barriers were related to the public transport systems and building characteristics at destination. In Tokyo suburban areas, barriers were associated with pedestrian and bicycle environment. Finally, in local cities in Northern Kanto Region barriers were more related to car use. We also found evidence suggesting that mothers with children under three years old, and nuclear families not living close to others who could support them in raising children felt the existence of more barriers. On the other hand, mothers with more years of experience in child-raising felt fewer difficulties in raising children.

1. INTRODUCTION

Against the backdrop of an ageing Japan, and as a countermeasure against the low birthrate phenomenon, the promotion of an environment that allows children, pregnant women, and parents of babies and young children to participate in out-of-home activities in a safe and comfortable manner is increasingly becoming more important (*1*, *2*).

Parents of babies and young children who are not able to travel alone encounter many kinds of barriers when conducting daily activities including out-of-home activities. In recent years, through the enforcement of the Accessibility Improvement Law in Japan (2006) and several other institutional measures, barrier-free environment not only for elderly and disabled people but also for parents with children is being promoted in public facilities, commercial spaces, and in road and public transportation facilities such as railway stations and their vicinities. However, other than barriers in transportation facilities and public facilities, there are several categories of barriers such as barriers in household activity scheduling, childcare services and childcare information (*1*, *2*). Furthermore, the types of barriers and their impact on out-of-home activities of child raising parents vary according to individual and household characteristics such as household structure, number of children, gender and age of children, support for childcare, employment and so on (*1*, *2*).

As mentioned above, the nature of many of the barriers child raising parents face during out-of-home activities is different from those elderly or disabled persons face; therefore, new measures to support out-of-home activities of household with young children are emerging in Japan. For example, “Kosodate Taxi”, is a childcare taxi service, which offer special service for passengers with young children and in addition, a child can use the taxi service alone (*3*). The NPO “Childcare Network of Setagaya-City” offers a web-based map for out-of-home activities with young children called “Kosodate Odekake Map”, which shows useful information for those who want to travel with their children (*4*). Koto-City government designates several facilities as “Akachan-no-Eki”, i.e. baby’s station, which offer nursing places for babies, and put out information about the station on the Internet as an “Akachan Map”, i.e. baby’s map (*5*). However, little is known about the types and characteristics of barriers for out-of-home activities with young children, effective measures to mitigate such barriers, or the role-sharing arrangement between departments such as city planning, transportation, and public welfare. From the viewpoint of countermeasures to the falling birth rate related to welfare, family and labor policy, there is not much research focusing on child-raising in the field of transportation planning or policy. Existing literature relates to out-of-home activities of parents with young children focusing on actual condition of, and attitudes towards public transport use (*6*, *7*), factors which affects destination choice of parents with small children (*8*, *9*), women’s travel behavior patterns (*10–12*), the relationship between women’s or children’s travel behavior and the built environment (*13–17*). However, there is not enough knowledge about the effect of residential location, personal and household characteristics on out-of-home activities.

The purpose of this research is therefore, to reveal the actual condition of out-of-home activities of child raising mothers and their attitude towards barriers given residential location, personal and household characteristics.

2. BARRIERS AGAINST OUT-OF-HOME ACTIVITY PARTICIPATION FOR WOMEN RAISING CHILDREN

As shown in Figure 1, there is a variety of barriers against out-of-home activity participation of child-raising parents related to *the transportation system*, *activity opportunities* in their daily living area, and personal and household characteristics that affect parents' out-of-home activities and their attitudes. Although there might be several ways of classifying these barriers, the authors propose the six categories as listed below:

(i) Barriers in *the transportation system*
(ii) Barriers in *activity opportunities*
(iii) Barriers in *childcare services*
(iv) Barriers in *household activity scheduling*
(v) Barriers in *childcare information*
(vi) Barriers in *public attitudes towards childcare*

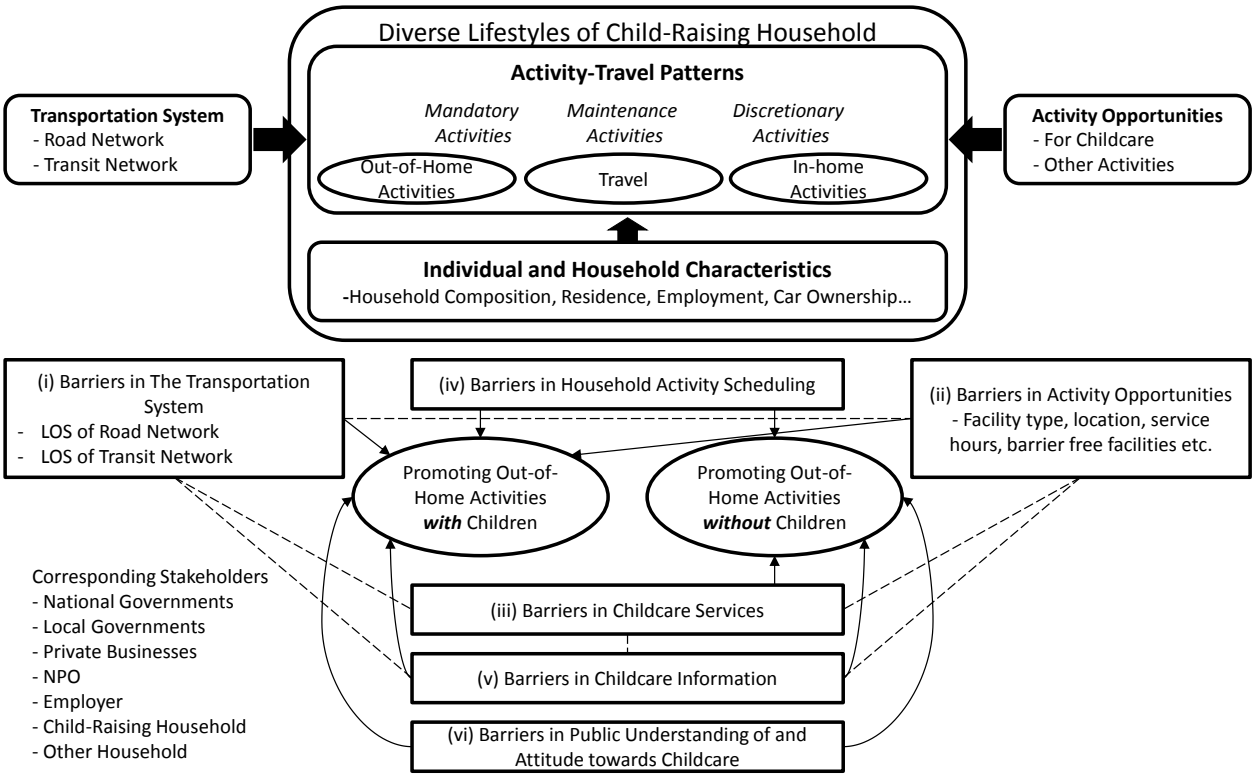

FIGURE 1 Barriers Restricting Daily Activities for Child-Raising Parents

By mitigating (i) barriers in *the transportation system*, and (ii) barriers in *activity opportunities*, child-raising parents' *out-of-home activities with children* are promoted. It is also important to promote *out-of-home activities without children* by mitigating (iii) barriers in *childcare services*. In Japan, policy measures tackling barriers (i) and (ii) have been taken by the Ministry of Land, Infrastructure, Transport and Tourism in the national government, and by the bureaus of city/road/transport in the local government, whereas barrier (iii) has been tackled by the Ministry of Health, Labour and Welfare in the national government, and by the bureaus of welfare/childcare in the local government. Child-raising households encounter (iv) barriers in *household activity scheduling* and face strong time constraints or sudden changes of schedule by their children's behavior. Therefore mitigating these barriers is also important. Along with the mitigation of barriers (i) to (iii), it is effective to alleviate (v) barriers in *childcare information* by

offering general information on barrier-free infrastructures and childcare services. Finally, it is most important to deal with (vi) barriers in *public understanding of and attitudes towards childcare* to design counter measures against barriers (i) to (v) effective. To cope with many kinds of barriers, appropriate co-operation and role sharing between national and local governments, private operators, NPOs, employers, child-raising households and other households is necessary.

The questionnaire survey was designed based on results from existing research and an original interview survey on child raising mothers (*1, 2*). This survey placed special emphasis on figuring out varieties in barrier free environment in the transportation system and activity opportunities given different residential location (Tokyo central area, Tokyo suburban area and Northern Kanto area), and varieties in out-of-home activities and attitudes towards several barriers between different individual and household characteristics (e.g., household structure, employment). To recruit child raising mothers with diverse personal and household characteristics in such a wide study area in an efficient way, the monitors of an on-line survey company were used as the population. Table 1 summarizes the general characteristics of the survey. In the next section, the effect of barriers (i) and (ii) on out-of-home activities, which vary widely between residential locations, and barrier (iv), which differs greatly depending on personal and household characteristics, are examined. Attitudes towards these barriers are also analyzed.

TABLE 1 Web-Based Questionnaire Survey Description

Survey Period	April 28 - May 10, 2009
Respondents	1,000 women raising preschool children, living in Kanto Region (Monitors of on-line survey company, Rakuten Research, Inc.) *Residential location of the respondents. - Tokyo central area: Bunkyo, Shinjuku, Minato, Chiyoda and Taito cities: 200 respondents - Tokyo suburban area: Residents living along Tokyu railway line in Setagaya, Kawasaki and Yokohama cities: 200 respondents Residents living along Tobu railway line and Seibu railway line in the northern Tokyo and southern Saitama prefecture: 200 respondents - Northern Kanto area: Tsukuba, Mito, Hitachi, Utsunomiya, Oyama, Maebashi and Takasaki cities: 400 respondents
Survey Method	Web-based questionnaire survey
Information Obtained	Daily out-of-home activities - Frequency and travel modes by activity purpose Situation and attitudes about childcare - Usage of childcare services, changes in behavior and attitudes before and after becoming a mother, ownership and usage of childcare instruments, barriers in out-of-home activities with children, usage of childcare information Situation of children - Nursery or kindergarten school Individual and household characteristics - Gender, age, employment, household structure, household income, residence year, car ownership, nearby railway station Others - Reasons for residential choice, countermeasures against sudden illness of children

3. ANALYSIS

1) Individual and household characteristics and residential location

First, the characteristics of the survey sample are described from the viewpoint of variation in personal and household characteristics between different residential locations. The distribution of the age is as follows, 13% of the sample were 25 to 29 years old, 38% were 30 to 34, 36% were 35 to 39 and 12% were over 40. Three quarters of the sample were in their thirties and there was no significant difference in the age distribution given residential location. The total employment rate of the sample was 31%. This rate differed somewhat between residential locations: 39% in the Tokyo central area, 31% in the Tokyo suburban area, and 27% in Northern Kanto area. As for the number of the children, 53% of the sample had one child, 36% had two children and 12% had three or more. The ratio of mothers that had one child was 65% in the Tokyo central area, 53% in Tokyo suburban area and 46% in Northern Kanto area. The average number of children was 1.46 in the Tokyo central area, 1.58 in the Tokyo suburban area and 1.72 in the Northern Kanto area. 90% of the sample belonged to a nuclear household, which consists of husband, wife and their children. As for instruments for going out with children, 86% of the sample had a "baby stroller", 78% had a "baby carrier (string)", and 44% had a "baby sling (cloth)". There were few differences between residential locations in these rates. Household car ownership ratio was 76% as a total; 40% in the Tokyo central area, 74% in the Tokyo suburban area and 96% in the Northern Kanto area. In these rates there were significant differences between residential locations. Especially, in the Northern Kanto area, over 60% of the samples had two or more cars. As for household income, the ratios of the sample whose household earned under five million Japanese yen[1] per year were 15% in the Tokyo central area, 32% in the Tokyo suburban area, and 44% in the Northern Kanto area. The ratio of households with an income over seven million Japanese yen per year was 62% in the Tokyo central area, 38% in the Tokyo suburban area and 26% in the Northern Kanto area.

Figure 2 shows the household structure of the sample. The sample was classified into 14 (2x7) categories. The first two categories are divided by parent's employment situation, i.e. single income or double income, and the latter seven are divided by the residential location of the person on whom a household can rely for childcare: living together (three generation household), immediate neighborhood, same city, adjacent city, same prefecture, other prefecture and nowhere. The persons on whom the respondents rely except their husband were "mother" (42%), "father" (18%), "husband's mother" (18%), "husband's father" (10%), "relatives" (4%) and "other" (4%). About 40% of the respondents answered that no one other than their husband offered any kind support to their childcare. The ratio of households that did not have anyone to rely on or who had someone to rely on in other prefecture was about 60% in the Tokyo central area and about 55% in the Tokyo suburban area and the Northern Kanto area. On the other hand, the ratio of those that had someone to rely on in immediate neighborhood, same city or adjacent city was about 25% in the Tokyo central area, and about 40% in the Tokyo suburban area and the Northern Kanto area. As a total, over half of the sample did not have anyone, (i.e., parents of their own or relatives, to rely on for childcare) so basically, they managed to raise their children by themselves (i.e., father and mother alone).

Differences of individual and household characteristics between different residential

[1] USD 1 = JPY 98; EUR 1 = JPY 128 at the time of execution of the survey (March 2009)

locations are summarized below:

- Tokyo central area: Higher rate of double income households, smaller number of children, lower car ownership rate, higher household income, higher rate of nuclear households, less support for childcare from outside of the household
- Tokyo suburban area: Intermediate nature between Tokyo central area and Northern Kanto area
- Northern Kanto area: Higher rate of single income households, larger number of children, higher car ownership rate, lower household income, lower rate of nuclear households, more support for childcare from outside of the household

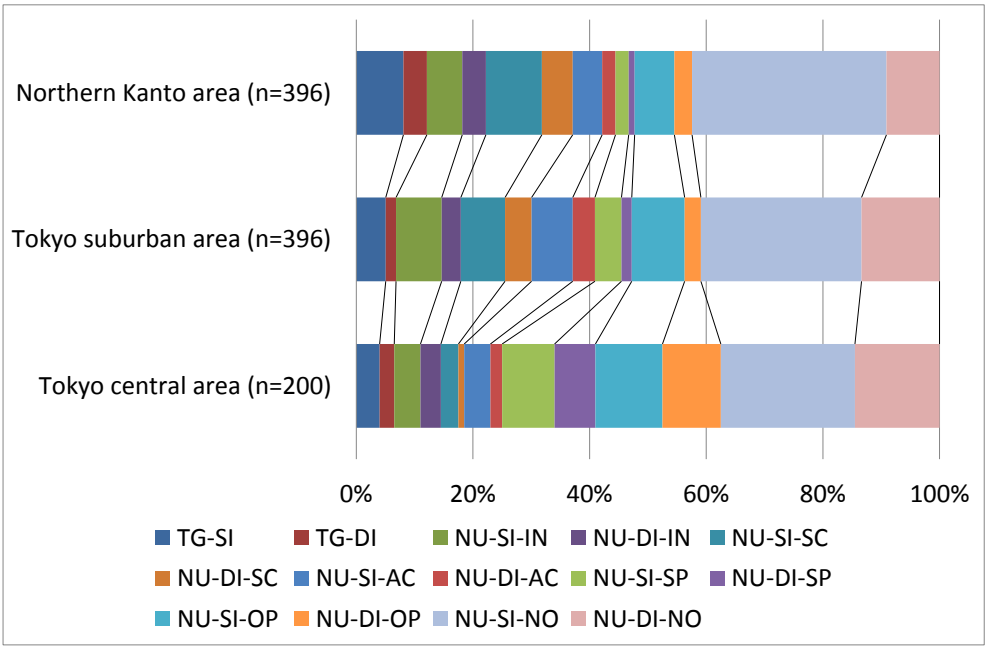

FIGURE 2 Household Structure of Respondents

Abbreviations:

- 1st level: TG: three generation household; NU: nuclear household;
- 2nd level: SI: single income household; DI: double income household;
- 3rd level: The nearest person on whom the samples could rely for childcare lived in: IN: immediate neighborhood; SC: same city; AC: adjacent city; SP: same prefecture; OP: other prefecture; NO: nowhere.

2) Main travel modes for out-of-home activities

In the questionnaire survey, frequency and main travel mode for several types of out-of-home activities: i.e., commuting, to and from nursery/kindergarten school, to and from children's culture lessons, outing to parks/strolls, grocery shopping, hobby/leisure/sightseeing, banking/post office/public office, hospital and others. Figures 3 and 4 illustrate the differences in main travel mode for "grocery shopping" and "outing to parks/strolls" between different residential locations. Including these two activities, in all of the activities, modal share of car increased and modal shares of walk and bicycle decreased consistently as one moves away from the Tokyo central area to the Tokyo suburban area out into the Northern Kanto area. These characteristics would

reflect differences in car ownership rate, level of services of public transport, geographical distribution of activity opportunities and so on. This finding on mode use is similar to a study that examined car use by household lifecycle stage and built environment in Kyoto-Osaka-Kobe area (*17*). As for "to and from nursery/kindergarten school", main travel modes both in fine weather days and in rainy days were asked. In rainy days, modal share of bicycle decreased largely and instead modal shares of car and walk increased compared to fine weather days in all the residential areas (Figure 5).

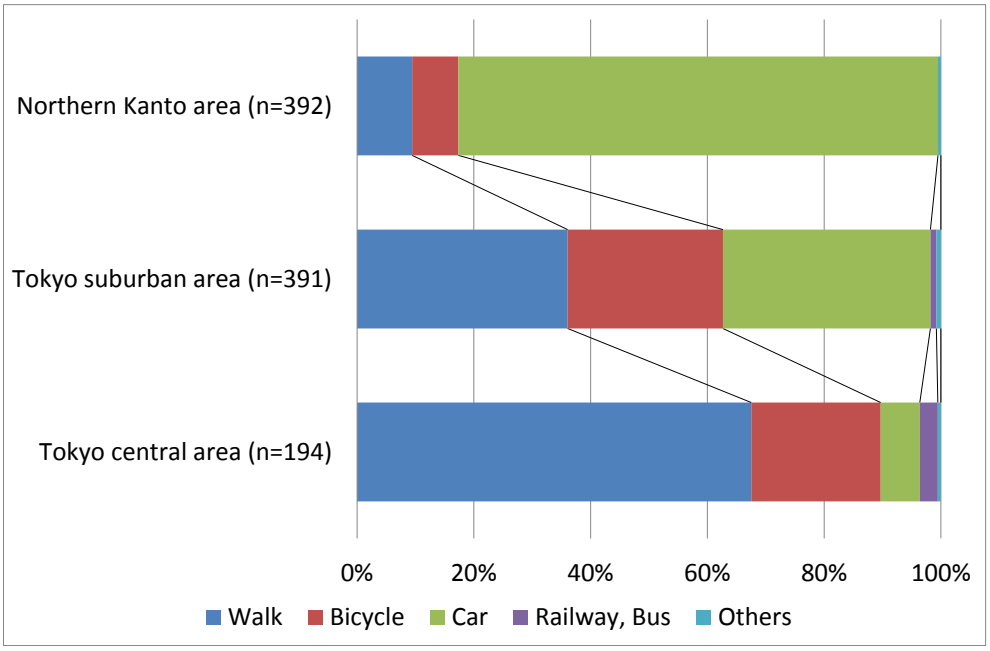

FIGURE 3 Main Travel Mode for Grocery Shopping

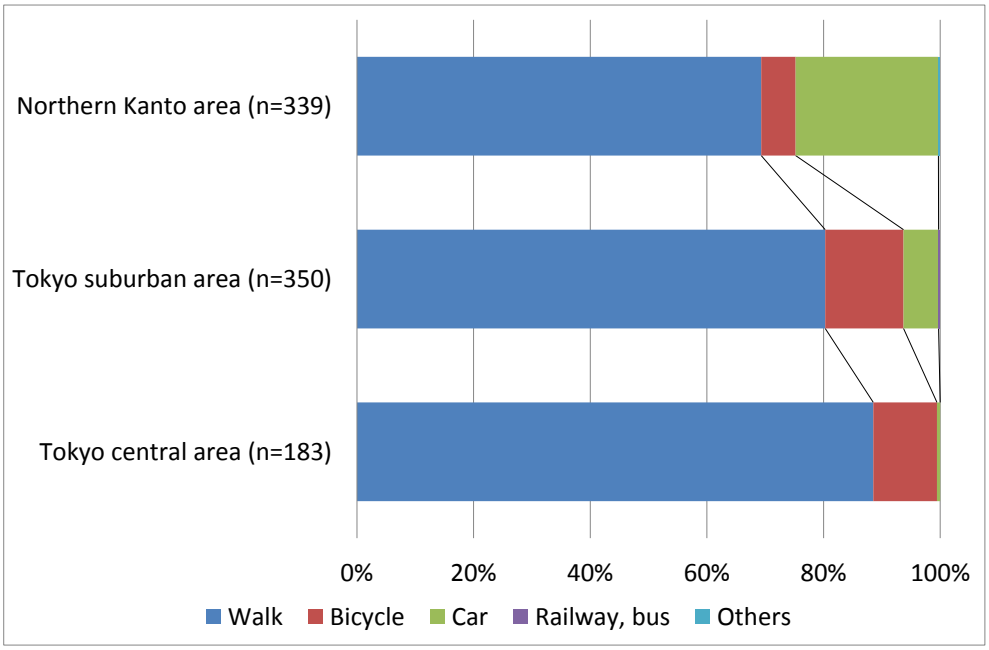

FIGURE 4 Main Travel Mode for Outing to Parks/Strolls

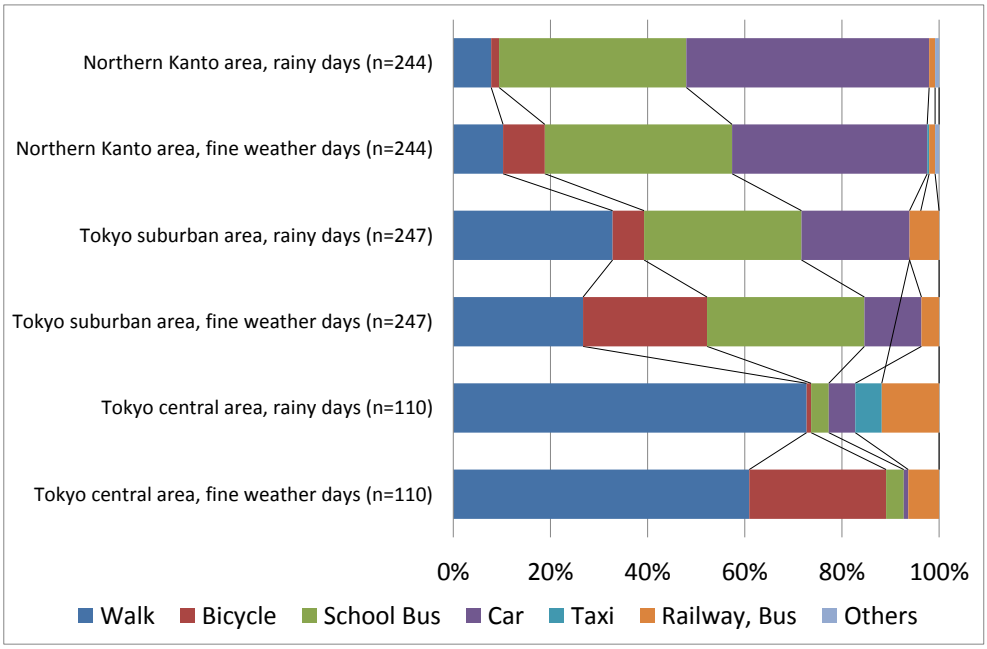

FIGURE 5 Main Travel Mode to and from Nursery/Kindergarten School

3) Analysis on frequencies of out-of-home activities: grocery shopping and outing to parks/strolls

In this section, the effect of differences in *the transportation systems* and *activity opportunities* given residential location, and the effect of differences in personal and household characteristics on out-of-home activity frequency is analyzed. In this analysis the number of days per week in which the respondent participated in an out-of-home activity was used as a dependent variable. Therefore, upper and lower censored Tobit model was used (Equation 1) (*18*).

$$y^* = \boldsymbol{\beta x} + \varepsilon \quad (\varepsilon \sim N[0, \sigma^2])$$
$$y = 0 \quad (y^* =< 0)$$
$$y = y^* \quad (0 < y^* < 7)$$
$$y = 7 \quad (y^* >= 7)$$

y: frequency (days per week) Equation 1
y^*: latent variable
$\boldsymbol{x}$: explanatory variables vector
$\boldsymbol{\beta}$: parameters vector
ε: error term

In the questionnaire survey, “frequency of participating in an out-of home activity with children” and “frequency with children and adults other than husband” were also asked. Therefore, three types of “frequencies” are analyzed; i.e., “out-of-home activity frequency of mother alone”, “out-of-home activity frequency of mother and children” and “out-of-home activity frequency of mother, children and adults other than husband”. In these analyses, respondents whose out-of-home activity frequency was zero were excluded because their main travel mode was unknown. Table 2 shows the estimation results of Tobit models for “Grocery shopping” and “Outing to parks/Strolls”. A positive sign of a coefficient means that the explanatory variable has a positive effect on frequency.

As for "Grocery shopping", the average values of "out-of-home activity frequency of mother alone", "out-of-home activity frequency by mother and children" and "out-of-home activity frequency by mother, children and other adults" were 0.63, 1.45 and 0.78 days per week respectively. Mothers take their children in about 80% of their outings for grocery shopping, and in about 30% of their outings they were accompanied with children and other adults. The models include several significant independent variables. As for "out-of-home activity frequency of mother alone", "number of children", "main travel mode is walk" and "main travel mode is bicycle" have positive effects and "number of children under three years old" has negative effect on frequency. On the other hand, for "out-of-home activity frequency of mother and children", "number of children under three years old", "unemployed", "nuclear household", "the nearest convenience store under five minutes trip", "main travel mode is walk" and "main travel mode is bicycle" have positive effects on the frequency. In the case of "out-of-home activity frequency of mother, children and other adults", "number of children under three years old", "main travel mode is walk" and "main travel mode is bicycle" have positive effects and "number of children" and "nuclear household without any support from outside" have negative effects on frequency. The findings are as follows:

- Shopping facilities within walking or bicycling distance promote shopping activity;
- It is not desirable to leave children under three years old at home;
- Large number of children makes it difficult to participate in activities; and
- Differences in time constraints resulting from employment situation and differences in household structure or support from outside of a household have some effects on frequency.

TABLE 2 Tobit Model Estimations for Out-of-Home Activity Frequencies of Child-Raising Mothers: Grocery Shopping and Outing to Parks/Strolls

Out-of-home activity types	Grocery shopping						Outing to parks/strolls			
Explanatory variables	Frequency by mother alone		Frequency by mother and children		Frequency by mother, children and other adluts		Frequency by mother and children		Frequency by mother, children and other adluts	
	Coeff.	*t-value*	Coeff.	*t-value*	Coeff.	*t-value*	Coeff.	*t-value*	Coeff.	*t-value*
Constant	−0.0192	−0.046	−0.647	−1.85 *	0.962	4.11 **	0.631	1.72 *	0.834	3.18 ***
Number of children	0.401	3.27 ***	−0.0323	−0.325	−0.22	−3.04 ***	−0.208	−2.14 **	−0.176	−2.39 **
Number of children under 3 years old	−2.44	−11.9 ***	0.72	4.55 ***	0.59	5.15 ***	1.22	7.71 ***	0.159	1.38
Mother's job: full time worker	0.393	1.47	−1.41	−6.16 ***	−0.0384	−0.248	−2.7	−10.9 ***	0.32	2.04 **
Mother's job: part time worker	0.0692	0.224	−0.597	−2.2 **	−0.0476	−0.246	−1.11	−4.05 ***	0.123	0.631
Nuclear household with support for childcare from outside	−0.28	−0.834	0.66	2.33 **	−0.189	−0.99	0.0695	0.253	−0.269	−1.35
Nuclear household without any support	−0.429	−1.35	0.736	2.73 ***	−0.504	−2.78 ***	0.0551	0.212	−0.305	−1.62
The nearest supermarket is within 5 minutes trip	0.0158	0.081	0.27	1.77 *	−0.0526	−0.48				
The nearest convenience store is within 5 minutes trip	−0.185	−0.88	0.394	2.39 **	−0.214	−1.83 *				
Living in Tokyo central area							0.298	1.46	0.443	2.92 ***
Living in Toyo suburban area							0.162	0.96	0.25	1.99 **
Main travel mode for this purpose is walk	0.484	2.13 **	0.934	5.46 ***	−0.275	−2.24 **	0.847	3.49 ***	−0.257	−1.5
Main travel mode for this purpose is bicycle	0.832	3.43 ***	0.704	3.53 ***	−0.387	−2.61 ***	0.896	2.75 ***	−0.401	−1.69 *
σ	2.27	21.9 ***	2.09	32.5 ***	1.46	29.3 ***	2.03	33.9 ***	1.45	28.7 ***
$L(C)$	−1105.9		−1689.7		−1311.2		−1678.8		−1207.1	
$L(\beta)$	−1004.2		−1622.7		−1275.0		−1563.0		−1193.1	
$\chi^2(=-2(L(C)-L(\beta))$	203.4		133.8		72.3		231.5		27.9	
Number of samples	961						870			

*p<0.1, **p<0.05, ***p<0.01

As for "Outing to parks/Strolls", the average values of "out-of-home activity frequency of mother alone", "out-of-home activity frequency of mother and children" and "out-of-home activity frequency of mother, children and other adults" were 0.08, 1.72 and 0.72 days per week

respectively. Mothers take their children in about 97% of their outings to parks or strolls, being their main purpose for this type of activity to let their children play outside. For about 30% of outings they were accompanied with children and other adults. The models show the following findings. For "out-of-home activity frequency of mother alone", "number of children under three years old", "unemployed", "main travel mode is walk" and "main travel mode is bicycle" have positive effects on frequency. On the other hand, in the case of "out-of-home activity frequency of mother, children and other adults", "full time worker", "living in Tokyo central area" and "living in Tokyo suburban area" have positive effects.

4) Mother's attitudes towards barriers when going out with young children

In this last section, sample's subjective evaluations on 14 types of barriers for out-of-home activities corresponding to the six categories discussed in section 2 are examined. Table 3 shows the results of a logit model based analysis of those attitudes towards barriers when going out with their children. The dependent variables of the models are whether the respondent identifies one of those factors as a barrier for herself or not. The independent variables include personal and household characteristics. The sample was divided into three subsets by residential location and three regional models were estimated for each barrier factor.

In the Tokyo central area, choice rates of "barriers in public transit" and "barriers in buildings or facilities at destinations" were relatively high. In the Tokyo suburban area, choice rates of "barriers in walking" and "barriers in riding a bicycle" were relatively high. In the Northern Kanto area, choice rate of "barriers in getting children into a car" (i.e., bothered by child safety seat) was relatively high. These results reflect differences in travel modes or destination facilities between residential locations. And these factors directly relate to barrier category (i) and (ii) as mentioned in section 2. However, compared to above mentioned barrier factors, most of the respondents consider "barriers caused by weather", "barriers caused by crowding" (indirectly relating to barrier categories (i) or (ii)) and "barriers in childcare schedule" (directly relating to barrier category (iv)) as barriers that affected them.

The effect of individual and household characteristics on attitudes towards barrier factors were as follow: In the Tokyo suburban area, "number of children" increased sense of barriers in walking and cycling, shortage of nursing rooms and weather related barriers. "The youngest child is under three years old" increased the perception of many of the barrier factors in every survey area. On the other hand, this variable decreased the perception of barriers in cycling and shortage of daycare centers in Tokyo central area only. "The age of oldest child", which would represent mother's experience on childcare, decreased the perception of several number of barrier factors in all of the areas. "Mother is over 40 years old" had an effect on many barrier factors in the Northern Kanto area. "Car owner" increased the perception of car-related barrier factors in the two areas in Tokyo. In addition, this characteristic decreased the perception of barrier factors related to bicycle use and crowded places in the Tokyo central area only. The car owners in Tokyo central area would tend not to ride a bicycle or not to visit crowded pedestrian areas with their children compared to the others. In Northern Kanto area, the coefficient of this variable was not significant because the majority of the sample in the area owned cars. "Nuclear household without any support from outside" increased the perception of barriers on shortage of daycare centers and childcare information at activity opportunities. Differences in degrees of effects of some characteristics between different areas might reflect differences in the built environment, the transportation system or in the demographic distribution. Further research is needed to reveal the effect of these regional factors.

TABLE 3 Relationship between Residential Location, Personal/Household Characteristics and Mother's Attitudes towards Barrier Factors in Out-of-Home Activities with Children

Barrier categories	no.	Barirer factors	*Choice rates*			Explanatory variables																							
						Number of children			The youngest child is under 3 years old			The age of the oldest child			Mother is over 40 years old			Mother's job: full time work			Mother's job: part time work			Car owner			Nuclear household without support		
			TC	*TS*	*NK*	TC	TS	NK	TC	TS	NK	TC	TS	NK	TC	TS	NK	TC	TS	NK	TC	TS	NK	TC	TS	NK	TC	TS	NK
1	1	Barriers in public transport	*74%*	*57%*	*37%*												− −												
	2	Barriess in walking	*36%*	*48%*	*37%*		+				+ +		−				−												
	3	Barriers in riding a bicycle	*26%*	*36%*	*22%*		+ +		−															−					
	4	Barriers in getting children to a car	*17%*	*26%*	*34%*					+	+ +													+ +	+ +				
2	5	Barries in buildings or facilities at destinations	*52%*	*36%*	*31%*				+ +	+	+						− −												
	6	Shortage of playground for children at destinations	*40%*	*42%*	*34%*												−												
1 or 2	7	Barriers in toilets	*58%*	*47%*	*44%*												−		+										− −
	8	Shortage of nursing room	*31%*	*23%*	*22%*		+ +		+ +		+ +		− −	− −															−
	9	Barriers caused by crowded people	*80%*	*75%*	*66%*					+	+ +													− −					
	10	Barriers caused by bad weather: rain, wind, hot and cold…	*84%*	*80%*	*76%*		+			+ +	+			−	−								−						
3	11	Shortage of day care centers	*31%*	*37%*	*30%*				−			−						−									+	+	
4	12	Barriers in child care schedules	*70%*	*61%*	*62%*					+ +	+ +			−															
5	13	Difficulty of getting childcare information of activity opportunities	*9%*	*12%*	*9%*					+																	+		+ +
	14	Shortage of guide signs for toilets or nursing rooms at activity opportunities	*32%*	*25%*	*24%*					+				− −			−		+										
Average value or composition ratio of each characteristics			−	−	−	*1.46*	*1.58*	*1.72*	*70%*	*63%*	*63%*	*3.14*	*3.96*	*4.47*	*11%*	*13%*	*12%*	*24%*	*17%*	*15%*	*8%*	*10%*	*9%*	*40%*	*74%*	*96%*	*73%*	*59%*	*55%*

Abbreviations: TC: Tokyo central area; TS: Tokyo suburban area; NK: Northern Kanto area.
+/-: Sign of coefficients
+/-: $p<0.05$, + +/- -: $p<0.01$.

4. CONCLUSIONS

This study focused on barriers encountered by parents with young children when conducting out-of-home daily activities. Barriers were classified in six categories: (i) transportation system, (ii) activity opportunities, (iii) household activity scheduling, (iv) childcare services, (v) childcare information and (vi) public attitudes towards childcare. To examine the effect of these barriers on daily out-of-home activity participation, a web-based questionnaire survey on 1,000 women with young children living in the Kanto Region, including the Tokyo Metropolitan Area was conducted. Using the data collected from this survey, the differences in travel mode by trip, segmented according to trip purpose on both rainy and fine weather days were analyzed. Then, frequency of with/without children grocery shopping, strolls and outings to parks were modeled to further investigate important barriers. Finally, differences in mothers' attitudes towards several kinds of barrier factors between different residential locations, and effects of personal and household characteristics on those attitudes were examined.

Findings from this analysis suggest that:

- In all of the study areas: the Tokyo central area, the Tokyo suburban area and the Northern Kanto area, more than half of the household did not have anyone who lived in their neighborhood and supported their childcare (i.e., parents or relatives).
- Regarding main travel modes for out-of-home activities of mothers with young children, share of car ownership increased as one moves away from the Tokyo central area to the Tokyo suburban area and out into Northern Kanto area. On rainy days, share of bicycle drastically decreased and share of car or walk increased compared to fine weather days in every study area.
- Frequency of "grocery shopping" increased when shopping facilities were within walk or bicycle distance. It is not desirable for the mother to go shopping alone and leave children under three years old at home. Large number of children makes it hard for a mother to participate in shopping activities. Differences in time constraints resulting from employment situation and differences in household structure or support from outside the household have some effects on shopping activity frequency.
- In almost all of "outing to parks/strolls" activities, mothers were accompanied by their children. Activity frequency was affected by the number of children under three years old, the mother's employment situation and travel mode. Out-of-home activity frequency of mother, children and other adults increased consistently from the Northern Kanto area, to the Tokyo suburban area, with the Tokyo central area exhibiting the highest frequencies.
- As for barriers in out-of-home activities with children, in the Tokyo central area, choice rates of barriers in public transit and barriers in buildings or facilities at destinations were relatively high. In the Tokyo suburban area, choice rates of barriers in walking and cycling were relatively high. In the Northern Kanto area, choice rate of car related barrier was relatively high. However, compared to these barrier factors, most respondents considered barriers caused by weather or crowding, and barriers in childcare schedule as important barriers affecting them.
- Mothers with children under three years old, and nuclear families not living close to others who could support them in raising children tend to feel the existence of more barriers. On the other hand, mothers with more years of experience in child-raising tend to feel fewer difficulties in raising children. Differences in degrees of effects of some characteristics between different areas might reflect differences in the built environment, *the transportation*

system or in the demographic distribution.

Further study should include:

- To examine the effect of barrier categories (iii), (v) and (vi) in section 2 on out-of-home activities.
- To investigate the effect of regional characteristics such as built environment, *the transportation system* and demographic distribution on attitudes towards barriers and behavior.
- To examine the existence or not of a causal relation between attitudes towards barriers and behavior.
- To survey the role-sharing arrangement in child-raising between a husband and a wife considering father's outings as well (*19–20*).

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Kathrin Sicks, Joachim Scheiner, Christian Holz-Rau

Cover letter

Thank you for the very helpful and critical comments. I have implemented them as good as possible into the paper. Here are the changes I have made:

- I restructured the literature review and sorted it by theoretical approaches explaining gendered travel behavior. For this I chose a separation between empirically direct approaches such as labor division and more indirect approaches as preference theory. Yet I am aware that the relevant theories in the field of gender-related transport geography are various. (review 1)
- I also restructured the description of data and methodology to give a better overview and clarify the choice and combination of the methods used. (review 1)
- The point of criticism concerning the "comparisons among different samples" seems to be a misunderstanding. Therefore I figured out more clearly that the point is about the different universe of the five surveys. By choosing a uniform analysis sample out of each survey there is no problem in comparing them to each other anymore. (review 1)
- I extended and clarified the theoretical underpinning of the analyses and the interpretation of our results. I did so in the context with the restructuring of the state of the research (above). (review 1)
- The point of criticism concerning the "sample selection (middle of the sample)" was obviously due to an inarticulate description of this step of analysis. This is not a hypothesis but a way of illustrating the results. I clarified this in the paper as an exemplary subgroup. This "middle of the sample" is not more than an exemplary subgroup out of the analysis sample. This group was chosen as a basic group for the interpretation of results because it is the most frequently occurring group in the analysis sample and therefore provides statistically stable coefficients and therefore a good basis for comparisons with other groups. (review 1)
- I figured out in a more detailed way, that preference theory is an explanation of gendered travel behavior in transport geography (state of the research). This makes clear that the approach we used in our paper is not only an intuitive way to interpret results. Instead, in doing so we follow an established, indirect approach to investigate in preferences as determinants of gendered travel behavior. This is not as unusual as it may have seemed to the reviewer. (review 1)
- Table 2 contains the main results of the paper. Therefore it of course has to be included. I removed the respective confusing sentence. (review 1)

- To handle with the first main concern of review 3, I extended the theoretical framework as explained above. Thereby I clarified that in our paper we follow an indirect approach that is established in gender-related transport geography. That makes clear that we do not want to use preferences as a direct determinant of gendered travel behavior. Instead we want to figure out, whether there are differences beyond labor division within households. The more detailed theoretical foundation shows that our results and the interpretations are far more than speculations. (review 3)
- The second main concern of review 3 refers to the non-significant coefficients in the Logit regression models. We are aware of their non-significance but also see their noteworthy strength. The models also contain several factors that are non-significant.

In a gender-context these have to be controlled for because otherwise we could not make statements concerning gendered travel behavior that goes beyond the socio-demographic context. For instance removing age/ cohort from the models, although they are not significant, could affect the sex –effect because cohort is a relevant factor for gendered behavior. Keeping even non-significant factors in the regression models does not reduce the model quality but increases the accuracy of the results and our interpretation. (review 3)

- Besides, that there are relatively stable estimates in the five regression models shows us, that the sex-effects are reliable and noteworthy. I figured this out in the methodology section. (review 3)
- Especially when looking at the non-significant sex-effect it becomes clear that ignoring non-significant effects would let interesting and considerably strong differences unregarded. In the exemplary calculations of participation rates we find that the coefficients represent a noteworthy behavioral difference. (review 3)
- I would like to comment on the point of criticism concerning the model fit: In transport geography dealing with data on an individual level, a low goodness of fit is the general case. Besides, our claim was not to explain a large share of variation. (review 3)

I hope this explains the theoretical and methodological approach of our work and clarifies the mentioned points of criticism.

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Abstract

In this paper we take a gender perspective to examine whether genderedshopping participation goes beyond differences in employment and labor division within households. We associate our empirical findings with theories from cultural sciences and discuss the connection between shopping, labor division, societal gender norms and individual preferences and attitudes. Moreover, we conduct a long-term trend analysis to discover changes in gendered travel behavior. Our results indicate that gendered travel behavior is largely affected by labor division within households but still goes beyond that. For instance more frequent shopping trips can even be observed for singles. This result can be interpreted as an indirect indication of gender norms, preferences and attitudes. We conduct differentiated descriptive as well as multivariate Logit regressions to take the complexity of gender as a social category into account. The data used are the representative German national mobility surveys of 1976, 1982, 1989, 2002 and 2008.

Born to shop? Gender-specific activitytravel in Germany

1. INTRODUCTION

Scientific discussion of gender-specific travel behavior has emerged since the 1970s. There are two different but complementary approaches to investigating gender and mobility.Firstly, cultural studies undertakea qualitative approach dealing with phenomena such as 'doing gender' and investigating how gender as a social role is constructed and reconstructed via behavior, including travel behavior ((1); (2)).The second and dominant approach is quantitativeand investigates how gender affects mobility. Such studies deal with questions about gender-specific travel behavior, and they understand gender as a determinant of travel behavior (e.g.(3); (4); (5); (6); (7); (8)). The findings presented below are the results ofa research project dealing with "Everyday life in the context of changing gender relations: activities, trips, travel modes and time use", funded by the German Research Foundation. The project follows the second, quantitative approach and can be located in the field of transport geography. An attempt is nonetheless made to integrate the cultural approach in the interpretation of the research results.

Quantitative studies on gender and mobility have developed significantly since their beginnings. Early studies were mostly based on simple comparisons between women's and men's travel behavior. Later on more differentiated approaches became dominantas an understanding of gender as a social role and complex social category emerged. This new understanding of gender and its complexityurged the application of far more differentiated methodologies as well as interpretation and assessmentof results. In the analyses described below, gender is taken to refer to a highly complex social construct. The analyses try to model this complexity as far as allowed by the travel behavior data available.

2. RESEARCH ON GENDER-SPECIFIC TRAVEL BEHAVIOR

Several studies on travel behavior and genderfind differences concerning driver licenses, motorization, travel mode choice, trip purposes, duration of trips and trip lengthswithin different spatial, temporal and social reference frames (see citations above). This paper focuses on the gender-specific relevance of trip purposes, particularly on shopping trips.

2.1.GENDERED TRAVEL BEHAVIOR AND COMMEN EXPLANATORY APPROACHES

Studies investigating the relevance of variousactivities and associated trips find that the daily mobility of men is strongly characterized by their gainful employment,while for women shopping trips are found to be much more relevant (see (4), 113 and(9), 377f. for Germany;(7), 200 for Norway;(10), 71f. for the USA;(11), 452ff. for the Netherlands). Suchstudies mainly use the gender rolebased approach to explain gender-specific travel behavior, assuming a gender-specific labor division on a household and society level. Herebywomen take on the major part of unpaid household work which is associated with more shopping trips whereas men are more often and to a greater extent economically active (e.g. (4), 113f.; (1), (3). Another, complementary theoretical approach is rational-choice

theory, whichassumes that labor division is an outcome of household action. Households attempt to achieve the greatest possible benefit from labor division (see(12), 30ff. as a key work). Because women have a lower average income, a household's income loss is less marked if the female partner reduces her amountof paid work rather than the male. On the other hand, there is an additional benefit and increased comfort for the household members if one partner has more time for housework.

2.2. PREFERENCE HYPOTHESIS

The above outlined reasoning has served feminist theory to argue that women are suppressed by patriarchy and associated household work-sharing, because they have only limited access to marketed work and, hence, economic power and autonomy. However, a younger stand of theory claims that work-sharing is an outcome of gendered preferences. This theoretical approachis also used to explain genderedbehaviors such as travel mode choice or trip lengths(e.g. (13), 21ff. concerning travel mode choice; (14); (15)).

Some psychological and sociological studies directly deal with gender-specific preferences and norms (e. g. (16)). For the discussion of gendered labor division and its change over time there is an interesting approach called 'maternal gatekeeping'. Allen and Hawkins (17) introduce this approach and find a considerable effect of norms, preferences and attitudes on the gendered division of housework ((17); also (18)). 'Maternal gatekeeping' implies that women consciously hold on to 'typically female' activities such as housework and childcare even though they could reduce their share and leave a larger proportion of such tasks to their partners. There is evidence found that women even tend to inhibit more involvement of their partners (e.g. (17), 208ff.). This is explained as a phenomena of social identification and role construction which can be interpreted as a kind of 'doing gender'.

In transport geography few studies directly investigate in preferences towards travel behavior ((15); (19); (20)). In contrast to psychological and sociological research, in transport geography a more indirect approach has become established to deal with preferences affecting travel behavior.This is due to the fact that, to our knowledge, there are no data available including direct information on travel behavior and individual preferences as a determinant.Some studies control for several gender-related factors and still find gendered travel behavior which is interpreted as a result of gendered preferences (e. g. (21); (22)).

3. HYPOTHESIS AND RESEARCH QUESTIONS

Particularly when discussing the gender-specific relevance of shopping trips, including everyday shopping as well as more leisure-oriented shopping activities, we expect preferences to be relevant for gendered activity participation. This idea is not frequently encountered in studies in the field of transport geography but is explored in some studies in cultural sciences and psychology that consider gender-specific labor division (e.g. (17); (18)). Individual preferences, norms and attitudes may in turn result from gendered practices, societal gender norms and roles and perceived societal expectations. There is no strict separation of the factors mentioned that affect gender-specific travel behavior. However, gender norms and roles have changed considerably in the last few decades. Nevertheless, even recentstudies find that different activities and associated trips are of different relevance

for men and women(see above). This also indicates that something relatively persistent may affect gender-specific labor division and travel behavior.

We therefore examine from a gender perspective:

- whether and to what extent shopping participation of men and women converges over time and
- whether or not there is (indirect) evidence for gendered preferences and attitudes affecting travel behavior.

4. DATAANDMETHODOLOGY

4.1. DATA

The analyses are based on the representative German national mobility surveys of 1976, 1982, 1989 (KONTIV 'continued survey of travel behavior') and 2002 and 2008 (MiD 'Mobility in Germany'). There are some limitations in comparison because different survey methodologies were usedin the five surveys. The differences between the KONTIV surveys and the MiD are especially considerable(23).While the first three surveys were conducted via mail, in 2002 and 2008 the telephone method was used and resulted in higher trip rates (24). The 1989 survey is noteworthy because the questionnaires were collected by couriers. Highly mobile persons are underrepresented in the 1989 survey(25).

Furthermore, the universe in the five surveys is not identical. The three KONTIV surveys and the 2008 MiD use German-speaking residents as the basic population, whereas in 2002 the basic population was the whole residential population. Only in 2002 and 2008 were both East and West Germany considered. Another difference is in the lower age limit: ten years in 1976 and 1982, six years in 1989 and zero in 2002 and 2008. We therefore limit our analysis sample to Germans aged 18 years and older living in West Germany (old 'Bundesländer'). Children and adolescents are not considered because of their specific everyday life, travel needs and behavior(see also (9): 374f.).

Nevertheless, the data allow analysis of long-term trends in activities and travel behavior. They also contain numerous sociodemographic factors that are interesting for analyses in a gendercontext. As a restriction for our research question, the data do not include direct information on preferences and attitudes.Hence our conclusions concerning norms, preferences and attitudes as influencing factors of travel behavior are necessarily more indirect. As outlined above, this indirect approach that we pursue in our analyses is established in transport geography.

4.2.ANALYSIS METHODOLOGY

The analyses focus on shopping trips because of their close relation to labor division, but we also expect preferences and attitudes to be more likely to impact on shopping than on commuting or leisure activities. We are aware that shopping trips recorded in travel surveys include everyday grocery shopping as well as more leisure-oriented shopping such as clothes shopping. Common gender stereotypessuggest that preferences should be relevant for gendered shopping frequency in the latter case. Some studies also show a considerable effect

of norms, preferences and attitudes on the gender-specific division of housework (e.g. (17); (18) on the idea of ‘maternal gatekeeping’). This gives rise to the assumption that not only ‘leisure shopping’ but also everyday shopping may be affected by preferences.

We conduct descriptive analyses and multiple logistic regressions. In the descriptive analyses we distinguish between selected household types and occupation groups. The three selected household types are:

1) couples with a child under six years (usually described as the most ‘traditional’ group regarding labor division),
2) couples without children (labor division is relevant for them but should be less traditional than in families; age limited to under 60 years to exclude typical pensioner households) and
3) single households (no labor division; age limited to exclude pensioner households).

These contain several interaction terms to model the complexity of gender as an explanatory factor for travel behavior, including numerous factors considered relevant in the context of gender. Such factors relevant in the context of gender and mobility are: age, cohort, occupation,educational level, spatial context, household type and motorization.As dependent variables we observe activity participation. In our case: Does a person conduct at least one shopping trip ona randomly chosensurvey day? We compute one regression model for each survey year. This enables us to observe specific trends for various groups of persons. What is more, we can use even non-significant effects for interpretation in cases of strong consistency in sings and magnitude over time.

For statements concerning trends between 1976 and 2008, the constants of the models have to be considered as well as potential change of the respective factors over time. There can easily be misinterpretations when looking onlyat the effects and their changes. As an example, adecreasing positive factor of ‘non-working’ (with full-time employees as a reference group) between 1976 and 2008 does not necessarily mean decreasing shopping trips among the non-working. It can also result from increasing shopping trips among the reference group while there is no change among the non-working sample. By way of illustration and to avoid misinterpretations, we undertake some exemplary calculations for selected groups. We calculate participation rates by applying the regression equation. As the basis for these calculations we choose as an exemplary group the ‘middle of the sample’, meaning the most frequent subgroup of each factor.For the overall sample covering all five survey years this ‘middle of the sample’ comprises: men and women living in couple households without children, working full-time, aged in their forties, without “Abitur” (university entrance qualification), living in municipalities with 5000 to 20000 inhabitants,and with limited car access (less cars than potential users in the household).The exemplary calculations are conducted for this basis group and additionallywith some variations, e.g. in occupation, to show different trends. As opposed to descriptive analyses, thisprocedure enables us to find differences that actually result from one special factor while keeping the other factors considered in the model constant.

5. DESCRIPTIVERESULTS

For the whole analysis sample (German individuals aged 18 and older, living in West Germany) there is an obvious trend of convergence in the shopping trip participation of men

and women between 1976 and 2008 (see Tab. 1). In every survey year women undertakesignificantly more shopping trips than men. But as the ratios show, this difference decreases during the investigation period. The convergence results from the changing behavior of men,as shopping trips gradually become more common in men´s everyday lives (from 19 to 30 %). On the other hand, women's participation inshopping trips is nearly constant,at around 35 % between 1976 and 2008. This is amazing because it would be reasonable to expect that increased shopping trips among men would relieve women and thus result in women undertaking less shopping trips. Here social change has to be taken into account.The number of single households and therefore the number of individuals who have to do their own shopping is increasing steadily. Additionally, the increasing labor participation of women should be relevant for shopping activity. On one hand, increasing work trips mean increasing opportunities to do small amounts of shopping on the commute, on the other hand the increasing time pressure in women´s everyday livescould encouragemore bulk purchases and, hence, fewer shopping trips or a redistribution of shopping between women and their partners. For these reasonsthis resultof the whole analysis sample can hardly be interpreted as representing a redistribution or non-redistribution of maintenance tasks.We therefore take a closer look at the selected household types and occupation groups mentioned above.

The ratios for men and women with a partner as well as for those living alone show a higher relevance of shopping trips in women´s everyday lives (ratios < 1; only exception: singles 2008). Especially in couple households the participation in shopping trips differs significantly between men and women, most pronouncedly in couples with small children.This aspect of labor division is, as found in several studies, remarkably 'traditional' in families. The low labor participation of mothers has to be considered here. These results show the relevance of the role theory, althoughthere are also hints that role theory does not explain gender-specific shopping trip frequencies entirely. Nevertheless, with exceptions in 1989 (poor data base) and in 2008 (outlier for men),even among singles women undertakemore shopping trips than men. Even though this is only significant in 1989 and 2002,single women undertakeabout 20 % more shopping trips than single men. This could be cautiously interpreted to hint at gender-specific preferences concerning shopping and the organization of shopping (frequent shopping of few items vs. seldom bulk purchases). Possibly women like shopping more than men, and therefore, for instance,shop more spontaneously and tend to do less than men to reduce shopping frequency by buying many items at onetime. Differing nutrition preferences in terms of the preference forbuying fresh food might be relevant as well.

TABLE1 Shopping trip participation, descriptive results

			shopping trip participation			
			men	women	ratio	sign.
whole analysis sample		1976	19.2%	34.3%	0.56	**
		1982	20.5%	34.6%	0.59	**
		1989	19.2%	34.2%	0.56	**
		1995	no survey			
		2002	27.8%	36.5%	0.76	**
		2008	30.0%	36.2%	0.83	**
household type	couples with child under six	1976	17.2%	39.8%	0.43	**
		1982	19.7%	41.4%	0.48	**
		1989	16.4%	45.1%	0.36	**
		1995	no survey			
		2002	25.3%	32.1%	0.79	**
		2008	25.1%	39.2%	0.64	**
	couples without children (both 18 to 59 years)	1976	18.0%	32.2%	0.56	**
		1982	21.0%	34.9%	0.60	**
		1989	16.0%	31.1%	0.51	**
		1995	no survey			
		2002	25.1%	34.6%	0.72	**
		2008	29.1%	33.3%	0.87	**
	single households (18 to 59 years)	1976	26.4%	33.0%	0.80	
		1982	25.2%	30.8%	0.82	
		1989	20.5%	29.6%	0.69	**
		1995	no survey			
		2002	25.5%	30.9%	0.83	**
		2008	34.5%	33.6%	1.03	
occupation	working full-time	1976	16.5%	24.2%	0.68	**
		1982	17.3%	26.1%	0.66	**
		1989	15.2%	23.9%	0.64	**
		1995	no survey			
		2002	23.0%	30.2%	0.76	**
		2008	26.2%	30.6%	0.86	**
	working part-time	1976	17.5%	36.6%	0.48	**
		1982	22.2%	37.7%	0.59	
		1989	19.4%	37.1%	0.52	**
		1995	no survey			
		2002	31.1%	39.3%	0.79	**
		2008	30.0%	37.7%	0.80	**
	non-working	1976	29.5%	39.5%	0.75	**
		1982	33.8%	40.5%	0.83	**
		1989	34.0%	41.0%	0.83	**
		1995	no survey			
		2002	38.3%	39.4%	0.97	
		2008	36.9%	38.7%	0.95	*

** $p \leq 0.01$, * $p \leq 0.05$ (McNemar for dependent samples, Pearson´s Chi^2 for independent samples)

In couple households with or without children convergence takes place between 1976 and 2008 (ratios draw near 1). While women´s shopping trips remainconstant over time, men in couple households undertakegradually more shopping trips. Yet women makesignificantly more shopping trips than their partners until 2008. Moreover,the great difference between the shopping trips of men and women living as couples with small children andthose living as couples without children persists until 2008. Mothers make more shopping trips than women without children, while fathers make fewer shopping trips than men without children. Notably, the increasein the shopping trip frequency of men does not cause a decrease in the shopping frequency of their partners. This gains additional importance in light of the fact that labor participation, especially part-time employment of women and mothers in particular, has increased notably since 1976. This implies an increasing variety of activities and possibly greater time pressure for women. But why,against this background, dowomen not reduce their shopping? One possible factor is that the majority of women in couple households works part-time and thus tends to be side-earners, therefore continues to take on the predominant part of the housework and associated trips. But this does not explain increases in their partners' shopping activities, while theirs remain constant. A possible explanation could be that couples shop increasingly often together. A third argument can be derived from cultural sciences. This is the concept of 'maternal gatekeeping'. According to this understanding women consciously hold on to 'typically female' activities such as housework and childcare even though they could reduce their share and leave a larger proportionof such tasks to their partners. Studies find that women even tend to inhibit more involvement of their partners (e.g. (17), 208ff.). This is explained as a phenomena of social identification and role construction which can be interpreted as a kind of 'doing gender'.

Differentiating by occupation shows that non-working men and women make more shopping trips than the employed. It should be mentioned that non-working people include pensioners as well as the jobless and housewives/ househusbands. Time constraints may be a relevant factor here. Interestingly, there is hardly any difference inshopping trips between non-working and part-time employed women. This might result from common constellations and the associated labor division within households: male heads of households are predominantly in full-time employment, whereas their female partners are often housewives or work part-time. From the perspective of rational choicetheory this logically results in a largeshare of the housework and shopping being done by the women even if they work part-time. On the other hand, preferences and attitudes can conduce to this as well. Women possibly have a higher affinity for maintenance and care tasks and consciously choose part-time jobs to facilitate the compatibility of family and work.

Another interesting finding is that even among full-time employees women makesignificantlymore shopping trips than men. This has to be seen against the background of very similar temporal constraints for both.On the one hand, gender roletheory provides an explanation for this. Several studies have found a 'traditional' labor division in households even if both partnerswork full-time(e.g. (26), 11). On the other hand, social norms, perceived societal expectations as well as preferences and attitudes may be relevant again (see 'maternal gatekeeping' above).

Considering the development of shopping trip participation shows a trend especially among the men and particularly employed men, who are increasinglyparticipating in shopping. A rise in shopping tripsisobservable among full-time employed women as well. Probably their motorization growth, increasing car use and the associated temporal and spatial flexibility are conducive to more frequent purchases of few items on the way to or from work.

In summary, it can be stated that there are some indications of the relevance of factors such as individual preferences and attitudes that are surely interrelated with social norms and perceived societal expectations. The explanations of the findings proposed so far imply the relevance of several factors for gender-specific travel behavior. The following multivariate analyses are thus able to provide a much more differentiated view.

6. MULTIVARIATERESULTS

The multivariate logistic models(dependent variable: at least one shopping trip on the survey day = 1, no shopping trip = 0) presented here contain a variety of factors considered relevant when thinking about gender and mobility (see Tab. 2). Still, the given set of determinants is a compromise in terms of the lowest common ground of the five surveys used. The modelsyielda vast number of results, butthe following remarks focus on those that are interesting for our research questions.

Beginning with the constant (as the average of all reference groups), there is no systematic trend observablein shopping trip participation. The general effect of the factor sex (female), although not significant, is positive and fairlystrong from 1976 until 2002. This effect cannot be interpreted as a higher level of shopping activity of women in general because of the numerous interactions (*female). Yet this effect has to be considered for all subgroups of women which are differentiated by using interaction terms. Remarkable effects of genderare described for the respective groups.

Occupation significantly affects the likelihood of whether a person undertakesa shopping trip. Compared to full-time employees, non-working men and women makesignificantly more shopping trips, which confirms the descriptive results. This effect does not differ between men and women (no remarkable effect of 'non-working*female'). Although not significant, men and women working part-time also makemore shopping trips than those in full-time work. This effect is nearly identical for men and women, but it must be taken into account that part-time work is an exception among men but more typical among women. Although there are no noteworthy interaction effects, women undertake more shopping trips than men, regardless of whether and to what extent they are gainfully employed (see Fig. 1). Thesemore frequent shopping trips among women can be seen in the effect 'female' which is relevant for all groups of women unless adjusted by the respective interaction effect. Despite the similar temporal constraints of men and women in full-time work,this is not associated with more similar shopping trip participations. Labor division within households (although these results do not explicitly show differences within households) seems to be independent of the occupation of the female head of household. This could be related to social norms or individual preferences, which are closely linked to each other. The idea of 'maternal gatekeeping' (see above) might be relevant as well.

In contrast to thedescriptive findings, the multivariate models do not show similar shopping trip frequencies for part-time working and non-working women. This may result from the control of household type in the Logit-models. Part-time working women are disproportionally mothers and therefore live in households identified as very 'traditional' concerning labor division. An additional descriptive analysis shows that 13 % of the part-time working women live with children younger than six years (referring to the youngest child in the household) and 41 % live with children between six and 17 years. For comparison, only 4 % of the full-time working women live with children under six and 16 % livewith children between six and 17 years.With respect to trends the decreasing effects of 'non-working' and 'part-time employee' between 1976 and 2008 suggest decreasing differences in shopping trips between the occupational groupsconsidered. As in the descriptive analysis this results from an increase in shopping trips among full-time employed men and women, while there are no such systematical trends for the part-time and non-working men and women (see Fig. 1 illustrating the exemplary calculation for occupation). This illustrates that there is an increase in shopping among full-time working men and women beyond the scope of increasing motorization (this factor is held constant in the model). Among men the increasing employment rate of their partners and the associated redistribution of a certain share of the unpaid work such as shopping might be relevant. Of course, this has to be set into the context of changing societal and individual norms. For women this argument is not applicable. Perhaps there actually is a greater preference for shopping among women that can increasingly be realized because of their increasing average income. Perhaps women working full-time in 1976 were different from those working full-time in 2008. It is conceivable that it was predominantly women with a 'modern' lifestyle and relatively equal labor division within the household who worked full-time in 1976.Perhaps in 2008 working full-time is more normal thanit was in 1976,even for women living in relatively 'traditional' households as far aslabor division is concerned.

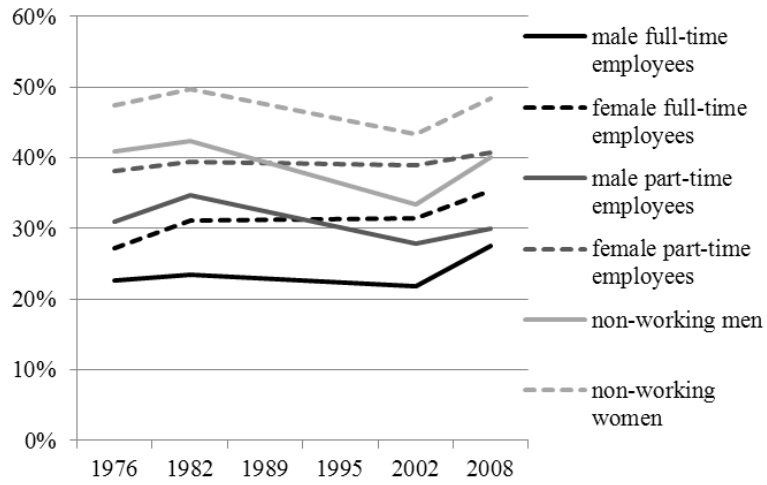

FIGURE1Shopping trip participation by occupation (calculated from Logit regression)

As shown by the descriptive analysis, household type is an interesting factor for gender-specific shopping participation as well. For our research question, the effects of 'multi-person household*female' and 'couple with children*female' are of most interest. First of all, the main effect 'female' is relevant for all groups but in each case adjusted by the respective interaction effect. Hence the consistently positive but insignificant interaction effect 'multi-person household*female' shows greater differences between men and women living together concerning their shopping trips than between men and women living alone. Additionally, the interaction effect 'couple with children*female', although not significant, is worth mentioning. It shows that differences concerning shopping trip frequencies are largest between mothers and fathers living together.

Firstly, even among singles, women make more shopping trips than men (see consistently and fairlystrong positive but insignificant effect 'female'). Secondly, living with a partner is associated with a 'traditional' division of shopping. Thirdly, living together with children is associated with an even more 'traditional' labor division in terms of shopping trips between mothers and fathers (this can be stated for couples with school children and small children likewise). The exemplary calculation illustrates these findings (see Fig. 2) and confirms the descriptive analyses above.

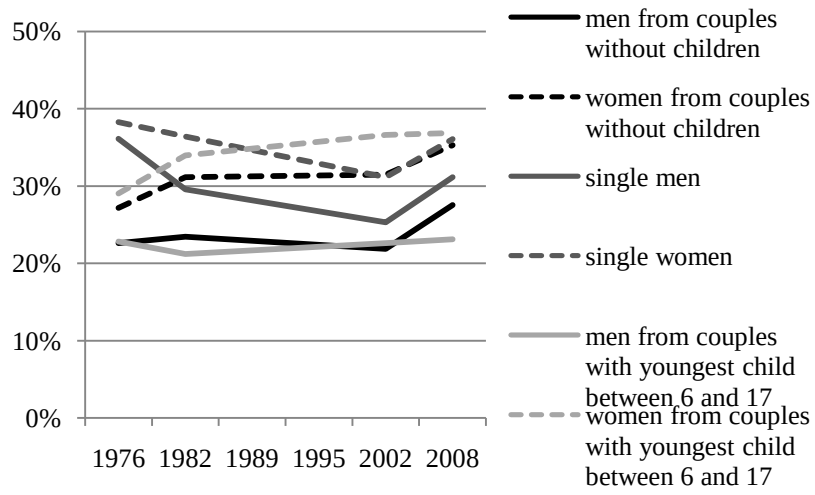

FIGURE2 Shopping trip participation by household type (calculated from Logit regression)

Furthermore, the multivariate analysis shows that the 'traditionalizing' effects of cohabitation and especially living with children not only results from gender-specific labor participation in the sense of a rational choice approach. The differences found within couples and families in the descriptive analysis can also be observed when occupational status is held constant. As the results for singles show, neither gender-specific labor participation nor labor division within households can entirely explain differences in shopping trips. These results may be interpreted as indicating gender-specific societal norms and expectations and their perception as well as individual norms and preferences even though there is no direct measurement of these factors in the data.

The effects of sex ('female') vary over time but do not change systematically between 1976 and 2008. This shows that the findings described above are consistent until 2008. Against the background of changing gender norms this is an interesting result.It is possible that mothers are especially affected by societal norms and expectations(e.g. the model of the 'good mother') or perceive these norms very intensely. Those societal norms change over time but suchchange is a very slow process (e.g. (27), 37f.).This may be accompaniedby a consistently 'traditional' labor division in families and therefore high shopping trip participation of mothers. Furthermore there might be specific individual norms among mothers that are associated with a 'traditional' labor division within families. The conceptof 'maternal gatekeeping' may explain this persistence. Of course, individual norms and preferences and societal norms are strongly interrelated. Besides, a selection bias concerning family formation has to be taken into account. Presumably women with 'traditional' norms and lifestyles are more likely to start a family and have children than those with very 'modern' lifestyles.

TABLE2 Shopping trip participation, Logit regressions

	1976		1982		1989		2002		2008	
	B	**Sign.**	**B**	**Sign.**	**B**	**Sign.**	**B**	**Sign.**	**B**	**Sign.**
sex (ref.: male)										
female	0.21		0.35		0.60	*	0.28		0.03	
age groups (ref.: 44-49.5)										
18-23.5	-0.23		-0.22		-0.18		-0.30		-0.40	*
23.5-30	0.16		0.14		0.00		-0.46	*	-0.14	
31-36.5	0.11		0.14		0.13		-0.12		-0.13	
36.5-43	0.00		0.04		0.11		-0.07		0.20	
44-49.5 (reference)										
49.5-56	0.00		0.18		0.10		-0.03		-0.25	
57-62.5	0.01		0.15		0.17		0.13		0.07	
62.5-69	0.00		0.22		0.13		0.09		0.00	
70-75.5	-0.13		0.14		0.04		0.21		0.00	
75.5-82	0.14		-0.09		-0.10		-0.18		-0.08	
83-88.5	-0.23		-0.58		-0.27		0.51		-0.42	
88.5 and older	-0.52		-1.17		-1.20		-0.34		-20.83	
18-23.5*female	0.07		0.00		-0.27		-0.19		-0.05	
23.5-30*female	-0.05		-0.07		-0.13		0.18		-0.25	
31-36.5*female	-0.11		-0.13		-0.15		-0.15		-0.19	
36.5-43*female	0.04		0.00		-0.10		-0.09		-0.31	
44-49.5*female (reference)										
49.5-56*female	0.07		-0.10		-0.04		-0.02		0.28	
57-62.5*female	-0.17		-0.26		-0.25		-0.15		-0.21	
62.5-69*female	-0.22		-0.46		-0.26		-0.18		-0.17	
70-75.5*female	-0.34		-0.30		-0.45	*	-0.41		-0.36	
75.5-82*female	-1.04	*	-0.59		-0.67	*	-0.25		-0.43	
83-88.5*female	-1.30	*	-0.69		-1.05	*	-0.99	*	-0.30	
88.5 and older*female	-2.87	*	-0.21				1.19		20.59	
occupation (ref.: full-time employees)										
non-working	0.86	*	0.88	*	1.10	*	0.58	*	0.56	*
non-working*female	0.02		-0.10		-0.24		-0.07		-0.02	
part-time employee	0.43		0.55		0.58	*	0.32		0.12	
part-time employee*female	0.08		-0.19		-0.13		0.00		0.11	
students and apprentices	0.51	*	0.44	*	0.24		0.14		-0.19	
students and apprentices*female	-0.38		-0.30		-0.15		0.08		0.06	
educational level of those with completed education (ref.: lower than "Abitur")										
"Abitur"	0.24	*	0.10		0.21	*	0.13		0.17	*
"Abitur"*female	-0.12		0.18		-0.09		0.00		-0.06	
household type (ref.: single household)										
multi-person household	-0.66	*	-0.31	*	-0.23	*	-0.19	*	-0.17	*
multi-person household*female	0.15		0.08		-0.10		0.21		0.14	
couple with children	0.01		-0.13		0.00		0.04		-0.24	
couple with children*female	0.08		0.26		0.16		0.19		0.30	
couple with child under 6	0.02		0.21		0.01		-0.05		-0.01	
couple with child under 6*female	0.02		-0.19		0.16		-0.18		-0.02	
single father/ mother	0.45		0.50		0.48	*	0.25		0.04	
household with only adults	-0.22		-0.31	*	-0.21	*	-0.12		-0.17	
household with only adults*female	0.06		0.22		0.06		0.05		0.02	
grown-up "child" living with parents	-0.50	*	-0.39	*	-0.49	*	-0.22		-0.40	*
grandfather/ -mother living in 3-generation household	-0.78		-0.72		-0.54		-0.95		-0.86	
municipality size (ref.: less than 5 000 inhabitants)										
5 000 to under 20 000	0.23		0.24		-0.05		0.10		-0.05	
20 000 to under 100 000	0.19		0.30	*	0.04		0.27	*	0.13	
100 000 to under 500 000	0.13		0.32	*	0.08		0.37	*	0.15	
500 000 and more	0.25		0.35	*	-0.09		0.31	*	0.28	*
5 000 to under 20 000*female	-0.04		-0.09		0.09		0.03		0.09	
20 000 to under 100 000*female	0.15		-0.05		0.03		-0.09		0.05	
100 000 to under 500 000*female	0.14		0.04		0.04		0.00		0.12	
500 000 and more*female	0.23		-0.09		0.18		-0.07		-0.03	
motorization (ref.: car is always available[a])										
car not available[b]	-0.34	*	-0.21	*	-0.22	*	-0.05		0.02	
car not available*female	0.16		0.17		0.19		-0.12		-0.08	
limited car availability[c]	-0.07		-0.05		-0.11		0.01		0.00	
limited car availability*female	-0.08		0.05		0.05		-0.02		0.10	
constant	-0.73	*	-1.07	*	-1.12	*	-1.20	*	-0.74	*
Nagelkerke`s R^2	0.10		0.09		0.11		0.05		0.05	

[a] persons with a driver license and at least as many cars as potential users (persons with driver license) in household
[b] persons without a driver license and persons with a driver license but no car in household
[c] persons with a driver license but less cars than potential users (persons with driver license) in household
significance level = 0.1% (5 % / number of tests = 53) after Bonferroni-adjustment; * = significant

7. DISCUSSIONANDCONCLUSION

We find shopping trip participation is greater for womenthan men in both our descriptive and multivariate analyses. This is widely independent ofsocioeconomic factors and observable for every survey year from 1976 until 2008.

Interestingly, the descriptive analysis shows increasing shopping tripsfor men living with a partner, butthis does not result in fewer shopping trips by their female partners. This suggests the relevance of societal norms on the one hand and preferences on the other hand, both of which are interrelated. An explanatory approach is the concept of 'maternal gatekeeping', meaning that women hold on to 'typically female' tasks even though their partners increase or try to increase their contribution. Inthe case of shopping this could mean that men increasingly accompany their partners on shopping trips.

Furthermore, the higher shopping trip participation of women observableeven among singles has to be emphasized. This is noteworthy, especially as genderbased role theory is to date the most common explanatory approach for gender-specific activity patterns and trip purposes.However, among singles labor division has no relevance. Other explanations must therefore be found. Primarily, gender-specific preferences seem to be a relevant factor at this point.

Other findings also suggest the relevance of 'soft' factors such as societal gendernorms but also individual norms and preferences. Firstly, even among full-time employees women undertakemore shopping trips. Secondly, there is a remarkably largedifference between mothers and fathers concerning their shopping trips. This goes beyond the gender-specific employment patterns within households in terms of the male main earner and the female additional earner (controlled for in multivariate models). Moreover,it is consistent over time and therefore suggests norms and preferences with a particular relevance for families with children.

To sum up, some of our results can be interpreted as indicating that 'soft' factors such as societal and individual norms, preferences and attitudes arerelevant for gender-specific activity and trip patterns.

However, the data base has important limitations. The KONTIV and MiD data do not contain direct information on lifestyles or preferences. This is why our conclusions concerning these 'soft' factors are more indirect. Furthermore, there is no information on the division of indoor work. Therefore, it would be desirable for future surveys and studies to bring together information on travel behavior, indoor labor division, lifestyles and preferences. This would allow interesting analyses of the relation of individual and societal gender norms, preferences and everyday life and mobility from a gender perspective. Qualitative surveys and studies on this topic would undoubtedly be a worthwhile supplement to this.

8. ACKNOWLEDGEMENTS

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Women-Only Passenger Cars in Cairo's Metro: Widening the Gap to Bridge it Later?

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(This text is a revised version of the first abstract sent. The full article will be submitted by November 1.)

The research presented here is a part of broader research project that studies male-female interactions in different subway systems, particularly those where sex segregation has been in operation. This project involves a community of researchers: Martin Aranguren, Carole Gayet-Viaud, Perrine Lachenal, Rashmi Sadana, Mina Saïdi-Sharouz and Stéphane Tonnelat.

The research presented here looks at the institutional decision to separate men from women in within the context of urban transportation, based on a case study of women-only passenger cars in Cairo Metro trains. This work-in-progress research aims to identify the reasons why the decision to institute such a system was taken, at the end of the 1980s (3 years after the opening of Line 1, not before), to launch these cars, and how these reasons are currently being updated in reaction to the resistance of men who have been deliberately entering women-only cars, particularly since the 2011 revolution.

In Egypt (Khalifa, 2011), as well as in other countries concerned by women-only cars, the literature (Horii & Burgess, 2012; Sadana, 2010; Tara, 2011) focuses on the practical implications of the system for the passengers. Here, we intend to understand who decided that the separation was the most suitable response to the harassment problem in transportation and why. Importantly, we aim to determine which alternative solutions could have been taken and why they have been ruled out. This means analyzing how the issue of harassment in public transportation in itself has emerged as a public problem.

Our research method consists of interviews with the stakeholders (institutions, lobbies, public) involved in both contexts (the launch of the system as well as the post-revolutionary challenges to it), analysis of press articles, and study of historical archives. As the institutional stakeholders (National Authority for Tunnels and Cairo Metro) felt reluctant to speak about what they considered to be a subject and fearful that information supplied may harm their country's international reputation (Abu Amara, 2011), we decided to focus our interviews on representatives of women action groups (associations and NGOs). This has allowed us to examine the question of institutional intentions of the sex segregation in the subway while approaching it from the perspective of its reception by the civil society. Furthermore, it has opened up a new field of research: how women's activist organisations might use sex segregation as an effective way to combat harassment inside subway cars (as some women passengers are doing), and the linking of this issue to a political agenda. The development of closer ties with women's activist organisations is an opportunity to increase the potential for the practical implementation of this research by practitioners.

A short comparison with other cases across time (New York, 1909 ; Tokyo, 1912) and space (for the case of Mexico: Hancock, 2000) will help to demonstrate that factors specific to Egypt play a secondary role in comparison to more transverse factors such as class.

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Travel Experiences in Delhi's Autorickshaws after the Nirbhaya Tragedy

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The cities are not always experienced positively by women, it is even seen as an area of obscenity and deviance, a space of anxiety and insecurity which participates in the marginalization of women and in their exclusion from public place. This paper finds that after the Nirbhaya tragedy (sexual assault of a 23 year old in Delhi in a bus) the government's effort to improve the safety of women travelers have been minimal. The travel diaries of 12 women and 6 men indicate that the government's public notice against harassment by auto drivers has been ineffective. The participants (both men and women) are still being overcharged, refused and facing misbehavior. Women participants in this group do not use the new helpline instead they use other methods to ensure their safety. Public places and auto rickshaw travel still remain unsafe and unpredictable after 10 months after the Public Notice against "Harrasment by Autorickshaw Dirvers" was issued by Delhi Transport government and 11 months after the Nirbhaya tragedy .

Introduction

Sexual assault [1]of adolescent and adult women has been called a silent epidemic, because it occurs at high rates and yet is rarely reported to the authorities. (1) The issue of sexual assault and sexual harassment[2] specifically street assault, and violence against women in public space is quite common when gender inequalities are present. (2-5)

The cities are thus not always experienced positively by women, it is even seen as an area of obscenity and deviance, a space of anxiety and insecurity which participates in the marginalization of women and in their exclusion from public place. (5)
Women constantly have to deal with remarks and improper behavior. This can be verbal violence, sexual attacks such as touching in public transport or even in extreme cases rape committed individually or in groups. (5-6) In some countries, aggression in the public space affects even women who are with men. The fear of women is to have remarks or be harassed while accompanied by their father, husband, or a male friend may result in deadly altercation.

> On December 16, 2012 at 8.30 pm, a 23-year-old medical student stepped out of a South Delhi mall after watching a film with a friend and the two first took an autorickshaw. At 9 pm, they boarded a private licensed bus. Some time later, the bus diverted from its normal route and six men ganged up on the 23-year-old after beating up her friend. She fought back, but was repeatedly sexually assaulted and her abdomen and private parts were badly beaten. At 10 pm, she was stripped naked and was thrown off the bus. For the next 25 minutes the Nirbhaya (braveheart)[3] and her male friend kept begging for help from the passersby. It was only around 10:30 pm that a PCR van reached them after receiving a call from a passerby. By the time the PCR van arrived, the two of them were surrounded by locals but none of them gave a helping hand. 7)

The association between aggression and intoxication and aggressive behavior has been observed in one form or the other for many years and across many cultures. (8) Although estimates of the proportion of violent crimes that involves alcohol vary considerably depending on the type of crime as well as the country it occurs, studies done estimate that 50 percent were drinking before their offense, (8 quoting 9) In India, harmful and dependent drinkers were more likely than moderate drinkers to be illiterate, have no education, and receive low pay than moderate drinkers. In addition, harmful or dependent drinkers were more likely than the remainder to be at medium risk of psychological disorder, use tobacco or report having been the victim of crime or perpetrated interpersonal violence in the past 12 months (10). Four men who had never completed high school and were harmful dependent drinkers perpetrated the Nirbhaya incident on December 16, 2012.

> It was a Sunday evening routine: heavy drinking, some rough, rustic food, and then out in the bus, cruising Delhi's streets looking for "fun". This particular Sunday, 16 December last year was like many others for Ram and Mukesh Singh, two brothers living in a slum known as Ravi Das Colony. The "fun", on previous occasions, had meant a little robbery to earn money for a few bottles of cheap

[1] **Sexual assault**: The full range of forced sexual acts, including forced touching or kissing; verbally coerced intercourse.
[2] Unsolicited verbal or physical behaviour of a sexual nature.
[3] Disclosing a female victim's identity, is an offence under section 228(A) of Indian Penal Code.

> whisky and for the roadside prostitutes who work the badly lit roads. (11)

This tragedy would not have happened if one of the auto rickshaws had given them a ride.

> I might have passed this over as a routine risk that women in Delhi live with. But now I think the story should be told, especially after Nirbhaya's friend has revealed that none of the 50-odd auto-rickshaws at the Saket malls agreed to take Nirbhaya and him to their destination. If one of them had, they wouldn't have taken that deadly bus and Nirbhaya might have been alive. (12)

The auto rickshaws play an important role in the transportation system (Figure 1). The autos are taken for distances ranging from (1 to 10 kms). There are currently about 70,000 autos in Delhi (the precise number is unknown). Different drivers drive most autos for two daily shifts. So, there are approximately 120,000 to 130,000 drivers. (Harding 2011)

While the city and country was still seething with anger after the Nirbhaya case, Priyanka Singh, a journalist from Times of India (TOI) published her personal experience with an autowallah (auto driver) three weeks after the deadly tragedy. Singh was refused a ride and was threatened when she warned him that she would lodge a complaint with the police. (Singh, 2013). When she called the police, she found them unresponsive, and she tried other help lines to get help that were futile.

> I tried calling up this number several times but the line kept on beeping. I tried the women's helpline, 181, but it went on ringing. (12)

After her article was published, the Union home ministry ordered a probe into the non-responsiveness of Dial 100 helpline her. (13) On January 23, 2013, the Government of Delhi issued this notice(14) :

> It is brought to the notice of general public that a helpline of the Transport Department, Government of NCT of Delhi is functioning round the clock at telephone no. 42-400-400. Incase of refusal or overcharging or misbehaviour by the Autorickshaw drivers; the commuters are requested to register their complaints at this helpline by dialing **42- 400- 400**. All such cases are investigated and strict action including the prosecution of the Autorickshaw owner/driver and suspension of the Permit is taken in such cases.

The objective of this paper is to make a qualitative determination through travel diaries, whether commuters (both males and females) were still facing "refusal, misbehavior, and overcharge" after the Nirbhaya incident and when they did, how useful was the helpline to address their concerns.

Methodology:

Participants were recruited for this study using a social media network. The request to participate in a study based on travel diaries was sent out in January 2013. The prospective participants had either been taught by the author or knew of the author through their friends. Most were still undergraduate students. Initially, 50 participants were interested but for different reasons the final group came down to 12 women and 7 men. The age of the participants varied from early 20s to mid 20s. They were mostly undergraduate architecture students. The participants were given a template that

instructed them how to maintain their diaries. The diary was to be kept for consecutive seven days by the participants. The diary would describe their journeys, the modes of travel, personal reflections, observations, and pleasant and unpleasant experiences, time of the day and day of the week. They were also asked to indicate whether they traveled alone or in a group and whether the experiences were different depending on the number of people traveling. The diaries were completed between February and May 2013. The diaries were followed up with an online discussion in November 2013. The online discussions were conducted so that the author had an opportunity to talk in depth about the issues that the participants had brought up in their diaries. The topics that were discussed online were: influence of gender and auto, women and men's experiences in autos, auto travel in other cities compared to Delhi; reaction to the auto helpline; helpline abuse; and effect of Nirbhaya incident on their every day life. All the participants preferred to use their first name and reviewed the statements presented in the findings for accuracy.

Findings

The travel diaries indicated that, both men and women participants relied on autorickshaws for convenience but they also shared their frustrations with them in Delhi. The level of frustration with autowallahs was high in almost all the diaries and it was clear that over the years the unpleasant experiences with auto in Delhi had built up. One of the male respondents compared the drivers "to living images of Satan. He further added a cautionary note for people with health issues trying to ride an auto:

> …trying to catch an auto in Delhi is a real test of patience. It's not a task with weak hearts or those suffering from hypertension and other blood pressure related issues. Yasir, Undergraduate student intern

In a city of teeming millions there are many roads and lanes that do not conform to standard road designs, autos offer the best mode of transportation after cycle rickshaw. They are greener alternative to traveling in single occupancy vehicles where roads are extremely congested and parking spaces are hard to find. However, in this excerpt from Aditi's diary (undergraduate architecture student), all her environmental goals were shattered during her journey.

> Autos are a great way of travelling this city. They are less expensive than taxis and unlike buses, they take you to the doorstep of your destination. Yes, they definitely saving my petrol (gas). And since they are run on CNG they are also causing less pollution than my car. I had to reach Vasant Kunj at 3 pm to meet my old friend. I left around 2 pm, assuming 45 minutes would be enough. Well , the guy took the longest route possible 'cause I never specified a route to him ! He took me all over from Tughlaqabad and God knows where and told me he is trying to avoid the traffic. For a route which should have been no more than 80 bucks and 45 mins, the fare showed 200 bucks and he took me almost one and a half hour to reach! This was insane.
>
> Aditi, Architecture student

The two consistent complaints about auto drivers are that they overcharge and they refuse passengers. Their meters are often broken, tampered with or simply never turned on, forcing the passenger into a bad-temper haggling on the road. If a mutually acceptable

price proves elusive, the driver just speeds off. (Harding 2013) The diaries provided by the participants showed that both men and women had experienced the consistent complaints that Harding (2011) had written about. Overcharging was the most common complaint for both the genders. The "autowallahs" pick up a sense of urgency when a prospective passenger approaches them and the drivers start with a higher price. Men tend to "somewhat" effectively bargain down the price.[4] Almost all the participants who kept their diaries and participated in online focus groups seem to have been unhappy with their negotiations and some did conjure up ways to get back at this blatant unfairness:

> An auto driver is a man that is out to loot you for every cent that you have in your pocket. They will almost never agree to go to a destination that you wish to go!! If they agree to the location, they will not agree to go via a meter as ruled by Delhi government as fair practice but instead charge you double or even triple if they notice you are desperate. I finally give in to pay 60 rupees [5]to get to a place where it would cost 35 rupees if he went by the meter. I sit in the vehicle cursing him in my mind… angry and upset, fantasizing in my head to pay him nothing when I get there.
>
> Diary of Yasir, Architecture Student Intern

Although numerous websites offer advice on ways to avoid being over-charged, they are not very effective. Saad was an architecture student intern when he poured his anger and frustration of rules being broken in his diary

> Being overcharged here in Delhi, is a daily routine. If the rate to a particular destination is around 80 rupees by meter, they usually ask for 120 rupees. After some negotiation both the parties agree for 100 rupees. But, in the case of tourists and foreigners, they usually charge 150+ rupees. They also charge 20-30 rupees extra for excessive baggage (the suggested rate is Rs. 7.50). There are very few auto-rickshaw drivers who agree to travel by the meter. Even after new tariff and safety rules, the law is broken everyday…sometimes, it's very annoying, when multiple autos stop at your request, ask the rate for the destination, simply reject and move on, in such cases people usually agree to pay extra.
>
> Diary of Saad Architecture Student Intern

Women participants are routinely over-charged. Their reactions with over-charging vary by time of the day, their personalities, whether they are in a group or a combination of these factors.

> I was running late…. I am not very good at bargaining with the auto-rickshaw drivers. For a one-way trip to … University, I should be paying around Rs. 75 to reach the college, which would be in accordance to the meter. But more often than not, I end up paying Rs. 90 which is '*Vajib' or* appropriate in their 'haggle-jargon.'
>
> Taru , Architect and Assistant Professor

Rahema, was still an architecture student when she wrote her diary. She found that autowallahs were particularly difficult and moody when ladies with shopping bags sought

[4] There are numerous websites such as these that offer advice to avoid being over-charged. http://goindia.about.com/od/delhitransport/qt/delhi-auto-rickshaw-guide.htm

[5] No conversion was made from rupees to dollars. The objective of this paper is to show the variability in the auto fares would not be as clear.

rides. It was late in the evening and she was shopping with her mom. After several futile efforts of trying to hire an auto, she gave into paying extra to the autowallah to get a ride back home.

> The day went well (shopping) but we were so tired that we decided to take auto instead of a bus. Autowallahs when they see you with lots of bags in your hands and tired faces suddenly, God knows why, they start acting too smart. We asked 5-6 autos some said clearly NO, one of them was going to charge extra and another was not interested. Finally, one of them agreed but asked for extra Rs. 30 since. It was getting late and we couldn't find any other auto so we agreed.
>
> Travel diary of Rahema undergraduate architecture student intern

Female passengers have developed different skills that they use to avoid being cheated routinely. Sonam in this section of her travel diary wrote that once she pretended to be a law student and approached this as a teachable moment.

> Today was a mild cold day, so I preferred to walk till I found my auto and to my surprise the auto driver agreed to go by the meter. Although he had agreed, he was still trying his luck at getting extra money. I lectured him on the importance of truthfulness while acting as a law student till I reached Govindpuri metro station. I paid him by the meter, exactly 30 rupees. The auto driver said he has hardly ever spoken to a female traveler let alone a woman teaching him his moral duty.
>
> Sonam Architectural student intern

The door to door service of autos offer an opportunity for travelers to trip-chain--getting multiple errands done in different parts of the city-- which would be difficult by traditional public modes of transport. Haggling and overcharging are routine hassles and when it doesn't occur it is so unusual that the diary participants commented on it favorably.

> Had taken leave (from work) today for some documentation work. I went by an auto to reach the place. It is a sort of a relief when the auto driver charges by the meter. No *jhik-jhik* (hassle*)*. Easy journey. Again, took an auto till Nehru Nagar to where I had to meet my sister.
>
> Travel diary, Sadiqa, Architect

> … left from home, took an auto. An unusually decent guy, who agreed to go by meter rates, took me to college via Lajpat Nagar. I picked up my colleague at Lajpat and we reached the college together.
>
> Travel diary Taru, Architect and Assistant Professor

Influence of Gender in getting an Auto

There was no clear way of determining whether men have more difficulty in finding autos compared to women in Delhi based on the travel diaries. The online focus group November, 2013 discussion indicated that the *autowallahs* were driven by maximizing their earnings not by "humanitarian" reasons as one of the male participants (Maarif) clarified. One of the female participants (Taru), shared that most *autowallahs* know that with male passengers they cannot charge exorbitant amounts or misbehave. Yasir, a male participant, has assisted his female friends to bargain down the prices charged by the drivers late in the evening. He expanded, that men often volunteer as a courtesy to negotiate the auto fares for their female friends.

> Friday evening around 11 pm, the female friends have either left or leaving, we are bargaining for them with autos and rickshaws to take them home.

(From Yasir's diary)

However, these negotiations are not very successful. When the autowallahs sense that it is a male intervention for a female, they charge a higher price. Yasir further added, "Some reduce the cost, most don't, especially if it's late and there are few autos." Women in the group confirmed that they normally don't ask their male friends to negotiate down the fares but they appreciate these gestures.

Another male participants (Salil) somewhat agreed that males have difficulty with autos but explained that most often than not, when they have enough time, male students choose the metro or the busses because these alternatives are a lot cheaper. Sadiqa didn't seem to see a gender bias in securing autos. Instead, she strongly felt that the autos consented to take passengers only if the routes and the destinations met their expectations.

> Once I had to go to the railway station in the evening...I asked about 30-odd autowallahs (no exaggeration) and NONE of them agreed...they will only care if the route suits them-male or a female-doesn't matter.
>
> Sadiqa, Architect November 2013 online discussion

Men participants negotiate aggressively when they have time and when they do not, they too suffer from being overcharged. Maarif had started his architectural internship and was working long hours. Here are three different experiences he had with bargaining and being over-charged by autowallahs ondifferent days and at different times of the day.

> I hurry to the bus stop not to take the bus but to catch an auto. Getting an auto has becomes an everyday ordeal and I get an **auto after seven disappointed negotiations.** I reach office at 9.20 am. (Maarif's diary)
>
> It's 2 in the morning…At this hour negotiating with the auto-wallahs needs utmost patience and a cool head which I didn't have. The first rate quoted to me made me lose my calm almost to the point of getting physical. I was so appalled by his audacity that it brought out extreme emotions. For a journey that is Rs. 90.00 by the meter (including night charges) became Rs.150.00. I somehow control my emotions with a grin pasted on my face as I proceed to the next auto. He says he will charge Rs. 120. I have had a long day and am in no mood to negotiate further with any of the others. I decide to wait for some time more and I saw another auto arrive after five minutes. I get back home for a hundred rupees: just Rs 10.00 extra, I am proud of myself (Maarif's diary)
>
> I have made up my mind to hop into the first auto that comes my way. And that is what I did. I hop into the auto and then inquired about the price. It's a huge mistake. He says he will charge Rs. 170.00 straightaway. I bargained it down to a somewhat to Rs. 160 (I am not good at bargaining and I didn't have the time either). I reach the station just in time for the train. The driver has already charged a good Rs. 60 extra yet he asks for a bakshish (tip), I am stupefied, but being in no state to argue, I give him two hundred rupees note while he gives me back only twenty rupees instead of the forty he owes me. I take the money and rush to the train.
>
> Maarif's diary, Architect student intern

All the women had unpleasant experiences during the seven days they kept their travel diary. Women have to be extremely cautious and worry about different security issues. Most women write down the auto license number and text it to friends and family members while hiring autos. The frequency of texting was extremely high after the Nirbhaya incident. Nooreen, an undergraduate student, had written in her diary that many of her women friends had started to carry pepper sprays as a precautionary measure. Women also rely on male companions or male assistance for safety while using autos. Aditi had written in her travel diary that when one of the autowallahs took an unusually long route and overcharged her, her male friend whom she was meeting up with had intervened and brought down the price at the destination.

Men take different approaches in lending assistance to their women friends. Late in the evening they are more likely to assist, also, during festivals when they are difficult to flag down autos they volunteer to help. It's a gesture of courtesy. They explained, that none of their female friends asks them to do so but it was normal to do so. They may also offer to accompany back their friends. In most cases, they write down the auto numbers and keep in contact with their female friends as they take the rides.

Women and Autos

Women approach autos warily in Delhi. The travel diaries of the women who participated showed that they are cautious and careful. This was further strengthened during the online focus group discussion in November 2013.

> A girl in Delhi knows to be suspicious. Yes - easier prey. Some autowallahs talk a lot. Some may try to flirt. It is ridiculous. The best bet is - if you are in such a situation - avoid that autowalla or spend half an hour with him in the auto while he made a fool of himself. (Taru, Architect, has had numerous encounters with flirtatious autowallahs shared in the online discussion in November 2013)

Another woman participant, Sadiqa shared that while she personally didn't face overly-friendly auto drivers but one of her colleagues had.

> One of my office colleagues was once returning from the station to Kalkaji and to her shock, the young autowallah asked for 'friendship'. She left the auto immediately making an excuse and hired another one. (Sadiqa shared in the online discussion)

Kashish has graduated last August with an architecture degree. She prefers traditional attire and hijab when she is in public places. In the November 2013 focus group discussions, she summed up her experience with autowallahs as they being sexists and with no scruples.

> I have experienced some auto rickshaw rides with my friends where the driver had started playing stupid romantic songs, looked into the rear view mirror to see us, initiated topics to talk about (although we showed no interest to answer), wanted to take the longer route saying that the shorter route has a traffic jam, charging higher than the meter price if there was a traffic jam, not dropping us to the exact destination, etc. I think these things can happen only with girls. Guys are physically stronger and can challenge the auto rickshaw driver easily unlike girls. (November 2013 online discussion group)

Falak has moved to Lucknow after becoming an architect in August 2013. She confirmed what Kashish had summarized about autowallahs:

> I agree with Kashish with what she mentioned about the auto-wallahs. They're smitten by the young women passengers and they keep adjusting their rear view mirrors. Sometimes they're comical when they sing songs inspired by what color the female passengers are wearing. (November 2013 online focus group)

Sadiqa added that she never took a shared auto where a male passenger was already sitting in the front. Her suspicions and fears with such a scenario were based on anecdotal evidence that she brought up in the November 2013 online focus group discussion.

> My roomie's friend once hired an auto with a guy sitting in the front. When the guy got off, he touched her and ran...he was caught up and beaten. (The woman had yelled out what he had done, and the people around beat him up) (November 2013 online discussion group)

Nooreen an undergraduate student had observed an interesting difference in her travels by auto.

> Here is another interesting "fact", if a girl alone tries to stop an auto rickshaw they always do agree to drop you but if a guy with you tries to hire one they would never agree to go. I don't know if it's done out of goodwill or is it another thing to make girls feel uncomfortable. (Nooreen's diary)

She explains her diary entry more during the online discussion. Although, it seems like the autowallahs do care and stop for women who need rides, she seriously doubts that it is out of concern. She explains, that if they were truly concerned, then they would also stop when a guy accompanying the girl wants to hire an auto. To her, it seems suspicious and scary why an autowallah would only stop for a girl alone. She is not at all convinced that the autowallahs stops for girls only because they care for their safety. (Focus group November 2013 online discussion)

Noreen emphasizes her mixed feelings of having male company for safety and resents the lack of preparedness when time comes to step out of her comfort zone.

> Well I reached home safely today, as may be because I had a male company. Well, it's definitely not a good sign for me as I just can't be so much dependent on somebody all the time. One of these days I'll have to step out alone at an "odd" hour and I won't be prepared. (Travel Diary Nooreen)

Rahema, was still an architecture student when she wrote her diary. She found that autowallahs were particularly difficult and moody when ladies with shopping bags sought a ride. She wrote of an instance when she was traveling with her mom and finally gave into paying extra after many futile efforts.

> The day went well (shopping) but we were so tired that we decided to take auto instead of a bus. Autowallahs, when they see you with lots of bags in your hands and tired faces suddenly, God knows why, start acting too smart. We asked 5-6 autos some said clearly NO, one of them was going to charge extra and another was not interested. Finally, one of them agreed but asked for Rs. 30 extra. It was getting late and we couldn't find any other auto so we agreed. (Rahema undergraduate architecture student intern's diary)

In the November online discussions, Archna, responded as being lucky to have not encountered any problems with autowallahs. She has been living in Delhi for the past five years and has not been a victim of

an autowallah taking her the longer way to her destination. A few times though, she had to ask the auto drivers to turn on the meters but other than that, she seemed to have had favorable experiences.

How do Delhi autos compare to other Indian Cities?

In the November 2013 online focus group, the participants compared their experiences in Delhi with other cities. Travelling to new cities and taking autos is stressful pointed out one male respondent (Salil, Undergradiate student In Architecture) "in a new city one can be overcharged or fooled easily." There are fair charts posted online for major cities to alleviate some of the problems associated with over-charging but the experiences varied considerably based on the city they traveled to.[6] Salil had the worst experience in Bangalore where he stayed for a month. (He had pleasant experiences in Hyderabad, Ahmedabad, Varanasi, Mumbai and Kolkata.) In Bangalore, he relied on autos more than other modes of travel and felt that the language was a barrier. As a North Indian used to Hindi he found it difficult to communicate with the *autowallahs* in Bangalore. Lohit, an undergraduate architecture student participant, confirmed the language barrier definitely exists in Bangalore. The autowallahs in Bangalore chose not to respond if the passenger didn't speak in Kannada the local language. Lohit, Yasir and Anadit concurred with Salil about their worst experience in Bangalore. In Bangalore, the fares are too high and the drivers are extremely rude and according to the male participants-- they are worse than Delhi. (Salil had devised a plan to avoid being overcharged. Not knowing the going rate for different distances, he would offer 10-20 rupees over the meter bill and this worked. He felt he had control over the price and was not asked an exorbitant amount.)

Maarif who moved to Mumbai for graduate studies after completing his undergraduate in architecture in Delhi, found that the autowallahs are better both in terms of following the fare chart and their behavior in Mumbai compared to Delhi. Their minimum fare was lower than that of Delhi's although the cost of living is about the same in both the cities. According to Maarif, the autowallahs of Guwahati were not rude like those in Delhi, but they often charged two to three times the fare. The meters are all broken so overcharging is the norm.

Anandit who is working as an architect shared his pleasant experiencs with auto in Ahmedabad. The autowallahs go by the meter and always set the meters to zero. He found them well behaved and he attributed it to being the "land of Gandhi" (Gandhi was from the state of Gujarat where Ahmedabad is located). He compared his experience between the two cities, Delhi and Ahmedabad.

> It must have been around 2130 hours or so. We were waiting for an auto. None came. After about 15 minutes of walking in the direction we were supposed to go, one autowallah stopped. We asked him to go to the university, he told us to hop in and reset his meter to zero. Usually in Delhi, if one is looking for an auto at such an odd hour, there is almost zero probability that the first auto that comes your way would agree to go to the destination and not charge an exorbitant rate. There is no chance that autowallahs in Delhi would go by the meter after office hours. (Anandit, travel diary)

Saad another graduate student commented on his wonderful experience in Kochi, Kerala.

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[6] Autorickshaw fare charts for some of the major Indian cities.
http://goindia.about.com/gi/o.htm?zi=1/XJ&zTi=1&sdn=goindia&cdn=travel&tm=39&f=11&su=p284.13.342.ip_&tt=13&bt=0&bts=0&zu=http%3A//www.taxiautofare.com/Default.aspx

> As 3rd year architecture students, we took a trip to Kochi, Kerala (state in Southern India). Believe me, I have never seen such educated, polite, honest and humble autowalllahs anywhere and so eager to help. We also noticed a few women autowallahs...

Yasir was visiting Jaipur, Rajasthan (a state in North west of India) during the online focus group discussion was going on. He wrote back from Jaipur that he found that auto's responsible and not overcharging them.

> ...even though I was staying a bit out of the main city area it was easy to commute anywhere. One autowallah actually made it his point to get us another auto as his lights stopped working because it wouldn't be safe for us. Such a difference in attitude! And we are only a couple of hundred kms away from Delhi.

Women shared their experiences with autos outside Delhi. Tavishi was a student when she visited Varanasi. She felt unsafe and insecure in the city. She was surprised to hear from their guide that women don't walk in the evening. She was advised not to venture out in the evening in Varanasi. Riding an auto alone was deemed unsafe. She found the attitude and mannerisms of the autowallahs in Varanasi offensive and only traveled in autos when she had friends accompanying her. She is currently living in Ahmedabad and she finds autowallahs in there much better than in Delhi and Varanasi. They are courteous, caring, and helpful. She also pointed out that a new application is available for the smart phones in Ahmedabad. Travelers can download the application on their smart phone people are good to go. There is no need to ask for the meter card from the autowallah because the application tracks the ride through GPS and provides the correct fare based on the time of the day.

Two of the female participants, Wafa and Sonam had great experiences in Mumbai. Wafa also had a great experience in Ahmedabad, while Sonam had a pleasant experience in Chandigarh. Their comparison of these cities and Delhi are quoted below:

> In my experience, the Mumbai autos are the best...they're not rude and they don't even charge extra...they always go by the meter reading. In Ahmedabad too, the autowallahs are friendly and go by the meter. They don't say no to you unlike the ones in Delhi. (Wafa, Architect in November 2013 online focus group)

> I have had a very good experience with the auto in Mumbai. They don't overcharge at all (or maybe in my experience they never did). Contrary to the extremely indifferent and 'moody' autowallahs in Delhi, they are very professional and honest. You just stop autos in Mumbai and sit inside as a matter of right and it's so obvious once you are in. The driver will take you to the destination no questions asked. I have travelled in Chandigarh via auto and it wasn't much of a trouble finding one. All I had to do was tell them where I had to go. I went twice and travelled in auto most of the times. (Sonam, Architect in November 2013 online focus group)

Rahema has completed her architecture degree last August. She is also a seasoned traveler. Here are a couple of pleasant experiences she shared in the online focus group.

> In Agra, they have highly decorated autos and autowallahs are generally friendly and if you are a tourist they'll tell you about what all to eat and where to go.

> Autowallahs of Mumbai don't overcharge. The drive carefully and are all soft-spoken. They are

> always ready to go by the meter. First, you have to tell them where you have to go, then you sit in auto, next they'll turn on their meter on their own and take you there. The fare is reasonable.

Rahema found the autowallahs to be the worst in Bangalore. During the November 2013 online focus group, she describes the incident when her friend faced language discrimination.

> As the city is booming many North Indians have settled in the city. Bangaloreans are left with very little option of public transport unlike other cities …autos are frequently and most commonly used. The drivers are well aware that we don't have an option. Once my friend took an auto from MG Road to her college hostel…She got a call from her mom, when she started talking to her in Hindi he figured that she is not a Kannidiga (local). When she got down from the auto, the meter showed Rs 78. She didn't have change so she had to give him Rs 100. Instead of giving her the change, she asked her for 50 more. When I refused she started abusing me in Kannada, "you north Indian girls come and dirty our city". The moment she replied in Kannada to him and warned him that she will be calling police, he left. Autos in Bangalore are a serious menace.

Women during auto strikes

The diaries of the female participants indicate that they rely on autos for various reasons, they are cheaper and greener alternative to driving; ensure on-time arrival compared to buses; offer the ability to accomplish several different trips and most importantly, women can avoid crowded buses. Autos also offer an important service of being a feeder mode to buses and metros. They also help women avoid walking through "gendered" spaces and poorly defined sidewalks due to lack of encroachment control. When autos strike, journeys become even more harrowing.

> After waiting almost fifteen minutes for an auto to show up, I realized that something was amiss. On asking the hawker (vendor) who had set his shop on the sidewalk, I was duly informed that the auto-rickshaw drivers are on strike. A list of issues with the government, including authorized parking spaces, an increase in their daily fare….I ended up walking for half an hour to Greenpark bus station. Delhi is not very friendly to pedestrians. Usually there are no sidewalks, or they are boarded up or encroached upon – not by street vendors but by the huge bungalows that exist in this area. Half the road is used up by these very well-off people to park their cars …. (Figure 2a) A pedestrian ends up walking on the middle of the road, competing for space with automobiles (Figure 2b). I reached the bus stop, waited around ten minutes and caught the Green Bus that would directly drop me at New Friends Colony. The buses are great – they are comfortable and airy and they seem safe. The problem is that they are over-crowded. **I spent another hour, standing, squelched in a corner, in a bus more crowded than usual because of the strike**. **Thank god that it is February! This would have been killing in the summers.** Any way, I got to college around an hour late and exhausted. (Travel diary Taru, Assistant Professor)

When there are auto strikes occur, women are particularly insecure and not very eager to leave home.

> …there was no auto rickshaw **because of the strike. This day is definitely not safe for girls and women to travel.** Buses are passing me by at the bus stop in the morning and the people are literally hanging out of the busses. The buses are overloaded. Due to the protest, there were fewer buses as well.… So, after getting grip of the situation and not being able to come up with a decent reason to avoid office, I decided to get on the next bus. **When this next bus came to our stop, people were already wrapped around each other.** But I had to get on it anyway. I being the last person to get on, it took around 5 minutes to completely get in as people moved in inch by inch so that the driver could close the gates. (Travel diary Wafa, architectural student intern)

Wafa further elaborates with cynicism and disgust about how uncomfortable and dangerous are the days with auto strikes:

> **This day might have turned into a lucky one for all the losers in town, like the pickpockets, the cheapsters,** the flirts, the eve-teasers, etc. When being in a bus in a situation like this, groping and feeling up girls by men is really common. Those idiots take advantage of situations like these, where people are stuck and cannot move even a bit. As more and more people keep coming in, the space for you gets lesser and lesser and the rate of these inappropriate activities keeps on increasing…

Reaction to the Auto Rickshaw Helpline

Saad explained in his diary, after the *Nirbhaya* incident, the Delhi Police had set up a help line that is painted on the back of the autos that one could call. If an *autowallah* rejects any woman requesting for a pickup and a specific drop off, the woman can call the number and report. Theoretically, based on the complaint a heavy fine would be imposed on the auto rickshaw. When the online focus group was asked about the helpline,[7] they gave it mixed reviews. Sadiqa, an architect shared that she figures out alternatives instead of calling the number because she has limited faith in the police and their responses to incidents. Wafa, an architect was sharing her avoidance to call through this story

> About that number, I remember an incident that happened with a colleague's friend. The autowallah was overcharging and misbehaving with her. So, she immediately took out her phone and warned him that she'll call the helpline. In response to this the man took out his phone and clicked that girl's photo and told her that if she made that call, he'll forward it to other autowallahs and then she'll have to face the consequences. (Wafa, November 2013 online focus group)

Aditi, an undergraduate student found the helpline was not very helpful. Although, she describes one incident shared by her friend who had instilled some fear into the driver when she warned him that she will lodge a complaint against him. Her friend did lodge a complaint but what happened after that remained unclear.

The feeling of helplessness stems from the particpants' personal experiences with the Delhi police. Sonam had written in her travel diary that she had to call her brother and alert her parents when she was being stalked by an autowallah for more money. Prior to the call she had approached a policeman and asked for help. The policeman didn't want to be involved (this incident occurred after Nirbhaya tragedy).

> On my way back (from work) , no auto driver would agree to take me back unless I pay them higher than the standard meter rates. This becomes really frustrating when you are alone, and it's dark …. When I finally gave him forty rupees, he asked for twenty more and an argument started. **He started verbally abusing me and I was so embarrassed**. He was actually using this as a defense for himself. **He kept following me until I found a policeman and told that this guy is misbehaving. Not to my surprise** the policeman did nothing and said he didn't know the current trends for money and in fact requested me to 'sort out'. I then called my brother who is a lawyer and he finally came and sorted things out. My parents were drop dead worried throughout. They

[7] Ankur Bhardwaj, How to Complaint Against errant Auto-Rickshaw Drivers in Delhi http://kractivist.wordpress.com/2013/06/19/how-to-complaint-against-errant-auto-rickshaw-drivers-in-delhi/

were repeatedly suggesting me to change routes from now on, not go to office tomorrow and following days, and even suggested that my brother should drop me off and stuff like that. I seriously felt pain at that time. (Travel diary Sonam, Architecture student intern)

Witnessing daily incidents make people unsure of the effectiveness of emergency calls to the police whether they are witnesses or victims. Sadiqa, an architect shared an incident that didn't increase her confidence with the Delhi police's willingness to be involved.

On my way back from office, I once saw a woman, in her 40s, who seemed poor and was wearing a discolored saree, lying on the footpath, unconscious. When I passed - the scene was like this – the police van had just arrived. A policeman got out of the vehicle and came near the man standing next to where the woman was lying. The first question asked by the policeman was, "Haan Bhai…kisne phone kiya?" (Yes, Brother, so who made this call?) The policeman looked well-rested as if he had just finished a nap. The young man who had called the police looked terrified and answered guiltily, "Ji, maine…" (I did, sir). (As if he had committed a heinous crime to call the police up.) I left and I don't know what happened to that woman or to the young man afterwards, but I am pretty sure, the police must have wasted a lot of the man's time asking frivolous questions instead of helping the woman. Probably, this is the main reason behind people not helping/reacting in any inappropriate situation or an unpleasant scenario, even if they want to, which I strongly felt at that time. Even if somebody wants to help, the attitude of the police shatters the 1% chances of people getting involved. (Sadiqa, November 2013 focus group)

Helpline Abuse

There was an experience that one of the male respondents shared that brings to our attention to some of the issues faced by auto drivers. At times honest auto drivers (Figure 3) are vulnerable to classicism and unfair reporting system. Here is an example, described by Saad, a male undergraduate architecture student when he wrote this diary.

While travelling in the auto-rickshaw , the autowallah takes a right turn, when suddenly a motorcyclist comes near the autowallah and orders him to drive safely. The autowallah politely answered all right. The motorcyclist must have gotten into some trouble or was in a bad mood, because, he stopped his bike in front of the autowallah and started a traffic jam. The motorcyclist accused the autowallah of rash driving and started calling the traffic police in order to teach the autowallah a lesson. He called in the autorickshaw's plate number and forwarded it to the operator on the phone and started shouting at the autowallah. The autowallah then tried to note down the motorcyclist's vehicle number. Immediately, the motorcyclist snatched the autowallahs's pen and threw it away and then took off. In the meantime, I noted down the motorcyclist's number and called up the traffic police, and explained the entire situation from my perspective. The operator then replied that he would still fine the autowallah. I then defended the autowallah. He was the first one that day who agreed to drop us at our required destination on meter basis and he deserved some fairness. If the operator manning the helpline was imposing a heavy fine on him just on the basis of complaint that he had just received then this helpline is not working. The helpline was for the passengers to complain. It was not for traffic related issues. So, I pleaded with the person to reject the complaint, as imposing a heavy fine on some baseless traffic violation without having any proof or witness was a gross abuse of the system. Finally, he agreed and rejected the complaint and confirmed that he won't be imposing any fine now. By now the traffic was open and we were dropped at our destination
(Saad's travel diary)

Gaurav had become an architect. In his diary he had mentioned that he almost never took an auto before. During the November 2013 focus group discussions, he had started to do

so because of a pre-existing knee injury. His conversation with the auto driver offers an insight to what may be happening to all the complaints lodged against the auto drivers.

> Thankfully, I got one outside my house (as compared to the 10 min walk to the main outer ring rd where auto frequencies are higher). The autowallah switched on his meter. I asked him about the complaint numbers provided for the benefit of the commuters and how they had affected him and the auto driver community. He responded, "The government will do any thing to secure votes. The police are now busy because of the election. [8]Once that's over, they will be spending their days sitting in shady street corners. This is when they start hassling us. The police will ask for bribes to keep the cases brought against autowallahs off the record." The bribes, he added are also on behalf of the person manning the help line. For drivers like him, who follow the rules and are honest, end up paying after being wrongly accused. It's all about money and whom they can catch to get it.
>
> Gaurav, architect, online focus group

The distrust of police is pervasive. Their ability of being of assistance during an emergency is unpredictable. Roquiaya, one of the woman participant brought attention to the fact how the police spent their time assessing the jurisdiction of the Nirbhaya case while the victims lay begging for help. Roquiaya cited the following article:

> … three Police Control Room vans arrived at the scene only after about 45 minutes and wasted time in deciding under which police station's jurisdiction the case fell. National Commission for Women chairperson Mamata Sharma sought "strict action" against the policemen-…"Two people were lying on the ground. Even on grounds of humanity, they should have been taken to a hospital. But the police did not do that," she said. (15)

Gender and Keeping Informed

Both men and women keep their family members and friends informed of their whereabouts. One male architecture student, Gaurav, who is very independent and prefers bicycling over autos had humorously written in his diary:

> I prefer to report my whereabouts to my parents. … Whenever I go out, I'm supposed to call on reaching the destination or when the situation calls for it. But in case I forget, I receive a call from them. If I'm biking, and I receive the call, I am reprimanded for being irresponsible and talking on the phone while riding a bike. AND in case I don't answer, then, no church, temple, mosque or synagogue can save me from my mom's wrath

Salil is an undergraduate architecture student who is very independent and travels using various modes to his college. He always communicates with his parents and provides his travel plans particularly when he is running late or planning to work late in his college.

Both men and women have to be vigilant while they are getting a ride at night. In the online focus group, Kashish relayed a scary incident that her cousin had faced.

> Once, my cousin told me about a bad experience he had had with an auto rickshaw driver at night. The driver was making phone calls to his friends to meet him at some place which was on the route. My cousin used his presence of mind and started calling his friends to the same place with hockey sticks. The driver got scared and dropped my cousin to his destination.

[8] Press Trust of India, Post Delhi gang-rape, women's security a key issue in polls Wednesday, Nov 20, 2013, 12:09 IST | Place: New Delhhttp://www.dnaindia.com/delhi/report-post-delhi-gang-rape-women-s-security-a-key-issue-in-polls-1922018

Sana is an architectural student and she is cautious and makes sure her parents aware of her schedule after 6 pm. It has become second nature to her to inform them to alleviate their worries. She doesn't feel comfortable traveling alone and many a time she has a self-imposed curfew after 6 in the evening.

> Whenever I have to stay after 6 pm in the college I have to inform my parents before 5 pm otherwise they are worried. My father or my brother usually comes to pick me if I have to stay after six in the evening. Whenever I have to go somewhere after sunset my parents usually send someone with me. I also feel little uncomfortable after sunset to travel alone as the some of the area are not well lit and usually deserted after sunset. And, it is also very difficult to hire a rickshaw after sunset. So in short if I have to travel alone I have travel between 8 in the morning till 6 in the evening. Sana' diary

Kashish is independent and has become an architect last August. She usually informs her parents about where she is going and by what time she will be back home. She calls them when she is running late. On the other hand, her brothers don't inform their parents everything about their schedule for the day unless they are asked. Her parents are mostly worried about her.

When Sonam was still an undergraduate architecture student, she had an unpleasant experience with an autowalla(described previously). Her brother came to her rescue and her parents were understandably worried. The Nirbhaya incident was still fresh in every parent's mind.

> My parents were drop dead worried throughout. When I returned home, they repeatedly suggested me to change routes from now on and not go to office tomorrow and following day. (From Sonam's diary)

Both men and women communicated their daily travel plans to friends and families. The level of detail and frequency was greater for those who were still living with their parents. While the amount of information was less when the participants lived by themselves or in a hostel (dorm).

Effect of the Nirbhaya incident (December 16, 2012)

According to the participants, the Nirbhaya incident had changed every one forever. During the online discussion both men and women shared how their lives and travel were affected. Participants, regardless of their gender had to increase their level of communication with their family and friends. The students and recent graduates felt that their parents were overly anxious about them and they (parents) resented late night travels. Taru is a very independent and a capable woman who has lived by herself since her undergraduate days. As a young Assistant Professor, she had to teach evening classes but after the incident, her mom wanted her to leave her job.

> My mother wanted me to change my job. I leave college at 9 pm and for the first few days my mother was beyond worried. (November 2013 online discussion)

Sana has grown accustomed to her restricted movements and her self-imposed curfew.

> Whenever I have to stay after 6 in the college I have to inform my parents before 5 otherwise they are worried. My father or my brother usually comes to pick me if have to stay after six in the evening . Whenever I have to go somewhere after sun set my parents usually send someone with me. I also feel little uncomfortable after sun et to travel alone as the some of the area are not well

> lit and usually deserted after sunset. And it is also very difficult to hire a rickshaw after sunset. So in short, if I have to travel alone I have travel between 8 in the morning till 6 in the evening. Sana's Travel Diary

Sadiqa talked about the days after the event when the police had placed barricades all over the city and were checking the identification cards. According to her, the police were asking a lot of questions to couples who were travelling to Saket, Mehrauli, Munirka and Gurgaon (the area mentioned in the Nirbhaya incident). Women became reluctant to travel in the evenings. Men too, they didn't feel comfortable being stopped all over the city when they accompanied females. It seemed to her that the police were indirectly discouraging men to travel with their women friends.

> It brings strange emotions in me to share that I now feel scared to even go along with a single male friend in late hours, or to long distances. Now, I have to plan ahead and ask a number of people to make up a large group while going somewhere. It is extremely upsetting to cancel plans simply because any travel in the evening has now become life-threatening not only for me but the person with me, just because, I am a woman. (November 2013 online discussion)

Roquaiya was still a student when the Nirbhaya incident occurred. She recalls the sudden change in her parents' attitude. They became more anxious and worried if she was out after 7 pm. Prior to this incident, they never expected a call from her if she was as late as 8.30 pm, but now she has to inform them every 30 minutes if she stays out till 9.30 pm. One of her friends had to quit her studies in jewelry design, leave Delhi and return back to Lucknow because her parents felt the city was too unsafe.

Men were shocked, cautious and taking on different roles to ensure safety of the women friends. Gaurav described his personal feelings in the online discussion

> Openly speaking for all... WE WERE SHOCKED!!!!
>
> Vigilance became a major part of every day schedule. I also didn't call women to join me for bike rides. My rides are endurance types and usually I speed off often only to mark a rendezvous point and regroup there. For slow riders, this becomes an issue as they are constantly under pressure to keep up with me. And, when I take off, if something happens to the riders, then I am responsible. Neither I, nor they can enjoy the ride. (November 2013 online discussion)

Gaurav was finishing up his architecture degree when the Nirbhaya incident had occurred. After the incident. he was instructed by his mother to take care of his female friends and either accompany them during late hours or ensure they had a ride back home in the evenings. His mom wanted him to do everything to ensure his female friends didn't travel alone late in the night. Lohit had bought a pepper spray for a friend of his as a precautionary measure to carry all the time. One of his friend who travels with him to Gurgaon, a suburb of Delhi, got calls from her parents every 10 minutes or so till she would reach the metro, during the first few months.

Both Anandit and Yasir were very aware of the vulnerability of their women friends. Anandit was in Ahmedabad when he wrote the diary and he found that women were much safer there and travelled more freely without male company late in the night. Nevertheless, according to his diary, he accompanied women when needed. Yasir was in Delhi during and after the incident, he became extra alert and he not only ensured that women were able to secure autos late in the night, but also, he wrote down the license numbers of the autos as a precautionary measure.

According to Lohit, there were some positive changes after the Nirbhaya incident. It made the community more open-minded, People looked at male-female relationships with more openness and in a mature way. A male accompanying a woman was not ostracized or looked at with distorted lens. Lohit also felt that women took more charge of their right to be in public places and became more empowered to speak up.

Conclusion

The travel diaries and the online focus group give a more rich and descriptive picture of the issues faced by men and women while riding autos in Delhi The findings indicate that the young men and women in this group still have problems with overcharge and refusal by auto rickshaws. All the encounters in autos were not unpleasant but majority were. The participants were not too excited about the helpline. Some of their mistrust with such a helpline is because of their previous experiences with the police. The helpline has also been abused as one of our participants had explained and what one of the autowallahs had shared with a male student in this group.

Not all autos are out to get passengers (Figure 2). The students have encountered those who follow the rules. It would be unfair to paint all autowallahs as crooks. As Harding (16) pointed out that the autowallahs are victims of the system too.

> … after a sweaty 10- to 12-hour shift on a rock-hard seat, breathing in the city's traffic fumes, most drivers must hand over around half of their total income to their *maliks* as rent (around Rs 250-350) - leaving them with Rs 100-200 to take home to their families every day, sometimes less, or even nothing at all if the traffic police demanded a larger bribe than usual that day.

The students had found the autorickshaws to be professional, courteous and honest in Ahmedabad and Mumbai. The Delhi Transport Division should look at the best practices and learn how to modify the transportation system.

While we address the issues relate to autorickshaws we cannot ignore the constant threat that women face while they are out in the public places.

> Well speaking of today, it was a relief. Nothing unfortunate happened and I reached home safe …. Every time I go out, there is a sense of constant fear of the daily realities faced by women and girls in public spaces … Nooreen Undergraduate architecture student

The solution lies when the transportation system is not treated in isolation. For women to be able to use the transport system they need to feel safe accessing the mode and using it.

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Autorickshaws are typically three-wheelers and they usually given female names as pointed out by Lohit who took the photo.

Figures 2a (Photo by Yasir) and 2b (Photo by Anandit) Uncontrolled use of sidewalks by parking forces pedestrians out in the traffic.

Figure 3 An honest autowallah going by the meter. Photo by Yasir.

Are Millennials Really the 'Go-Nowhere' Generation?Divergent Patterns between Men and Women

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Abstract
News reports and academic articles have contended that Millennials are different from previous cohorts in their consumption and travel patterns. Declines in licensure and travel have been documented in the United States and other industrialized countries. This paper investigates the travel behavior of young adults aged 20 to 32 and compares the behavior of Millennials to those of previous generations using data from the 1995, 2001, and 2009 National Household Travel Surveys and focuses on differential changes for men and women. We found that while trips and travel distances declined for all cohorts between 1995 and 2009, the declines were largest for 20 to 32. Among young adults, men's travel declined significantly more than women and has therefore led to a decrease in the travel gender gap among young adults. Analysis showed that the decline in the travel gender gap came from the elimination or narrowing of the gender gap in key influences of travel such as employment and licensure, as well as unobserved factors likely related to societal gender roles.

Introduction

In a *New York Times* opinion, Todd and Victoria Buchholz (2012) characterized Millennials as the "go-nowhere generation," linking low levels of licensure with increased internet usage and lack of mobility.Other media reports have hypothesized that Millennials prefer to spend their money on smartphones rather than cars and that these preferences will have dramatic implications on the spatial distribution of economic and population growth in America (Florida 2010; KRC Research 2010; Thompson and Weissmann 2012; The Economist 2012).

A growing academic literature also indicates that Millennials may have different travel patterns from previous generations.Transnational comparisons of licensure have found that young adults with licenses has decreased considerably over the past 25 years and that the declines may be largest for men (Sivak and Schoettle 2011; Delbosc and Currie 2013; Kuhnimhof et al. 2012). Studies of the travel behavior of young adults across multiple industrialized countries have found decreased vehicle usage; in some cases increased use of public transit has off-set the decrease in automobility(Kuhnimhof et al. 2012; Anonymous2013; Blumenburg et al. 2012). Researchers have noted gender differences in these patterns with men experiencing larger declines in auto use (Kuhnimhof et al. 2012).The shifts in Millennial travel have also been linked to the larger pattern of plateauing traveldemand known as 'peak travel'(Millard-Ball and Schipper 2011; Metz 2013; Goodwin and Van Dender 2013).

A difficulty of these reports has been the confounding of the observed downturn in travel among Millennials with the economic decline of the late 2000s which has affected younger adults disproportionately(Sum, Khatiwada, and McLaughlin 2010).Are the observed travel changes the result of economic conditions or do they reflect changing preferences? To address this question, this study compares the travel patterns of Millennials, defined as those born between 1977 and 1989, with those of Gen X (born 1965-1976) and Young Boomers (born 1955-1964).Investigating these trends is important for improving our understanding of how people change their driving behavior in response to macroeconomic shocks and changing technology. This knowledge informs policy debates about how to change travel behavior to achieve congestion relief or environmental goals and is critical to practitioners that regularly forecast travel demand twenty to thirty years into the future.

A Changing Landscape: Trends in Employment, Lifestyle, and Attitudes

The first decade of the 21st century marked considerable changes in the economic fortunes of younger adults. Newspaper articles that had commented upon the high salaries and signing bonuses conferred upon recent college graduates in the 1990s have been replaced by stories about the difficulties of finding work for this same group (Light and Weber 2011; Rampell 2011). Drops in employment and income during the Great Recession of 2007 to 2009 have led some to nickname Millennials the "boomerang generation" – referring to recent graduates returning to their childhood homes because of difficulties finding work (Hirsch 2010; Parker 2012).

These media reports have been backed up by labor statistics. Young adults (16-24) experienced a sharp decrease in employment during the Great Recession, with steeper declines in employment than any other age group (Sum, Khatiwada, and McLaughlin 2010). From 2006 to 2010, the share of 18 to 29 year olds with full time jobs dropped from 50 percent to 41 percent, compared

to marginal decreases among 30- to 45-year-olds (65 percent to 63 percent) and 46- to 64-year-olds (54 percent to 53 percent) (Davis, Dutzik, and Baxandall 2012). A 2010 report by the Pew Research Center indicated that job loss has been more prevalent among young adults than older age groups; 10 percent of adults age 29 or younger had recently lost a job, compared to 6 percent for workers age 30 and older(Pew Research Center 2010). Young adults are also more likely to be unemployed if in the labor force, and more likely than other age groups to not be seeking jobs at all(Edwards and Hertel-Fernandez 2010). 2011 unemployment rates remained highest among young adults. The unemployment rate for workers age 16 to 19 was 24.4 percent in 2011, 14.6 percent for workers 20 to 24 years old, and 10.3 percent for workers age 25 to 29. The average 2011 unemployment rate for all workers age 16 and over was just 8.9 percent (Davis, Dutzik, and Baxandall 2012).

Less Ability to Pay

With a higher likelihood of being unemployed or underemployed than other age groups, a reduced ability to cover the costs of driving may at least partially explain the decline in driving rates among young adults. With annual car ownership and operation costing an average of $8,946 in 2012 (American Automobile Association 2012), many Millennials may find it impractical, if not impossible, to drive regularly. The steady increase in gas prices over the past decade has added to the high cost of driving; since 2001 the average annual cost of gas has risen from $1,100 (inflation-adjusted to 2011) to $2,300 today (Davis, Dutzik, and Baxandall 2012). According to a survey conducted by KRC Research and Zipcar, 80 percent of young adults (age 18 to 34) find it difficult to own a car due to the high costs of gasoline, maintenance, and parking. In contrast, 72 percent of adults age 35 and older felt that these costs made owning a car difficult (KRC Research 2010).

Increases in other expenses may also be contributing to lower driving rates among Millennials. Today's young adults are financially less well-off and are more likely to be burdened by college loans than previous generations (Martin and Lehren 2012). More young adults went to college in 2004-2005 than in 1984-1985, and over this time period the cost of college tuition and fees more than quadrupled. At the same time, the average cost of all other goods and services rose an average of 93 percent (Paulin 2008). Two-thirds of college students who graduated in 2010 had student loan debt, with an average balance of $25,250 (The Project on Student Debt 2011). The sheer magnitude of this debt may make car ownership infeasible and may be preventing many Millennials from driving at the same rates as previous cohorts.

Less Need to Drive

In addition to restricting the ability to pay driving costs, lower employment rates through the Great Recession may have reduced the need to drive among young adults. For the unemployed, the lack of a work commute can account for a significant decrease in car use. Of those who are employed, young adults today are less likely to be working full time and more likely to be working part time than young adults in the past, potentially reducing the frequency of commute trips (Paulin 2008).

Later transitions to adulthood may also reduce auto dependence and driving rates among Millennials. Compared with previous generations, young adults are delaying marriage and parenthood, which creates fewer restrictions on where they live and how they travel(Pendall

2012). Young adults may have more flexibility to live closer to work if they choose, and looser travel time budgets that allow them to opt for slower modes of transportation. Based on recent surveys, the National Association of Home Builders predicts that the Millennial generation will favor living in major cities where cars are less necessary, with destinations accessible by transit, walking, and bicycling (Kalita and Whelan 2011).

Delayed Driver's License Acquisition

State driving laws enacted over the past 15 years have also reduced the percentage of young drivers on the road. Graduated Drivers License (GDL) programs have led to a decrease in the share of 16- and 17-year-olds who are granted a driver's license, delaying driving for young adults. Since 1996, every state in the nation has enacted Graduated Driver's Licensing laws, increasing the licensure requirements and driving restrictions for teen drivers (Stewart and Sweedler 2009). With cuts to public funding for driver education, obtaining a driver's license has also become more expensive (Armario 2009). Though the primary motivation of GDL programs has been to reduce the crash risk among young drivers by delaying licensure, these programs may also be influencing the future travel behavior of young adults by making license acquisition more difficult. Teens who are unable to obtain a license may seek out and become accustomed to alternative modes of transportation, which may reduce the need for and interest in driving even once they are eligible for a driver's license.From 1983 to 2008, the percentage of young adults with a driver's license decreased substantially (Sivak and Schoettle 2011). Only 75 percent of 19-year-olds had a license in 2008, compared to 87 percent in 1983; similar decreases in licensure rates occurred among 16-, 17-, and 18-year-olds. Young adults also make up a smaller share of total drivers today than in the past. In 1983, one-third of all licensed drivers in the U.S. were under age 30; by 2008, those under age 30 made up just 22 percent of all drivers (Sivak and Schoettle 2011). These declines are not unique to the United States; many industrialized countries have seen declines in licensure among younger adults (Delbosc and Currie 2013; Sivak and Schoettle 2012).

Less Desire to Drive

It is an open question whether reduced licensurerates among young adults may also be a result of less desire to drive. A growing body of evidence suggeststhat, among young adults, the ability to maintain contact through electronic communication may serve as a substitute for making trips to visit in person. Brown (2010) found that young adults today are more likely to prefer interacting with friends through social media than physically visiting them. KRC Research and Zipcar found similar results in a recent survey; 54 percent of young adults answered "agree" or "strongly agree" to the question "I sometimes choose to spend time with friends online instead of driving to see them," compared to just 18 percent of Baby Boomers age 55 or over (KRC Research 2010). In a multinational study of 15 countries, Sivak and Schoettle(2012) found that a higher proportion of internet users in a country correlates with a lower driver's licensure rate. Yet other researchers have suggested that communications technology acts as a complement, not substitute for physical mobility (Blumenburg et al. 2012).

Technological advances in electronic communication, GPS systems, and online sharing of information have improved the accessibility of other modes of transportation. Smart phone apps and websites that provide real-time transit information have made it easier for users to coordinate their schedules with transit, reducing waiting time and uncertainty. New transportation services,

such as car-share and bike-share systems, were made possible on a large scale by the ability to immediately access up-to-date information on vehicle availability and location. The improved ease in accessing transit, car-share, and bike-share systems may be another factor in the decline in motor vehicle use, particularly among tech-savvy young adults. KRC Research and Zipcar found in their survey that 45 percent of 18- to 34-year-olds reported making a conscious effort to replace driving trips with other modes, compared to 32 percent of older respondents (KRC Research 2010).

For Millennials, the virtual mobility afforded by smartphones may also be reducing the car's long-held prestige as a status symbol. Delbosc and Currie found young adults in Australia viewed the car as a "symbol of adult responsibility rather than an aspiration symbol of status" (Delbosc and Currie 2013). Unlike for previous generations of young adults, cars may no longer be the singular symbol of freedom; smartphones arguably provide as much – if not more – freedom than the car, offering instantaneous access to information, family, friends, and other contacts (Thompson and Weissmann 2012).

Methods

Our goal is to evaluate the claims that Millennials' travel behavior is truly different from previous generations and establish how employment and licensure patternsimpact trends in Millennials' travel.To do this, we ask:

1. Did Millennialsin 2009 travel differently than members of Gen X did when they were the *same* ages?
2. What factors explain Millennials' travel behavior and the disproportionate decline in Millennials' travel?
3. Do changes in young adult travel differ between men and women?

Definition of Millennials

While there are varying definitions of Millennials, it is generally agreed that they consist of those born in the 1980s.For this analysis, we based our definitions on thatused by the Pew Research Center in their Internet & American Life Project (Zickuhr 2010).Our definition classifiedMillennials as those born between 1977and 1989 (Table 1). This definition ensured that no one under the age of 20 is included in the analysis. In comparing changes in travel behavior over the past 15 years, we considered two other cohorts: Gen X –born between 1965 and 1976who were 33 to 44 in 2009– and YoungerBoomers, born between 1955 and 1964 who were 45 to 54 in 2009.

Table 1: Generational Definitions

	Birth Years	Age in 2009
Millennials	1977-1989	20- 32
Gen X	1965-1976	33- 44
Younger Boomers	1955-1964	45- 54

Travel Metrics

The US Department of Transportation's National Household Travel Survey (NHTS) provides nationallyrepresentative estimates of travel behavior.This cross-sectional survey occurs every 6 to 8 years and asks members of selected households to report all trips on a designated survey

day. We focused on three indicators of overall mobility: number of trips, miles traveled, and minutes traveled.For each of these, we measured changes in overall travel as well as travel by mode and purpose.

We compared travel behavior across the 1995, 2001, and 2009 surveys.We chose these surveys because the changes in the sampling methodology are relatively minor.Between the 1990 and 1995 surveys, the survey switched to a travel diary format (Federal Highway Administration 2011).This change increased reporting of trips (previous surveys were thought to severely undercount trips), but also required a two-stage data collection process that may have depressed response rates.This makes it difficult to compare travel behavior between the 1990 and later surveys.

Survey response rates for the NHTS have declined over time.In 1995, the person response rate was 34.3% (Federal Highway Administration 1997, p. 3-15); in 2001, it was 34.1% (Federal Highway Administration 2004, p. 4-5); and in 2009, it was 19.8% (Federal Highway Administration 2011, p. 4-11). The survey weights adjust for non-response, but it is a concern that response rates have dropped over time. Another issue is that the NHTS uses a list-assisted random digit dialing telephone number sample.This approach does not adequately account for cell phone only households.Younger adults are much more likely to have only cell phones and it is likely that there are differences in travel behavior between those with and without landlines.

Analysis

Shifts in travel behavior are documented through nationallyrepresentative descriptive statistics showing changes in average daily trips, miles, and travel time.These patterns are disaggregated by mode and trip purpose.We explore the causes of the decline in Millennials' travel through an individual-level model that tests the association between demographic characteristics and travel behavior and assesses whether these factors have a differential influence for Millennials.

The individual-level examinationof travel behavior models travel time and distance for person n at time t, y_{nt}, as functions of demographic variables, X_{nt}, and dummy variables for the survey year, D_t (Equation 1).This model is estimated only for individuals between the ages of 20 and 32 that traveled on a weekday and reported all variables included in the model.We assess whether Millennials are 'different' from previous cohorts of 20 to 32 year olds by examining the significance of an interaction term between survey year of 2009 and each demographic variable,D_txX_{nt}.For example, if the model showed a significant interaction between a survey year of 2009 and whether an individual was employed, this would suggest that the effect of employment was different for Millennials than previous generations. To facilitate model interpretation, we report marginal effects, dy/dx, for 1995 and 2009 and test for significant differences.Marginal effects are computed for each respondent and then averagedover the sample.

(1) $y_{nt} = f(D_t, X_{nt}, D_t \times X_{nt})$

The functional form for the individual-level model is Poisson quasi-maximum likelihood with robust standard errors accounting for potential correlation among respondents from the same metro area.Poisson models were selected because OLS approaches showed non-spherical errors;

adjusting the outcome variable by taking the logarithm was not possible because zeroes were a substantial (~10%) proportion of the responses and our goal was to recover the marginal effects of demographics on the expected value of the outcome, something which is not possible after taking logarithms(Wooldridge 2002, p. 672).These models use pooled cross-section data from three years of national travel surveys (1995, 2001, and 2009).Survey weights were not used in model estimation.

Gender Differences
We assess gender differences in the travel behavior of young adult by computing descriptive statistics separately for males and females and comparing the marginal effect of gender on travel patterns.

Sample Statistics
Our analysis included individuals between the ages of 20 and 54 who lived in a metropolitan area and reported information for key demographic and travel metrics.We also required that respondents were in the country and in town on the survey day, and made no trips of more than 100 miles on the survey day. These requirements resulted in a sample of38,654 in 1995, 55,527in 2001, and 82,468 in 2009.Table 2 details why observations were removed.

Table 2: Sample Size, 20 to 54 year olds

	1995	2001	2009
Initial Sample	51,489	74,867	113,357
Count of Respondents with Missing Information			
Driver	0	7	32
Worker	0	2	60
Trip Miles	1,871	2,090	3,864
Trip Time	1,716	408	978
Trip Mode	3,219	440	789
Trip Purpose	162	750	4,011
Count of Respondents Not Meeting Inclusion Criteria			
Out of Country	119	225	467
Out of Town	56	2,482	3,105
Not in Metropolitan Area	7,202	13,938	20,801
Trip >100 miles	1,969	2,981	4,523
Final Sample Size	38,654	55,527	82,468

The resulting sample was similar across the survey years (Table 3).Women accounted for 53-55% of respondents.The 2009 sample had a higher proportion of Hispanic respondents than previous surveys.Average household income (in 2009 dollars) was close to $70,000 in each survey year.In 1995 and 2009, approximately 1 in 10 surveyed individuals made no trips on the survey day; the proportion staying at home all day was slightly lower in 2001.

Table 3: UnweightedSample Statistics

	1995	2001	2009
Sample Size	38,654	55,527	82468
Household Income (2009 $)	69,644	73,338	72,363
Household Size	3.2	3.2	3.3
Age	37.7	39.0	41.6
20-32	31%	27%	19%
33-44	42%	40%	34%
45-54	28%	34%	47%
Sex			
Female	53%	53%	55%
Male	47%	47%	45%
Race/Ethnicity			
Non-Hispanic White	83%	82%	77%
Non-Hispanic Black	6%	5%	6%
Non-Hispanic Asian	2%	4%	4%
Hispanic	5%	7%	11%
Multi-racial	3%	3%	2%
Did not travel on survey day	10%	8%	10%

Travel Trends

In 2009, Millennials made fewer trips, spent less time traveling, and did not travel as many milesas Gen X or Younger Boomers (Figure1). Millennials did not simply travel less than Gen Xers in 2009; they also traveled less than Gen Xers had when they were 20 to 32 (Figure 1).In 1995, members of Generation X aged 20 to 32 made 4.4 trips per day on average, or 0.6 more trips per day than similarly aged Millennials made in 2009. Twenty-somethingsin 2009 traveled 29.8 or 6.3 fewer miles than in 1995. All age cohorts experienced declines in trip making and travel distances between 1995 and 2009; however, the decreases were sharpest among young adults. The only exception to the pattern of Millennials traveling less than older generations occurred for person minutes of travel.Across all age cohorts average travel times increased from 1995 to 2009.

Figure 1: Travel Metrics by Age Group and Survey Year

Analysis of the travel metrics by mode and purpose showed that the decrease in trip making among 20-32 year olds resulted from a decline in driving.For example, young adults made 0.8 fewer trips as drivers and 0.1 fewer trips as passengers.Other age cohorts also experienced declines in driving; however, the declines in minutes and miles for 20 to 32 year olds are nearly double those of other age groups (Table 4).There is some evidence of increased multi-modality with transit, walking, and biking increasing.However, increasing use of non-auto modes does not off-set the declines in vehicle use.In addition, all groups reported similar increases in walking and biking (no matter how measured).This likely reflects changes to the survey methodology between 1995 and 2001 that added prompts to elicit walking trips (Federal Highway Administration 2011, p. 3-12).

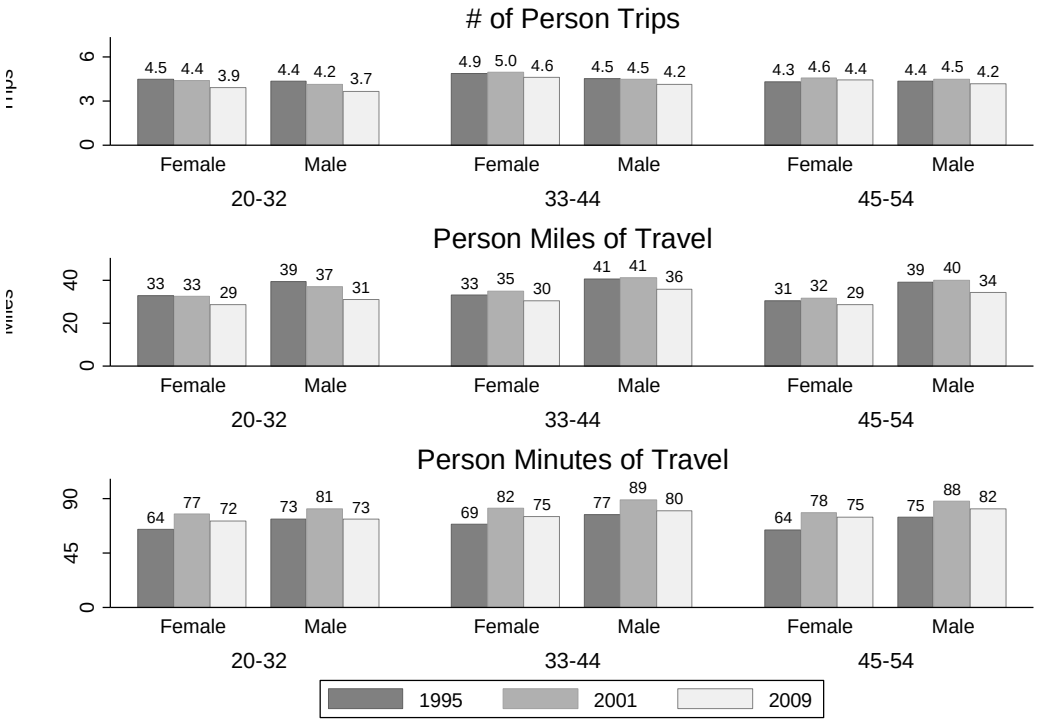
Table 4: Absolute and Percent Change in Miles and Minutes Traveled by Mode and Trip Purpose

	20-32 Year Olds		33-44 Year Olds		45-54 Year Olds	
	Change	% Change	Change	% Change	Change	% Change
Miles Traveled	-6.3	-17%	-3.7	-10%	-3.2	-9%
By Mode						
Driver	-5.4	-19%	-3.2	-10%	-1.8	-6%
Passenger	-1.3	-19%	-1.0	-18%	-2.0	-31%
Transit	0.2	22%	0.1	15%	0.1	9%
Walk/Bike	0.3	156%	0.3	200%	0.4	364%
Other	0.0	0%	0.1	82%	0.0	4%
By Purpose						
Work/School	-2.5	-16%	-1.7	-10%	-1.8	-12%
Shop	-0.2	-5%	-0.4	-9%	0.1	3%
Personal Business	-2.5	-35%	-1.6	-20%	-0.9	-13%
Social/Recreation	-1.4	-16%	-0.5	-6%	-1.1	-15%
Other	0.3	356%	0.5	343%	0.5	307%
Minutes Traveled	3.7	5%	5.0	7%	8.9	13%
By Mode						
Driver	-4.2	-8%	-0.3	-1%	3.1	6%
Passenger	-0.3	-2%	-0.7	-7%	-2.3	-20%
Transit	3.1	104%	1.1	35%	1.5	57%
Walk/Bike	5.0	190%	4.8	220%	6.3	347%
Other	0.1	23%	0.1	37%	0.2	37%
By Purpose						
Work/School	0.7	2%	0.5	2%	0.1	0%
Shop	1.6	17%	0.9	8%	2.3	21%
Personal Business	-2.4	-17%	-0.6	-3%	1.4	9%
Social/Recreation	3.1	19%	3.2	22%	3.9	28%
Other	0.8	540%	1.0	455%	1.2	513%

Differences in Travel Patterns by Gender

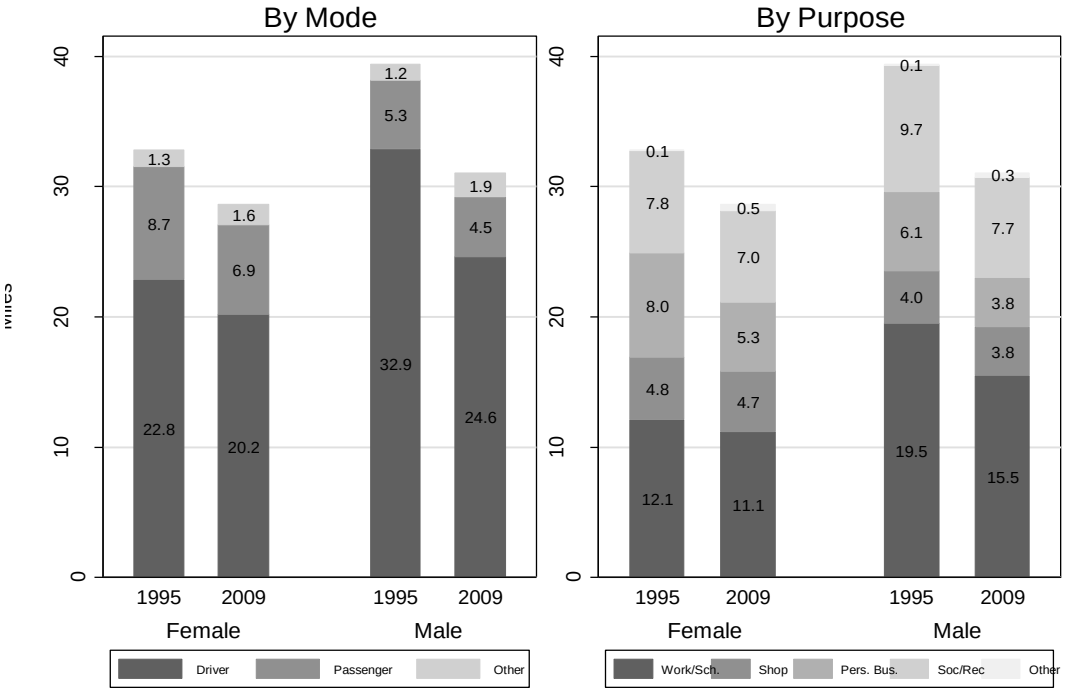
Disaggregating travel patterns by gender shows that while men and women experienced a decrease in trips and distance, the decreases were generally smaller for women, particularly for younger women (Figure 2).Among 20 to 32 year olds, men traveled 8 miles less per day in 2009 than 1995 -- the decrease for women was only 4 miles. For this same cohort women increased their travel by 8 minutes per day while men's average travel time remained the same between 1995 and 2009.

Figure 2: Gender Differences in Travel Metrics



The gender differences in aggregate travel metrics are consistent across modes and purposes (Figure 3).Women decreased auto travel by 4.5 miles compared with a 9.0 mile decrease for men.The decrease in driving was slightly offset by small increases in the use of transit and non-motorized modes for both men and women. Men experienced larger absolute and relative decreases in mileage across all trip purposes except personal business. Men decreased work and school travel by 4.0 miles while women's decline was 1.0 mile.Men also experienced a larger decrease in social and recreational trips with a 2.0 mile decrease compared with a 0.8 mile decrease for women.

Figure 3: Average Person Miles by Mode and Purpose for 20-32 year olds



What factors influence the travel of young adults and do these factors differ for Millennials?

Individual-level models investigated the associations between demographic characteristics of 20 to 32 year olds on weekday travel behavior and whether the impacts on travel patterns were different for Millennials (in 2009) than for Gen Xers (in 1995).We found associations between demographic factors and travel patternswere largely consistent across generations (Table 5).The factors with the largest positiveimpacts on the miles and minutes traveled were being a driver, being employed or attending school. For example, drivers traveled 13 to 15 more miles and 14 to 21 more minutes than non-drivers.Being a single parent significantly increased time spent traveling, but had no effect on travel distance likely because single parents use public transit and non-motorized modes more frequently. The built environment influenced miles traveled with individuals traveling about 12 miles less if they live at densities above 10,000 persons per square mile compared with those who live at densities of under 1,000 people per square mile.However, time spent traveling was lowest for individuals living at moderate densities of 1,000 to 9,999 people per square mile and highest for individuals in the highest-density neighborhoods.This pattern likely reflects the increased use of slower modes in higher-densities areas and increased travel distances in the lowest density areas.

Table 5: Marginal Effects of Demographic Characteristics on Weekday Miles and Minutes Traveled for 20 to 32 Year Olds

	Person Miles			Person Minutes		
	Marginal Effect - Gen X (1995)	Marginal Effect - Millennials (2009)	p-value of Diff.	Marginal Effect - Gen X (1995)	Marginal Effect - Millennials (2009)	p-value of Diff.
Driver	**14.94**	**12.93**	0.352	**13.65**	**20.89**	**0.046**
Primary Access to HH Vehicle	**7.20**	**5.26**	0.183	**5.64**	-2.71	**0.001**
Employed Full-time	**6.48**	**11.37**	**0.000**	**9.59**	**17.34**	**0.000**
Employed Part-time	1.27	**7.55**	**0.001**	2.61	**13.13**	**0.000**
Student	**13.19**	**9.88**	0.103	**24.49**	**18.27**	**0.044**
Male	**5.30**	**2.51**	**0.007**	**6.51**	2.09	**0.009**
Single Parent	3.87	2.53	0.669	**12.30**	**8.29**	0.440
Children < 16 in HH	-0.03	**3.06**	**0.006**	0.19	**3.90**	**0.040**
Living with Parents	-1.91	0.80	**0.049**	-0.68	2.52	0.158
Non-Hispanic Black	-2.90	**4.40**	**0.001**	2.65	**13.81**	**0.002**
Non-Hispanic Asian	**-6.42**	-0.48	**0.024**	**-9.23**	-0.70	**0.040**
Hispanic	-1.21	**1.99**	0.112	1.85	**5.36**	0.257
Multi-racial	-0.39	1.67	0.497	0.86	6.62	0.259
Some college	**2.41**	0.86	0.230	**4.55**	0.51	0.058
College or Graduate Degree	**3.94**	0.55	**0.015**	**6.88**	2.11	**0.036**
1,000-3,999 Persons/Sq. Mile	**-7.72**	**-7.96**	0.859	**-5.39**	**-3.03**	0.248
4,000-9,999 Persons/Sq. Mile	**-9.66**	**-9.45**	0.880	**-4.20**	0.78	**0.024**
>10,000 Persons/Sq. Mile	**-12.91**	**-12.11**	0.654	**6.46**	**8.31**	0.555
Income (Thousands, 2009 $)	**0.09**	**0.06**	0.123	**0.12**	**0.08**	0.120
Age	-0.21	0.15	**0.030**	0.08	**0.55**	0.080
Model Statistics						
N	29072			29072		
$\chi 2$ (p-value)	2620.85	(<0.001)		1439.71	(<0.001)	
Pseudo R2	0.0889			0.0444		

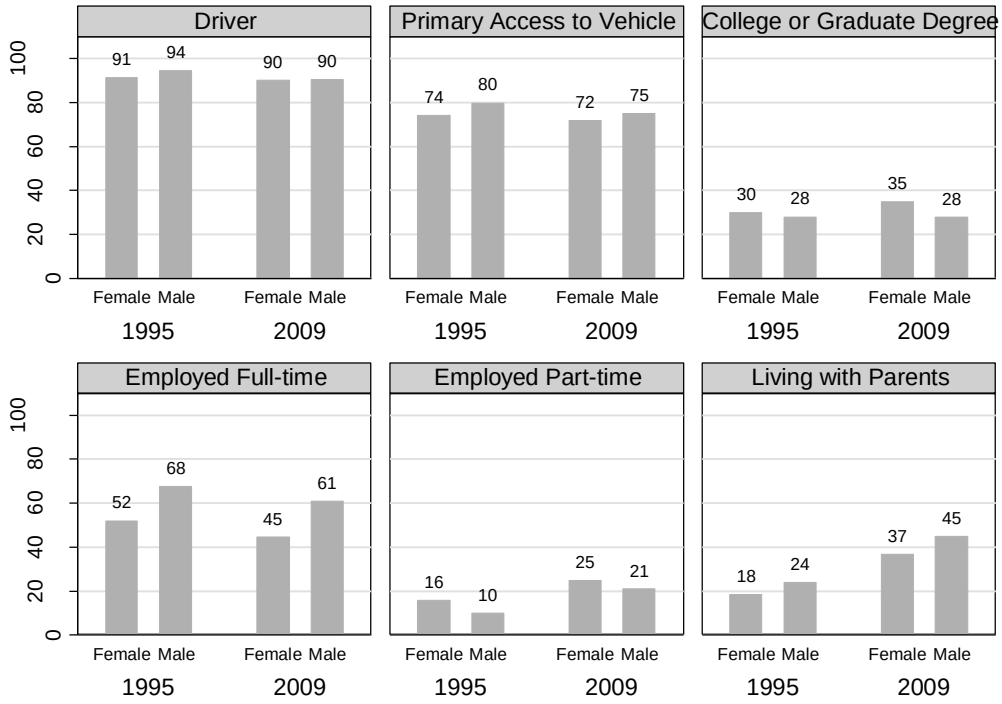
Bold indicates significance at α=0.05

We did find some evidence that Millennials, i.e. twenty-somethingsin 2009, had different responses to demographic factors than twenty-somethings in 1995.Being employed or in school was associated with significantly more miles and minutes of travel in 2009 than 1995.This suggests the suppression of discretionary trips for non-workers since average distance to work has not increased. The presence of children under the age of 16was associated with increased mileage and time for Millennials, but not in Gen X.The impacts of race and ethnicity varied substantially over time; it is likely that this correlates with modal patterns by race.

Gender Differences

The impact of gender also shifted between 1995 and 2009 as expected given the descriptive statistics.In 1995, the marginal effect of being male was an additional 5.3 miles and 6.5 minutes of travel (Table 5).By 2009, the gender effect had decreased by half for mileage and by a third for time. Why did the gender gap decrease?The data and models point to two explanations.The first is that men and women became more similar on observed characteristics.Stated another way, for many of the factors with a strong influence on travel behavior, the gender difference decreased or was eliminated between 1995 and 2009.Among 20 to 32 year olds, the NHTS showed that the gender gap in licensure was gone by 2009 and the gap in access to a household vehicle had narrowed considerably (Figure 4). Young women increased the gap in educational attainment between 1995 and 2009.In terms of employment, both groups were negatively affected by the Great Recession with the relative differences in employment between men and women staying roughly constant between 1995 and 2009.Both females and males were more likely to live at home in 2009, but the level was higher for males.

Figure 4: Comparison of Gender Gap in Key Demographic Characteristics for 20-32 year olds, 1995 and 2009



The second reason for the decrease in the gender gap is that women and men have become more similar on unobserved characteristics.The dummy variable for sex captures any systematic variation in behavior between men and women that is caused by factors that are not explicitly modeled.These factors could be attitudes or demographic characteristics that were not available in the data set, such as personal income (as opposed to household).The fact that the absolute value of the marginal effect of sex on travel behavior has declined substantially over time suggests that the unobserved sex differences are decreasing as well.

Discussion

We find a substantial decrease in tripmaking and mileage among young adults aged 20 to 32 in the United States between 1995 and 2009.While all Americans experienced declines in travel, the decreases were sharpest among younger Americans who made 0.6 fewer trips per day and traveled 6.3 fewer miles per day.The declines are the result of less car usage and are drawn relatively proportionately from all trip purposes. These trends correspond to those in other countries and those previously reported for the United States (Kuhnimhof et al. 2012; Blumenburg et al. 2012; Santos et al. 2011).While other countries have found the declines in automobility to be offset by increases in transit and non-motorized modes, that is not the case in the United States (Kuhnimhof et al. 2012).The small observed increase in non-motorized modes is likely a statistical artifact -- the result of changes in survey methodology to increase reports of non-motorized travel.

Individual-level models of travel time and distance suggest that the critical determinants of mobility are the need to get to work or school along with the ability to drive.The marginal effect of being employed or in school has increased over time, which suggests that the economic downturn of the late 2000s may be suppressing discretionary trip-making, thereby heightening the impact of non-discretionary activities.The importance of these variables in determining individual travel behavior also suggests that the decreases in employment and licensure among Millennials are critical to the observed decreases in mobility.

The analysis showed that gender differences in travel decreased for all age groups between 1995 and 2009.Among 20 to 32 year olds, the gender gap narrowed because men experienced a larger decrease in travel than women did.The larger decline in travel among men was the result of larger declines for men in key factors such as licensure and access to a household vehicle as well as men and women becoming more similar on unobserved factors such as attitudes.The literature on travel and gender has long linked differences in travel between men and women to differences in societal gender roles (Crane 2007; Rosenbloom 2006; Rosenbloom 1987; Hanson and Hanson 1980).In particular, women's responsibility for children and the home were reflected in travel patterns that tended to include more trips -- often to serve others -- but shorter distances traveled because either were not in the paid labor force or were reducing the range of their job search in order to accommodate household responsibilities(Madden 1981; Sang, O'Kelly, and Kwan 2011; Rosenthal and Strange 2012).We would expect delays in household formation to decrease gender differences among 20 to 32 year olds.However, there is evidence of the gender gap narrowing for older Americans as well. This indicates that the decrease in the gender gap cannot be attributed solely to young adults delaying marriage and parenthood;it may also be an effect of changing societal gender roles and resulting travel patterns across the population.

Conclusions

Millennials, born between 1977 and 1990, are making fewer trips and traveling fewer miles than previous generations and these decreases have been particularly strong among men.Multiple articles in the popular press have contended that these shifts are evidence that Millennials are fundamentally different from previous generations and will have markedly different consumption patterns from their predecessors.Our analysis showed that while Millennials have experienced large decreases in travel in the past two decades, much of this decline can be linked to decreases in licensure and employment.We will need to wait for future travel surveys to disentangle the

impacts of the Great Recession from the preferences of Millennials; however, this analysis suggests that as employment prospects for younger Americans improve, automobility among this cohort is likely to increase.We would also expect the gender gap in travel distance and time to continue to decline as the gender gap in licensure and employment continues to narrow.

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Urban nomads, mobility and gender

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Abstract

In the 1980s Jacques Attali used the term "urban nomads" to predict an age when rich and uprooted elites would jet around the world in search of fun and opportunity, and poor but equally uprooted workers would migrate in search of a living. What is certain is that today new ways of communicating, relating to other people, working and living are getting more and more close to nomadic uses. How will the new nomadic society be structured? Will it still refer to traditional roles and family structures or will it be made of "individuals" relating to each other on less permanent relationship? What will be the role of women in the new "urban nomadic society"? Will there be significant differences in life-styles/mobility patterns due to social/economic position? How will it impact e.g. on transport demand and commuting? Which are the trends to be considered for a better decision-making in urban planning, consumers' production and mobility schemes?

Keywords: gender; societal changes; mobility patterns; urban nomads.

Résumé

Dans les années 1980, Jacques Attali utilisait le terme 'nomades urbains' prévoyant un âge où les élites riches et déracinés voyageront autour du monde à la recherche de plaisir et d'opportunités, et les travailleurs pauvres, mais aussi déracinés, migreront à la recherche de survie. Ce qui est certain, est qu'aujourd'hui de nouvelles façons de communiquer, de se rapporter à d'autres personnes, de travailler et de vivre sont de plus en plus près aux habitudes nomades. Comment la nouvelle société nomade sera-t-elle structurée? Est-ce que cela fera encore référence à des rôles et structures familiales traditionnels sera-t-elle fait des «particuliers» liés les uns aux autres sur des relations moins permanentes? Quel sera le rôle des femmes dans la nouvelle «société nomade urbaine»? Quelles seront les différences importantes dans les styles de vie et de mobilité en raison de la position sociale/économique? Quel sera l'impact par exemple sur la demande de transport et des déplacements? Quelles sont les tendances à prendre en compte pour une meilleure prise de décision dans la planification urbaine, la production et les programmes de mobilité?

Mots-clé: genre ; changements sociétaux; modèles de mobilité; nomades urbains.

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1. Introduction

The aim of this paper is not to present research results, but to launch a discussion around a hypothesis, whose demonstration requires further foresight studies. The paper aims at giving some possible guidelines to steer the formulation of possible scenarios. The expected results will contribute creating a vision of possible societal developments complementing other studies on the changes in mobility trends and giving input to policy making in order to steer technological and regulatory developments in a way that will be beneficial to the society as a whole.

2. Women's mobility from caves to modern age

The first human beings had no stable living place. They were nomads led by the necessity to secure food. They were the hunters/gatherers who lived in caves and other precarious shelters that they abandoned when they changed their hunting territory. Their displacements were done by walking; the distance was measured by the time needed to cover it.
When 10.000 years ago the climate change stabilized, the populations started settling in the areas with a temperate climate: it was the beginning of the sedentary society of cultivators/breeders. At that time our ancestors trained horses and invented the wheel. This first revolution in mobility was made possible by the drastic societal change and is considered to be the beginning of „civilization". Wheel and horses made possible the transport not only of human beings, but also of different goods.
Women since the nomadic time have been segregated to the role of „housekeeper" and „child-minder". They have never been "protagonists" even when travelling: they had to follow the man, head of the family/group.
Ever since mankind has developed different mobility patterns and means, till the travel to the moon.
But our society has had mainly a sedentary structure, based on the principles of family, group, and ownership. Hunting has no longer been the driver for mobility: it was mainly the economic interest that induced mobility. Merchants remained for a very long time a special travelling group inside the society, led by trading interests, and able to guarantee wealth and power through exchanges with other regions and cultures. The goods and knowledge they brought back home raised the curiosity of other individuals who, pushed by hunger of knowledge started to travel to discover new parts of the world. These two figures (the Merchant and the Explorer) guaranteed the expansion and the economic growth of their countries. For their travels it was essential to have the adequate infrastructure: in XII and XIII centuries port cities were the pivot of the merchant economy, based on transport accessibility.
Women as well, pushed by a natural intellectual curiosity, started to travel. But they had to be disguised as men when they were travelling alone. Their limitation in travel and mobility was similar to that of the poorer and weaker (elderly, children, disabled).
A different role for women started at the time of the Frontier conquest in the New Continent:
the need to populate the newly conquered territories made the presence of women
indispensable for the most impressive wander of modern time. At the same time a new figure
emerged: the "solitary nomad", the cow-boy. If survival of nomadic populations always
depended from the group, now a new strongly masculine ideal of independent, autonomous
and individualist nomad emerges at the margins of the compact and conservative Frontier society. The cow-boy moved following working opportunities, carrying with him his extremely reduced properties, and having no attachment to any specific place where to come back.

3. Today's trends

Curiosity has continued to push people to discover new places and civilizations. The growing globalization has also allowed an easier movement of people and goods around the globe.
In the last decades mobility has hugely increased in many layers of the (Western) population; the number of driving licenses has been constantly growing, and the gap between genders was closed; the extended average life duration has also led to more travelling for leisure among the elderly – where women represent the majority - and their extended participation to productive life together with a rise of their weight in the decision-making

process, thus aligning policies with their needs and preferences… Main factors allowing such development were an improved economic situation and better accessibility and affordability of transport means.
The extended average life duration has also led to more travelling for leisure among the elderly, represented by the great majority by women.
Working independence and autonomy in life management have also generated a much higher mobility among women. One of the indicators is the number of driving licenses issued to girls and women since the 80ʺs, for the first time higher than those issued to boys and men.

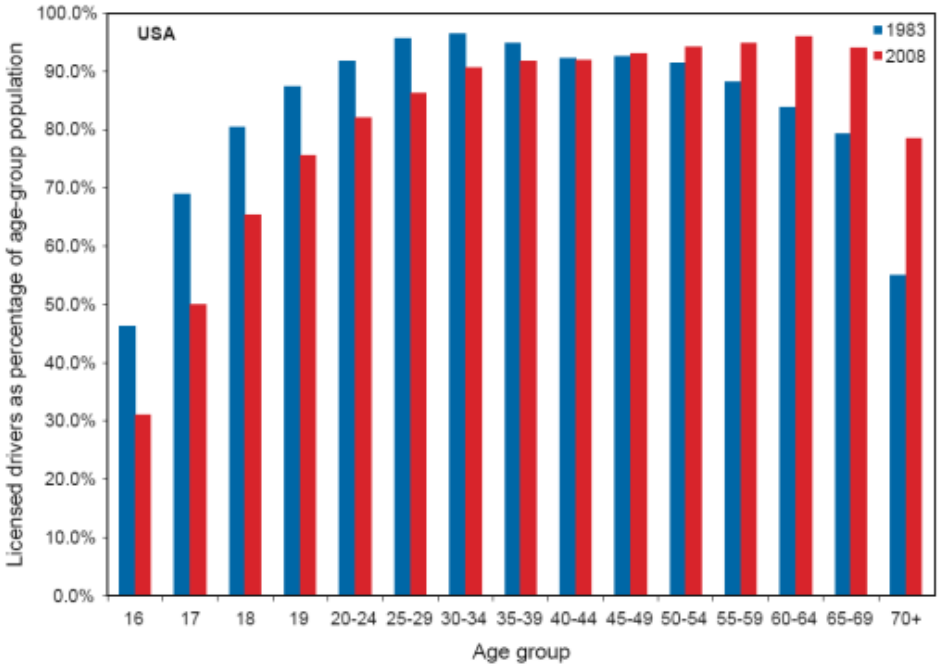

Figure 1. U.S.A.: Licensed drivers as a percentage of their age-group population (FHWA, 1984, 2009).

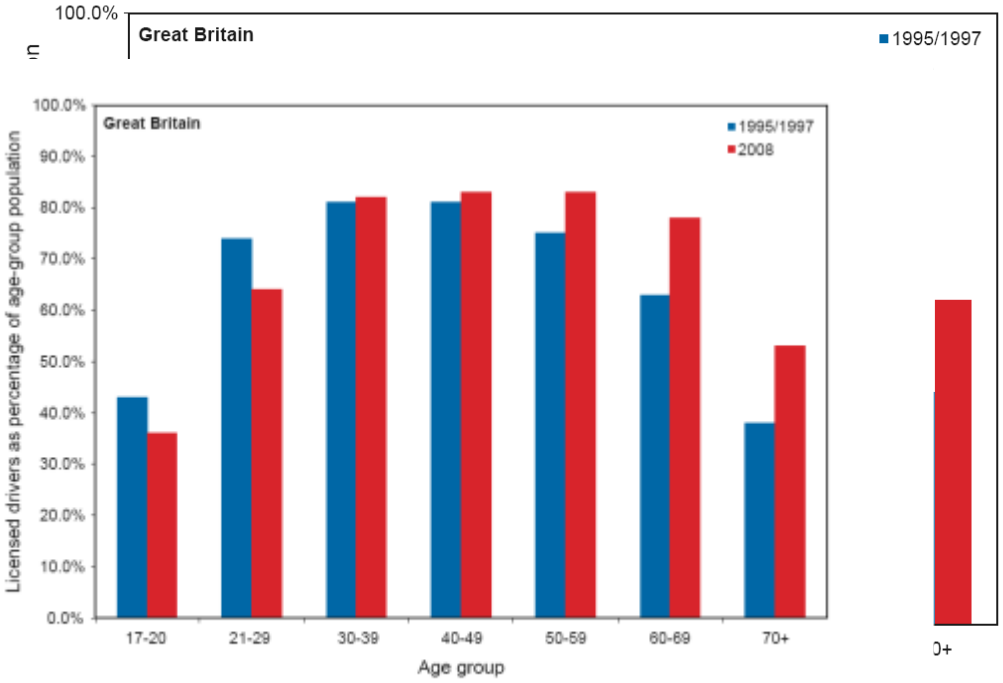

Figure 5. Great Britain: Licensed drivers as a percentage of their age-group population (Department for Transport, 2011).

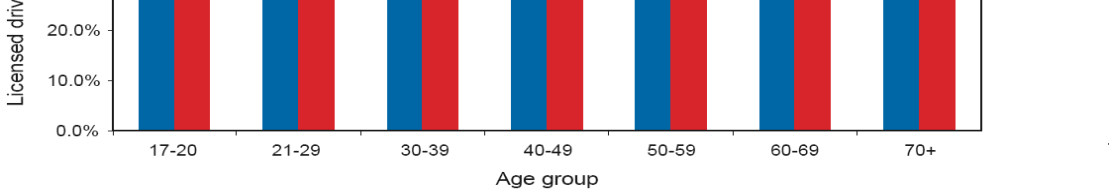

Figure 5. Great Britain: Licensed drivers as a percentage of their age-group population (Department for Transport, 2011).

This trend has continued until the early 2000. But recently it seems to face an apparent reversal, at least as far as the use of personal cars is concerned.

A significant drop in population growth, an increased urbanization, rising social inequality and unemployment seem to have contributed to an important change in passengers" choices in many Western countries.

It is commonly agreed to find in the economic crisis the main reason for such a shift in mobility patterns. Nonetheless the decline of car usage started well before the recession, and therefore other factors deserve to be investigated to understand the main factors causing the change.

Attaining the limits of car ownership and the impact of policy that are more favourable to alternative transport means, together with a higher social acceptance of public transport, could be at the origin of this shift.

It would be worth investigating other major societal changes to assess whether they also have an impact on mobility behaviour, and what could be the consequences for policy-making.

In recent time of crisis accessibility to transport has also allowed a new form of "hunting" among the urban population: the hunt for job. The growing precariousness of working positions has imposed to the younger generations – but not only – to be ready to move where job opportunities arise. Often these modern "hunters" move alone, thus returning to the model of the "solitary nomad" of the XIX Century in the New Continent.

Are we having today in our urbanized society a return to this prototype of wanderer?

"A meaningful planning should not only be limited to the extrapolation of trends, but should aim at understanding underlying factors affecting future travel demand".

Women are indeed today the real protagonists of this societal change: they are actively participating in the "nomadic movement" travelling for study and work; they influence life-styles; they can contribute creatively to the generation of new consumption patterns (sharing is more congenial to women than men) and to the creation of a different governance of data information/communication. A womanly approach to the management of data could modify the perspective from "control" to "participation", increasing public acceptance of increasingly invasive IC technologies.

As Beattie (2008) noted "boys are less likely to share than girls and … in order to resolve problmes of sharing girls were more inclined to negotiate whereas boys were more likely to be aggressive. This reflect the evolutionary gender difference that males are interested in personal gains and females in maintaining group harmony. Many studies have found that women are more co-operative and generous than men, …".

4. A new nomadic society

Several symptoms are giving evidence of the emergence of a new nomadic society:

- Sedentary living is abandoned since the training period; programmes like Erasmus facilitate exchanges of students and are becoming more and more popular, as much as a period of study abroad is now almost considered a necessity;
- New entrepreneurial structures do not give any more a long-term employment security and imply a high availability to move to other places to secure a job;
- The Nation-State structure (originated at the time of first sedentarization) is now dismantling and is losing its original role of identification of a group; smaller and smaller local organizations are replacing the central government, whereas a global super-national governance makes living conditions more and more equivalent across the world;
- The traditional family is becoming quite unusual among urban population: mono-parental, reconstructed, multiple families are growing in number and imply a totally different organization and management of daily life in comparison to what we were used to;
- The model of "throwaway" consumption is becoming the most usual, even if not the most sustainable; dismissing instead of repairing is natural in a very mobile life-style;
- Eating habits as well are changing: family meals are no longer common in many of the Western societies; each individual comes home – if not eating out - and "grabs" food before leaving again….
- Holidays patterns changed from long-term short-distance pattern to long-distance/short-term trips during the year;
- The language itself is facing a sort of "compression" becoming poorer and less precise; it might be due to the modern communication means (texts and mails), but it is also a characteristic of nomadic societies who do not "have time" to reflect and speculate;

- The baggage of the modern traveller is reduced to the minimum: it could in some cases be limited to an iPad!
- Investments in housing estate (once the most secure form of saving) become seldom, not only because of the non-affordability of such goods, but also because they become a "burden", tightening a person to a geographical location which might not be suitable after a few years.
- "Short-rent" offices are more and more available for companies with moving seats and time-limited business in different locations;
- Taxation of individuals who are not stable in one place becomes a major problem for National Authorities who have to decide between the place of residence and the place of production of the income. If a business is not entirely in a country of residence, the income can be structured to be partly taxed in other countries where the taxation rate is lower.

All these factors have of course a great impact on mobility and travelling schemes:
- Displacements increase, but they are „lighter" not implying a real move of persons (family) and goods;
- If there is a reduction in short, urban trips, we face a significant increase of long-distance travels and this affects mainly air transport;
- The switch from ownership to use – like in housing - applies as well to transport means: it is much more convenient to have the availability of the transport means more suitable to a certain situation than to have to care for and maintain one's own non multiple-usage vehicle!
- As it was the case for ports in the Middle Age, today AIRPORTS are the pivot of growth and economy;
- The measure of distance in time is coming back: travel speed is one of the major elements for modal choice. Today road congestion is pushing strongly toward a multimodal approach for a rapid transfer from departure to arrival. A paradigmatic example is given by the aviation sector that targets to 4 hours trips door-to-door everywhere in Europe by 2020;
- Fast growing ICT infrastructure is indispensable to allow the "light" and seamless displacements but is more and more intruding the privacy sphere and creating ethical problems for its governance.

5. Two different groups of nomads

This nomadic style of life will not be homogeneous throughout the society layers.
On one side we will find the "productive" individuals that will travel long distance for business or leisure without losing their links and contacts with their companies. They will be able to manage their affairs, follow financial transactions and having high level meetings from any distant resort making use of advanced telecommunication technologies. For this group of people the model of "rent" or "leased" vehicle will be the most convenient one, together with long distance public transport.
On the other side we will find the growing mass of underpaid, unemployed workers that will not be in the position to afford any private transport means (with the exception of two wheelers, motorized or not) and who will be in the need of frequent displacements in search of job or affordable accommodation allowing accessibility to cheap transport means and work.
This group will be constituted by the weaker and poorer (immigrants, disabled, unemployed…..). They will form a societal layer that risks to be more and more emarginated from the economic activities, but that could also represent a dangerous threat for the social stability. It is important that this aspect is taken into due consideration and that mitigating measures are put in force. Gender-related aspects must be taken in due consideration when planning those measures.
Another significant difference will be between the urban and the rural population. In cities the accessibility to multi-modal, public or alternative (walking and cycling) transport will be present and will allow mobility to an acceptable extent for everybody. On the contrary, in rural zones the private transport will remain a necessity, unless alternative modes will be implemented, in particular the demand-responsive services.
The location will also increase the gap between privileged and "emarginated" population groups, between the "rich middle-aged" and the "poor older" people, among which the gender difference adds another layer of discrimination.
It will be imperative to find policy measures that will contrast this gap and that will contribute to the achievement of a more inclusive and equalitarian society. The use of technology alone will not be sufficient to achieve the goal: a strong public participation – including the right proportion of women representation - in decision-making and new paradigms will be as important as the technological development of solutions.

Furthermore, it will be paramount to avoid the risk of technological gap between layers of the society, due not only to affordability of the products on the market but also on the capability of use by some part of the population de-facto excluded from certain developments, due to their economic status, education, age, accessibility etc…..

6. The responsibility of producers and policy makers

Transport OEMs and operators should consider the possible evolution in mobility patterns due to the new urban nomadism and adapt their business model to the new reality.
It is no longer viable to continue business as usual grounding the production and planning choices on the assumption of growing demand of private means of transport. „Sharing" models should be considered, an increase in two wheelers use should be taken into consideration especially in urban planning, scheme of demand-responsive transport services should be investigated, and innovative, creative solutions shaped. Investments in infrastructure should also foresee a decline in congestion, thus avoiding expensive enlargements of corridors that risk to be soon over-sized, and in cities softer modes (walk and cycle e.g.) should be facilitated by the creation of transport infrastructure more adapted to the variety of users' needs. Specific attention to women's requirements in terms of comfort, safety and security is a must.
Policy measures, such as incentives and disincentives, limited accessibility to specific areas, increased peripheral services, will be essential for a proper deployment of a new mobility system responding to the needs of a society in rapid evolution and will contribute to the achievement of social equity objectives.
A strong women's participation and contribution to the definition of such actions is essential to guarantee a more harmonious, shared, accepted and sustainable development of the modern transport system.

7. Future research needs

More research to investigate these societal changes is needed in order to increase our knowledge on the changing mobility demand. The rising heterogeneity of patterns is the reason for a rising uncertainty in predictions. We will need to develop policies that will result robust to uncertainty, i.e. able to fit a wide set of possible scenarios. As a baseline, one can consider that those policies that match gender-specific needs tend to rely on alternative multi-modal solutions, and that the implementation of such solutions will be virtually beneficial for the whole population, including the socially disadvantaged one, thus contributing also to the achievement of social peace.
The development of scenarios that consider under a gendered point of view new life styles and unprecedented mobility patterns should be included in transport research programmes in order to better assess the impact of present technological development and investments and give a stronger scientific basis for decisions to be taken to achieve a long term sustainable transport system.

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Gender differences in the travel behaviour of adolescents and young adults in Denmark

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Abstract

This study explores longitudinal trends in the travel behaviour of adolescents and young adults in Denmark in terms of mode choice, kilometres travelled, travel time, number of trips, and driving license holding. The analysis explores gender differences in travel behaviour for four age groups: 16-19, 20-24, 25-29, and 30-34 year-olds. Data are obtained from the Danish National Travel Survey between the years 1995 and 2012. The results suggest that in Denmark, in cases that there is gender-related gap in transport behaviour, the gap progresses across age groups and is different for rural and urban areas. Regarding the number of trips and the proportion of trips by purpose, the gap is greater for the older age groups and is more pronounced in rural areas. Regarding the travel distance, the gap over time diminished more rapidly in rural than in urban areas, and currently the gap is significant only for the oldest age group in urban areas. Regarding the trip proportion by mode, the difference is more pronounced in rural areas, and it diminishes with the lifecycle progression.

Keywords: adolescents; young adults; mobility trends; mode choice; driver's license; longitudinal travel trends.

Résumé

Cette étude explore les tendances longitudinales dans le comportement de voyage des adolescents et des jeunes adultes au Danemark en termes de choix du mode, les kilomètres parcourus, les temps de trajet, le nombre de voyages, et ayant leur permis de conduire. L'analyse explore les différences de comportement de voyage pour quatre groupes d'âge : 16-19, 20-24, 25-29, et 30-34 ans. Les données sont obtenues à partir de la Danish National enquête sur les voyages entre les années1995 et 2009. Les résultats suggèrent que, au Danemark, dans les cas ou il y a des écarts de comportements en matière de transports lié à la parité entre les sexes, l'écart progresse entre les groupes d 'âge et est différent pour les zones rurales et urbaines. En ce qui concerne le nombre de voyages et la proportion des voyages par objectif, l'écart est plus grand pour les groupes plus âgés et est plus prononcée dans les zones rurales. En ce qui concerne la distance de course, l'écart dans le temps a diminué plus rapidement dans les zones rurales que dans les zones urbaines, et actuellement, le fossé n'est significatif que pour le groupe le plus âgé dans les zones urbaines. En ce qui concerne le voyage proportion par mode, la différence est plus prononcée dans les zones rurales, et il diminue avec la progression du cycle de vie.

Mots-clé: adolescents; jeunes adultes; évolution de la mobilité; choix modal; permis de conduire; tendance de déplacements.

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1. Introduction

Gender equity is considered as a fundamental value of the European Union that is essential for continuing growth (European Institute for Gender Equality, 2013). Within this framework, monitoring the gender gap in travel across time is important in understanding the ability of men and women to equally benefit from transport provision. On the one hand, transport provision facilitates economic growth and social participation and increases the opportunity space for employment, networking and leisure. On the other hand, transport is associated with relatively high burden of monetary costs and time depletion at the individual level, and negative environmental and health externalities at the societal level (Jones and Lucas, 2012). The existence of a gap between the travel patterns of men and women has been established by extensive research since the late 1970's, and while the gender gap is decreasing with respect to automobile use and miles travelled due to a higher involvement of women in the workforce (Rosenbloom, 2006), gender differences persist. Women still have shorter commuting distances (Crane, 2007) and engage in extensive child chauffeuring with respect to men (Yarlagadda and Srinivasan, 2008; Scheiner and Holz-Rau, 2012; Siren and Haustein, 2013). On the bright side, women are more inclined to use sustainable transport modes relative to men (Polk, 2003).

This study analyses the gap in the travel of young men and women in urban and rural areas. In particular, this study provides information regarding two key research questions recently raised by Rosenbloom (2006). The first question concerns expanding the knowledge about the gender gap in the travel patterns of young adults, and its importance is twofold. Firstly, changing societal trends towards higher involvement of women in the workforce, the widespread phenomenon of dual-earner and dual-career households, and changes in household composition induce changes in the travel of today's young women in comparison with previous decades (Rosenbloom, 2006). Secondly, studies have shown that while in some countries car dependence is growing, in many OECD countries 'generation Y' sets new trends in reducing car travel and dependency, and increasing multi-modality and the use of sustainable modes (Kuhnimhof et al., 2012; Sivak and Schoettle, 2012; Frändberg and Vilhelmson, 2011). These trends may have an important impact on women's travel patterns and the gender travel gap in terms of individual benefits and societal impact. This study focuses on investigating whether the gender gap related to the role of women as workers and household members with respect to the task allocation in the household, or is already formed in the transition from adolescence to adulthood. The question is raised because while for adults travel gender differences persist despite converging trends in male and female travel, for children travel the evidence is inconclusive, for example with respect to active modes to school (McDonald, 2012). The second question concerns identifying gender differences in travel associated with land use and community designs with different transport options. In the current study, the question concerns the gender gap in travel opportunities and burden in rural versus urban areas. Differentiating between urban and rural areas in the analysis of gender-related gap in travel trends is important because of the long-term interest in rural accessibility and mobility, in particular with respect to disadvantaged population groups due to deeper social inequalities (Nutley, 2005).

To answer these questions, the current study explores longitudinal trends in the travel behaviour of adolescents and young adults in Denmark, which along with Sweden and Finland scores the highest on the Gender Equality Index among 27 European Union member states (European Institute for Gender Equality, 2013). While much of the previous research on the gender gap in travel focused on highly car-oriented nations such as the United States (e.g., Hanson and Johnston, 2985; Gordon et al., 1989; Rosenbloom, 2006; Crane, 2007), exploring the gender travel gap in Scandinavia can serve as an outer-marker for reducing the gap between males and females while also promoting sustainable transport (Carlsson-Kanyama et al., 1999; Polk, 2003). The investigated travel trends are car accessibility and driver's license holding, daily trips, daily travel distance and time, mode choice, trip purpose and the commuting time and distance. The analysis explores gender differences in travel behaviour for four age groups: adolescents (16-19), young adults in their early twenties (20-24), young adults in their late twenties (25-29) and young adults in their early thirties (30-34). These groups allow observing the changes in the gender gap related to travel behaviour in the transition from adolescence to adulthood. The Danish Rural Development Index (RDI) served to differentiate rural from urban areas. The travel data are obtained from the Danish National Travel Survey between the years 1995 and 2012.

2. Data

The data source for the analysis is the Danish National Travel Survey (Transportvaneundersøgelsen - TU). The survey is conducted on a yearly basis from 1992 (apart from a short discontinuation between the years 2004 and 2006) and consists of 24-hour travel diaries collected from a representative sample of the Danish population

between 10 and 84 years of age. The travel diary, completed on a randomly assigned day, elicits information regarding activity purpose, location and duration, and the trip description includes primary and secondary trip purposes, joint versus solo trips, intermediate stops, travel modes, travel distance and in-vehicle and out-of-vehicle travel time. The diary is accompanied by socioeconomic information such as age, gender, education, employment status, income, household structure (i.e., residence with parents, marital status and the presence of children in the household), residential location, driver's license holding and car ownership. Christensen (2013) provides a detailed description of the survey.

The current study focuses on adolescents and young adults and therefore the sample includes only respondents between 15 and 34 years of age. The considered travel modes are cars, motorcycles, public transport (including buses and trains), bicycle and walk. The trip purposes are aggregated to mandatory activities, shopping activities, escort activities and other non-mandatory activities. Trips by air and maritime transport and by heavy vehicles are not considered because of the interest in land-transport trips conducted by non-professional drivers. The sample size, after excluding non-relevant trips, outlier records, and records with missing values included between 2,200-4,800 observations per year representing around 110,000-120,000 young adults per year. The number of yearly trips in the sample ranges between 7,400 and 16,100 trips representing between 3,677,000-4,484,900 yearly trips.

The Danish Rural Development Index (RDI) served for differentiating rural from urban communities. The index includes 14 equally weighted criteria including population density, proportion of rural areas in the jurisdiction, employment supply and population share employed in agriculture, share of children and elderly population, share of highly-skilled workers, accessibility to motorways and job supply, and taxation per capita (Danish Ministry of Food, Agriculture and Fisheries, 2011).

3. Results

3.1 Driver's license holding and car accessibility

Figure 1 and Figure 2 present the driver's license holding and car accessibility, respectively, for the four age groups in rural and urban areas over time. Car accessibility refers only to young adults that do not reside with their parents. Pearson's chi-square tests assessed the significance of the gender difference at each year.

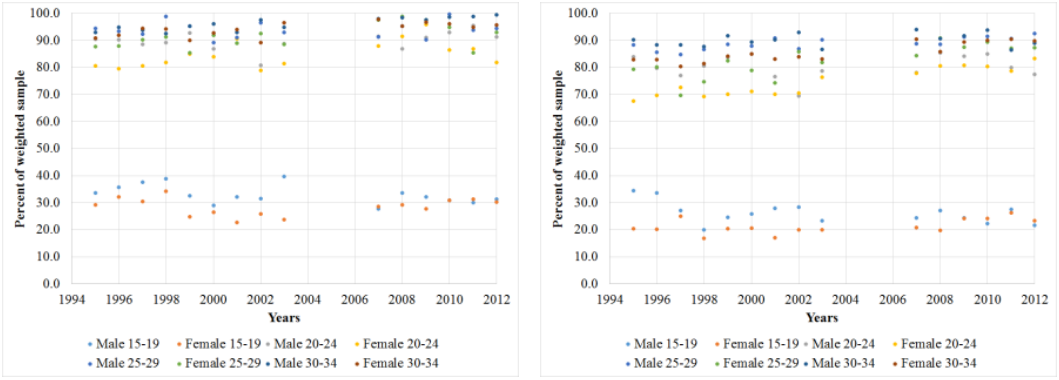

Fig 1. Driver's license holding by males and females in rural (left) and urban (right) areas

Across both genders, the driver's license holding and car accessibility are higher in rural areas versus urban areas. The last five years have witnessed a steep increase in car accessibility in rural areas, in particular for young adults in their thirties. In rural areas, the share of driver's license holders is below 40% for the youngest age group, but exceeds 80% people in their twenties and approaches 99% for people in their thirties. In urban areas, the shares are about 10% lower. In rural areas, a gender gap is non-significant for the youngest age group. For people in their twenties in rural areas, the gap became non-significant in the beginning of the millennium, and reappeared in the last four years. For people in their thirties, only the last three years are characterized by a significant gender gap, but because the share of driver's license holders is above 95% the gap has no practical implication. Regarding driver's license holding in urban areas, since 2003 there is no statistically significant gender gap. Adolescent girls 15-19 years old were the first to close the gap already in 1997, followed by young

women in their twenties in 2001, while a further two-year delay is associated with the older age groups. In rural areas, for young adults in their early twenties there is no systematic gender gap in car accessibility, while for young adults in their early thirties a significant gap appeared in the first decade of the millennium with higher car accessibility for women. In urban areas, there is no significant gender gap in car accessibility in any of the age groups.

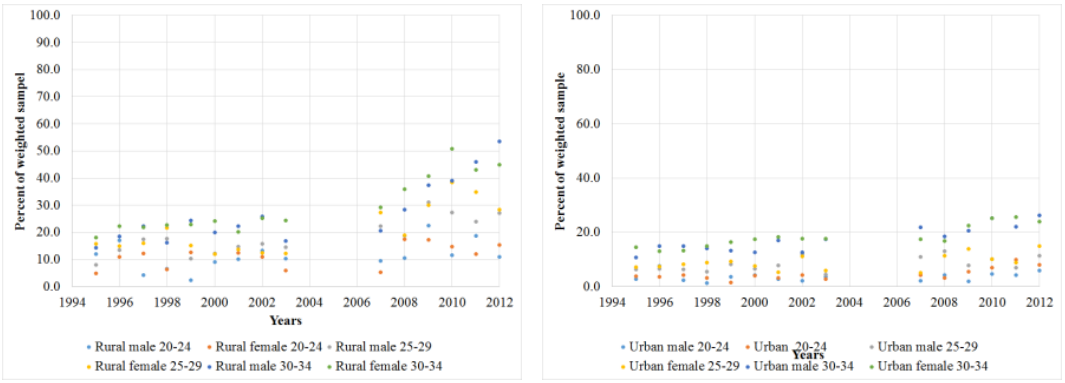

Fig 2. Car accessibility of males and females in rural (left) and urban (right) areas

3.2 Daily trips

Figure 3 presents the gender differences in the total daily trips as the percent difference from the male trips in rural and urban areas for the four age groups. Table 1 presents Student's t-tests for comparing the means across males and females in each group. Significant yearly differences at the 0.05 confidence level are marked in grey. For the youngest age group, during the 1990's the gender gap in the number of trips was not significant. Both in rural and urban areas a gender gap systematically appeared in the first decade of the millennium in 15-19 years females making more trips than males. The gap was significant at the 0.10 significance level until 2009 and 2011 in urban and rural areas, respectively. For 20-24 year-olds, the gap in rural area is non-significant across the two decades. In urban areas, the gender gap was non-significant until 2003, but a systematic gap appears since 2007 with females having a higher number of daily trips. For 25-29 year-olds, in rural areas there is a systematic gender gap over time in the number of trips, with females having a higher number of trips. In urban areas, the gap has been systematically significant only since 2007. The gap is systematically larger in rural areas compared to urban areas. The oldest group of young adults shows the most pronounced systematic gender gap both in rural and urban areas, with females having a much higher number of trips. The gap systematically appears across the two decades, and it is larger in rural areas compared to urban areas. The gap in rural areas is significant at the 0.05 significance level, while the gap in urban areas in some years is only significant at the 0.10 significance level.

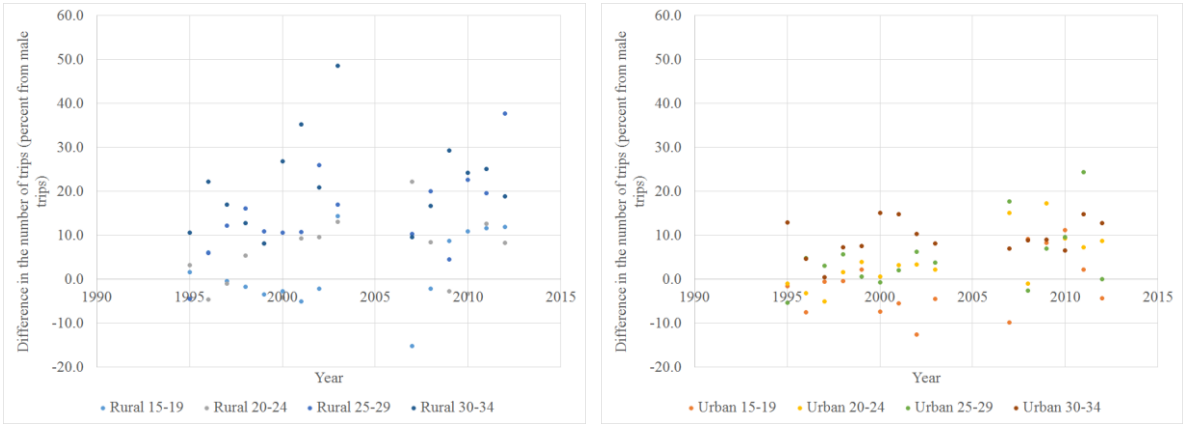

Fig 3. Gender differences in the number of daily trips (percent difference from male trips)

Table1. T-statistics for the comparison between the daily trips of males and females by age and region

Year	Rural 15-19	Urban 15-19	Rural 20-24	Urban 20-24	Rural 25-29	Urban 25-29	Rural 30-34	Urban 30-34
1995	-0.85	1.58	-0.52	0.27	0.66	1.44	-1.65	-2.97
1996	0.06	0.10	0.82	0.88	-0.91	-1.31	-3.62	-1.18
1997	0.28	0.08	0.15	1.37	-1.88	-0.82	-2.69	-0.15
1998	0.71	-0.48	-0.79	-0.46	-2.28	-1.58	-2.12	-1.95
1999	0.48	1.59	-1.16	-0.92	-1.69	-0.19	-1.31	-1.87
2000	0.73	1.15	0.52	-0.15	-1.49	0.17	-4.00	-3.38
2001	0.31	2.75	-1.04	-0.70	-1.37	-0.58	-4.50	-3.30
2002	-1.64	0.66	-1.39	-0.73	-3.12	-1.64	-3.00	-2.17
2003	2.00	1.66	-1.55	-0.45	-1.87	-0.90	-5.43	-1.94
2007	0.31	-1.74	-2.88	-2.90	-1.28	-3.29	-1.24	-1.48
2008	-1.52	-1.71	-1.03	0.22	-2.20	0.55	-2.20	-1.95
2009	-1.89	-2.45	0.38	-3.75	-0.68	-1.66	-4.82	-2.16
2010	-2.21	-0.57	0.59	-2.49	-3.19	-2.54	-3.79	-1.78
2011	-2.13	1.04	-1.64	-1.67	-2.46	-5.17	-3.07	-3.29
2012	-0.01	0.12	-1.03	-1.66	-3.31	-0.01	-2.00	-2.22

3.3. Daily travel distance

Figure 4 presents the gender differences in the total daily trips in rural and urban areas for the four age groups. Table 2 presents the Student's t-tests for comparing males and females in each group. Significant yearly differences at the 0.05 confidence level are marked in grey. For the youngest age group, the gender gap in the travel distance is non-significant. For 20-24 year-olds in rural areas, the gender gap related to the daily travel distance is non-significant, but in urban areas a significant gender gap systematically occurred in the 1990's with urban females travelling shorter distances. The gap became non-significant since 2003 due to a steady increase in the travel distance of females. For 25-29 year-olds, in rural and urban areas during the 1990's the daily distance travelled by females was significantly shorter, and the difference was significant at the 0.05 level. With the steady increase in the travel distance of young women during this period, the gap became non-significant in 2003. For the oldest age group, in rural areas the travel distance increased over time for both males and females, and because of a greater increase in the travel distance of females, the gender gap became non-significant since the mid-1990's. In contrast, in urban areas the travel distance of both males and females in their thirties remained rather steady over the years, with a consistently significant gender gap of roughly 20% shorter daily travel distance for females. The difference is significant at the 0.05 level.

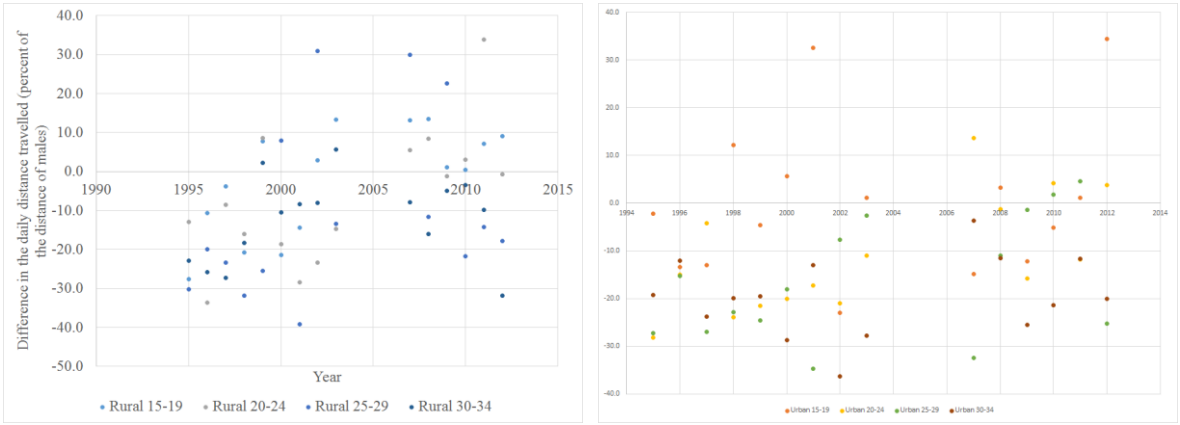

Fig 4. Gender differences in the daily distance travelled

Table 2. T-statistics for the comparison between the travel distance of males and females by age and region

Year	Rural 15-19	Urban 15-19	Rural 20-24	Urban 20-24	Rural 25-29	Urban 25-29	Rural 30-34	Urban 30-34
1995	2.14	0.27	0.97	4.22	3.09	4.37	1.95	2.84
1996	0.80	1.32	2.74	1.92	1.80	2.29	2.19	2.00
1997	0.31	1.42	0.68	0.64	1.96	4.17	2.22	3.54
1998	1.57	-1.50	1.34	3.45	2.97	3.33	1.49	2.91
1999	-0.50	0.48	-0.62	2.75	1.88	2.76	-0.18	2.85
2000	1.51	-0.79	1.30	2.25	-0.44	2.45	0.90	3.99
2001	1.15	-3.91	2.23	1.84	3.40	4.45	0.59	1.65
2002	-0.17	1.71	1.28	2.35	-1.84	0.82	0.63	3.65
2003	-0.72	-0.09	0.90	1.08	0.79	0.30	-0.36	3.03
2007	-0.67	1.65	-0.32	-1.56	-1.54	3.21	0.49	0.45
2008	-0.72	-0.28	-0.45	0.11	0.73	1.26	0.98	1.11
2009	-0.07	1.32	0.09	1.76	-1.25	0.20	0.36	3.85
2010	-0.04	0.67	-0.20	-0.63	1.95	-0.24	0.28	3.36
2011	-0.53	-0.15	-1.55	1.13	0.97	-0.54	0.69	1.51
2012	-0.42	-3.92	0.04	-0.32	1.12	2.56	2.00	1.90

3.4. Daily travel time

Figure 5 presents the gender differences in the total daily travel time in rural and urban areas for the four age groups and Table 3 presents Student's t-tests for comparing males and females in each group. Significant yearly differences at the 0.05 confidence level are marked in grey. In urban areas, the difference in travel time between males and females is approximately 10%, which is smaller than the difference of 30-40% in rural areas. For 15-19 year-olds, the gender difference in travel time is non-significant at the 0.10 significance level both in rural and urban areas. For 20-24 year-olds, the gender difference is not significant in rural areas, but it is systematically significant in urban areas since 2007, with females spending between 10-20% more time in their daily travel. For the group of 25-29 year-olds, the difference between the travel time of males and females is not systematically significant. For the group of 30-34 year-olds the difference in the travel time of males and females is non-significant across the two decades.

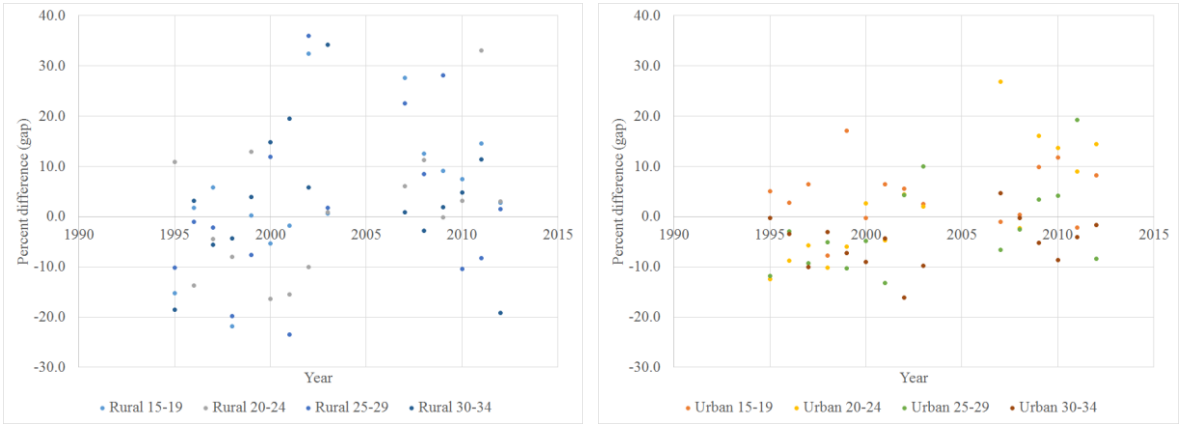

Fig 5. Gender differences in the daily travel time

3.5. Travel related to activity purposes

Figure 6 presents the gender differences in the total daily travel time in rural and urban areas for the four age groups and Table 4 presents the Pearson's chi-square tests for comparing males and females in each group. Significant yearly differences at the 0.05 confidence level are marked in grey. The youngest age group (15-19 year-olds) does not exhibit a significant difference between males and females. The group of people in their early twenties (20-24 year-olds) does not systematically exhibit a significant difference both in urban areas, although a difference appears in some years in rural areas. For people in their late twenties (25-29 year-olds), the difference between males and females is significant only in rural areas, where males engage in more mandatory activities and females in many more escort activities. The oldest age group (30-34 year-olds) exhibits significant differences with respect to the proportions of trips by purpose, both in rural and urban areas, with the main difference being that males engage in more mandatory activities and females in more escort activities.

Table 3. T-statistics for the comparison between the travel time of males and females by age and region

Year	Rural 15-19	Urban 15-19	Rural 20-24	Urban 20-24	Rural 25-29	Urban 25-29	Rural 30-34	Urban 30-34
1995	1.47	-0.33	-0.96	2.11	1.25	2.14	2.26	0.05
1996	-0.16	-0.63	1.39	1.50	0.11	0.49	-0.30	0.64
1997	-0.58	1.06	0.47	0.94	0.24	1.53	0.59	1.71
1998	2.17	-2.08	0.86	1.81	2.22	0.86	0.47	0.50
1999	-0.01	0.03	-1.06	0.98	0.66	1.63	-0.41	1.22
2000	0.50	-0.72	1.46	-0.38	-0.67	0.80	-1.43	1.47
2001	0.17	-0.58	1.57	0.65	2.40	2.34	-1.35	0.65
2002	-2.31	-0.24	0.76	-0.62	-2.71	-0.66	-0.62	2.38
2003	-0.06	0.10	-0.06	-0.24	-0.15	-1.36	-2.89	1.47
2007	-2.04	-0.04	-0.57	-3.26	-1.57	0.88	-0.08	-0.69
2008	-1.01	-1.13	-0.82	0.29	-0.66	0.34	0.22	0.03
2009	-0.98	-1.64	0.02	-2.29	-2.32	-0.52	-0.18	0.95
2010	-0.84	0.35	-0.29	-2.28	1.20	-0.67	-0.56	1.59
2011	-1.48	-1.16	-2.25	-1.26	0.71	-2.57	-1.04	0.68
2012	-0.23	-2.10	-0.25	-1.64	-0.12	1.13	1.45	0.23

Table 4. Pearson chi-square (p-value) for comparing the proportion of trips by purpose of males and females by age and region

Year	Rural 15-19	Urban 15-19	Rural 20-24	Urban 20-24	Rural 25-29	Urban 25-29	Rural 30-34	Urban 30-34
1995	0.17	0.93	0.24	0.90	0.02	0.47	0.00	0.13
1996	0.48	0.81	0.82	0.75	0.01	0.30	0.00	0.03
1997	0.84	0.89	0.41	0.98	0.00	0.33	0.10	0.17
1998	0.94	0.80	0.24	0.49	0.00	0.22	0.00	0.00
1999	0.99	0.89	0.00	0.25	0.00	0.12	0.00	0.00
2000	0.49	0.22	0.03	0.48	0.00	0.29	0.00	0.00
2001	0.01	0.56	0.44	0.25	0.00	0.02	0.00	0.00
2002	0.13	0.16	0.28	0.30	0.00	0.12	0.00	0.06
2003	0.57	0.32	0.02	0.51	0.07	0.29	0.02	0.01
2007	0.71	0.69	0.01	0.33	0.00	0.00	0.02	0.00
2008	0.94	0.56	0.26	0.76	0.00	0.05	0.00	0.02
2009	0.84	0.00	0.55	0.18	0.00	0.11	0.00	0.14
2010	0.21	0.17	0.61	0.08	0.00	0.07	0.00	0.26
2011	0.21	0.88	0.00	0.48	0.00	0.01	0.00	0.07
2012	0.49	0.03	0.04	0.30	0.00	0.54	0.00	0.00

3.6 Mode choice

Figure 7 presents the gender differences in the trip proportions by mode in rural and urban areas for the four age groups and Table 5 presents the Pearson's chi-square test for comparing males and females in each group. Significant yearly differences at the 0.05 confidence level are marked in grey. For the two oldest age groups (25-29 year-olds), for both males and females, while the car remains by far the dominant mode in rural areas, the car use is declining in urban areas and the use of non-motorized modes is steadily rising across the investigated time period. Regarding the gender gap, for the youngest age group there was a systematic and significant difference in the trip proportions by mode until 2007, with males conducting a higher share of trips by motorized private modes and females conducting a higher share of trips by bicycle and public transport. The difference is no longer significant in rural areas, although in urban areas a significant difference re-appeared in 2011-2012. For young people in the early twenties (20-24 year-olds) during the 1990s and the beginning of the millennium there was a significant difference in the mode choice, with males conducting more trips by car and females travelling more by bicycle and public transport. The difference became non-significant in rural areas from 2003 and in urban areas from 2007. The difference re-appeared again in rural areas during 2010-2011. For young people in their late twenties (25-29 year-olds), in urban areas there is no significant difference in the proportion of trips by travel mode, while in rural areas there is a systematic and significant difference with males travelling more by car and females more by bicycle. For the oldest age group (30-34 year-olds), there is no significant difference in proportions of trips by travel mode for most of the period investigated.

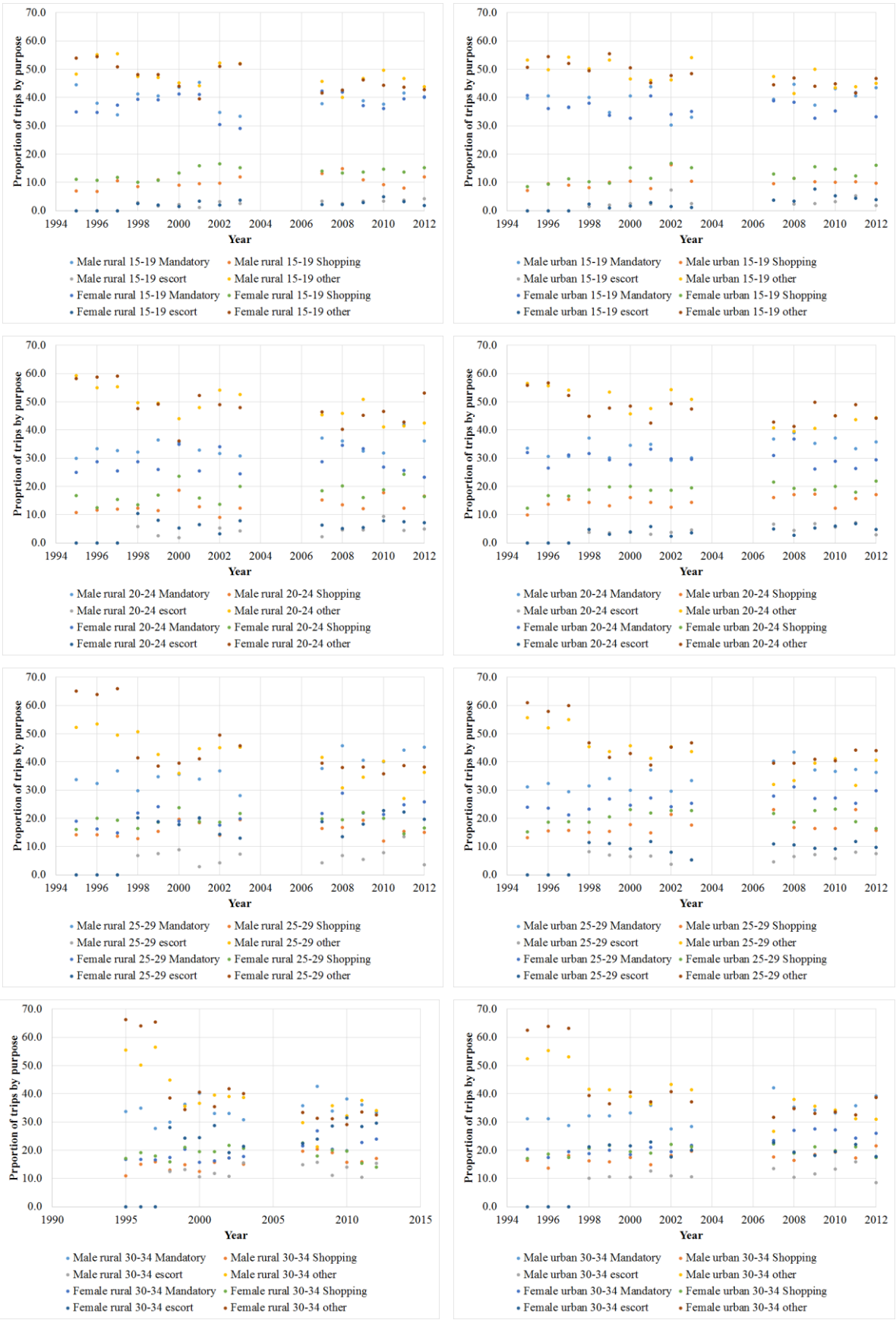

Fig 6. Gender differences in trip purposes

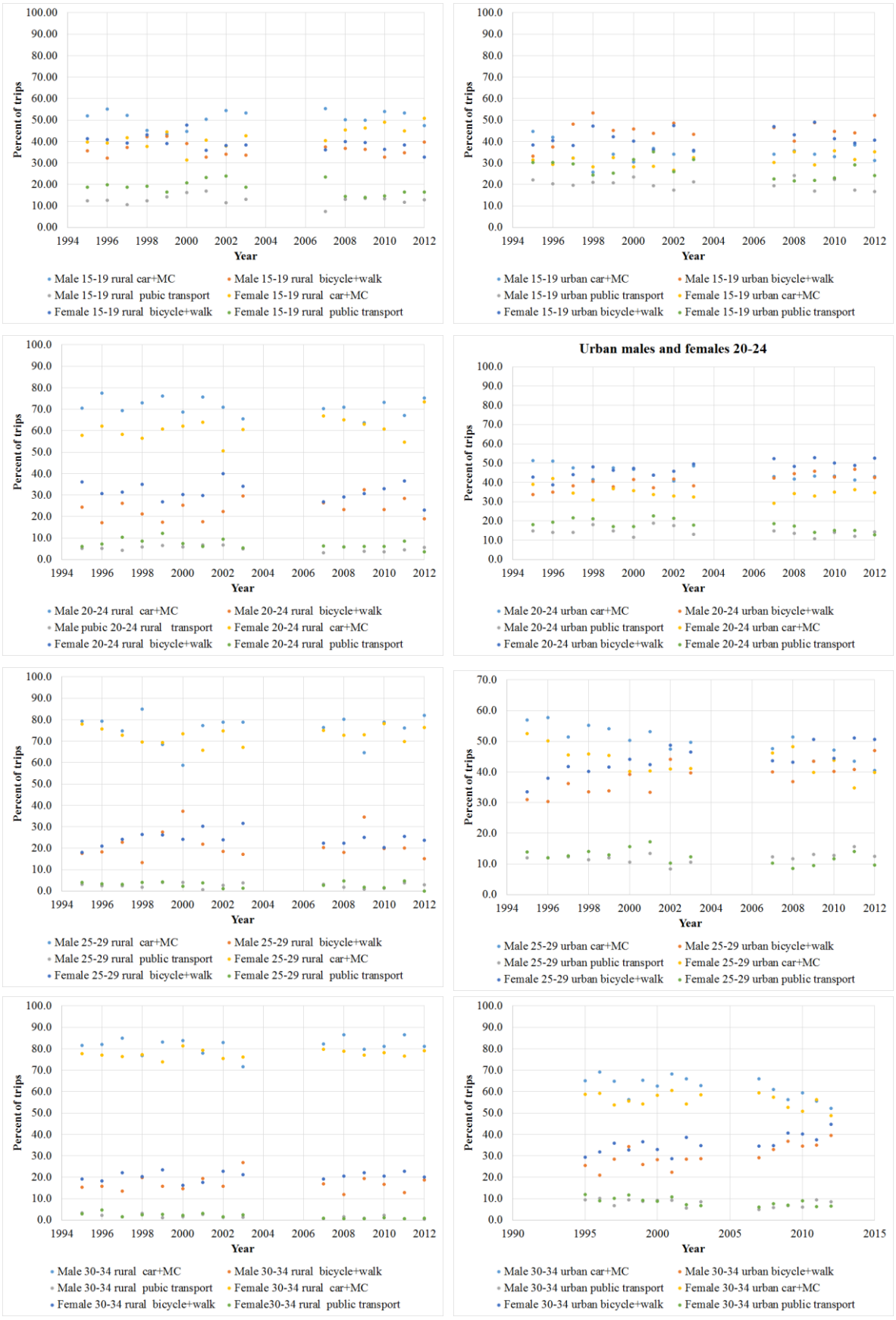

Fig 7. Gender differences in mode choice

Table 5. Pearson's chi-square (p-value) for comparing the mode shares of males and females by age and region

Year	Rural 15-19	Urban 15-19	Rural 20-24	Urban 20-24	Rural 25-29	Urban 25-29	Rural 30-34	Urban 30-34
1995	0.03	0.02	0.02	0.05	0.86	0.64	0.54	0.39
1996	0.00	0.01	0.00	0.12	0.65	0.24	0.18	0.02
1997	0.01	0.03	0.00	0.01	0.87	0.46	0.04	0.05
1998	0.08	0.46	0.00	0.10	0.00	0.17	0.93	0.72
1999	0.71	0.54	0.00	0.09	0.96	0.19	0.03	0.05
2000	0.03	0.16	0.37	0.05	0.01	0.08	0.75	0.59
2001	0.10	0.00	0.01	0.12	0.00	0.04	0.89	0.24
2002	0.00	0.05	0.00	0.25	0.29	0.40	0.14	0.04
2003	0.07	0.04	0.57	0.01	0.00	0.23	0.28	0.38
2007	0.00	0.63	0.21	0.02	0.85	0.70	0.78	0.37
2008	0.64	0.79	0.38	0.26	0.03	0.35	0.02	0.64
2009	0.76	0.33	0.48	0.10	0.08	0.29	0.80	0.73
2010	0.61	0.79	0.02	0.23	0.96	0.67	0.46	0.18
2011	0.17	0.01	0.01	0.49	0.34	0.11	0.01	0.54
2012	0.28	0.04	0.43	0.13	0.02	0.62	0.60	0.50

4. Conclusions

The current study focuses on analysing the gap in the travel of young men and women in urban and rural areas in Denmark in the years 1995-2012. The main research questions concern (i) the change in the gender difference with the lifecycle progression, and (ii) the gender difference in rural and urban areas. The first question is raised because while for adults consistent gender differences in travel are found in the literature, for children the findings are inconclusive. The second question is related to the gender difference considering the availability of different transport options and the socioeconomic gap between rural and urban areas.

Results show the following trends in Denmark. In terms of driver's license holding, there is no systematic gender gap in urban areas across all age groups. In rural areas, a gender gap is non-significant for the youngest age group, but is significant for young people in their twenties, with males having a higher licensure rate. The gap is irrelevant for young people in their thirties since almost all have a driving license by this age. Hence, while women exhibit a delay in obtaining the license compared to men, most of them acquire a license by their early thirties. Regarding car accessibility, in urban areas there is no significant gender gap, while in rural areas young women in their thirties enjoy a slightly higher car accessibility compared to men. The gender gap in the number of trips increases with age, with 30-34 year-olds exhibiting the most pronounced systematic gender gap both in rural and urban areas, with females having a much higher number of trips. In terms of daily driving distance, while in the 1990's female young adults have travelled significantly shorter distances than males, the gap became non-significant since the beginning of the millennium and even earlier in rural areas. The gap remains significant only for 30-34 year-olds in urban areas, with females travelling shorter distances. The difference in travel time between males and females is consistently non-significant across the two decades and it is around 1 hour a day although it has increased by 10-20% for both males and females across the two decades. With respect to travel purpose, the two youngest age groups do not exhibit a significant gender difference in the trip proportions by purpose, but the two older groups exhibit a significant difference, with males engaging in more mandatory trips and females engaging in more escort trips. For 25-29 year-olds, the difference is only in rural areas while for 30-34 year olds the difference is both in urban and rural areas. With respect to gender differences in mode choice, for the two younger age groups there was a significant difference in the 1990s with males travelling more by car and females travelling more by non-motorized modes, but the difference became non-significant in the last few years. For people in their late twenties, the difference is significant in the rural areas but not in urban areas, and for the oldest age group there are no significant differences in mode use.

The results suggest that in Denmark, in cases that there is gender-related gap in transport behaviour, the gap progresses across age groups and is different for rural and urban areas. Regarding the number of trips and the proportion of trips by purpose, the gap is greater for the older age groups and is more pronounced in rural areas. Regarding the travel distance, the gap over time diminished more rapidly in rural than in urban areas, and currently the gap is significant only for the oldest age group in urban areas. Regarding the trip proportion by mode, the difference is more pronounced in rural areas, and it diminishes with the lifecycle progression.

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The Contribution of Comfort, Convenience, and Liking of Bicycling to the Bicycling Gender Gap: Evidence from Davis, California

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The Contribution of Comfort, Convenience, and Liking of Bicycling to the Bicycling Gender Gap: Evidence from Davis, California

Abstract

Bicycling as a mode of transportation has many benefits for women, yet throughout most of the world, women cycle less than men. Researchers have put forth many reasons for the gender gap in cycling, including that bicycling is less convenient for women, that they are less comfortable bicycling, and that they like bicycling less than men. Thus, a deeper understanding of women's attitudes toward bicycling is an important step towards the development of policies and programs to increase bicycling among women. To that end, this paper explores results from a series of studies in Davis, California that have aimed to identify key factors influencing bicycling as a mode of transportation. The studies, conducted between 2006 and 2012, include both quantitative and qualitative approaches, with some focusing on adults and some on children. The results from these studies points to comfort and liking of bicycling as more important factors than convenience, and they suggest that differences between men and women begin early in life. These findings have implications for the development of policies and programs to reduce the gender gap in bicycling.

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INTRODUCTION

Bicycling as a mode of transportation has many benefits for women, including improved health, low monetary costs, and a smaller environmental footprint. Yet throughout most of the world, women cycle less than men. The notable exceptions are the Netherlands and Denmark, where over half of bicyclists are women; in Germany, Sweden, and Finland, nearly half of bicyclists are women (Garrard, Dill, and Handy, 2012). But in countries that are less friendly to cycling, the shares are much lower: less than one-third of bicyclists are women in Canada, the U.K., Australia, and the U.S. Within any given country, men and women face the same cycling environment – the same distances to destinations, the same bicycle infrastructure, the same vehicle traffic. The fact that women are less likely to cycle than men in most countries suggests that they are less able to overcome or less willing to overlook limitations of the cycling environment in these places.

Researchers have put forth many reasons for the gender gap in cycling (Garrard, Dill, and Handy, 2012). One potential explanation is the burden of household responsibilities that women often bear, including childcare duties and household chores. These responsibilities often mean less flexibility in daily schedules and more need for transporting others that could make bicycling inconvenient. Another potential explanation is that women feel less confident and comfortable bicycling and, conversely, that they are more concerned about safety and security when bicycling than men. A third possibility is that women simply don't like bicycling as much as men. Although the high shares of female bicyclists in the Netherlands and Denmark suggest that a good bicycling environment can erase these differences or at least their effect on the decision to bicycle, it is clear that, in other parts of the world, how women think and feel about bicycling plays a critical role in explaining their lower bicycling shares.

Thus, a deeper understanding of women's attitudes toward bicycling is an important step towards the development of policies and programs to increase bicycling among women. To that end, in this paper I explore results from a series of studies in Davis, California that have aimed to identify key factors influencing bicycling as a mode of transportation. The studies, conducted between 2006 and 2012, include both quantitative and qualitative approaches, with some focusing on adults and some on children. My exploration of the results from these studies points to comfort and liking of bicycling as more important factors than convenience, and they suggest that differences between men and women begin early in life. I conclude with a discussion of the implications of these findings for policies and programs.

BACKGROUND

Davis, a prosperous university town with a population of around 65,000 located in the Central Valley of California, is well-known for its bicycling culture. According to data from the 2005–2009 American Community Survey, 15.5% of Davis workers usually bicycle to work, far above the national rate of less than 1%. Nearly half of employees at the University of California, Davis (UC Davis) who live within the city commute to campus by bicycle. Its flat topography, compact development patterns, and generally good weather make it a good place for bicycling, and since the 1960s the city has supported bicycling through infrastructure investments and other bicycle-friendly policies (Buehler and Handy, 2008).

Several things make Davis an interesting setting for a study of bicycling behavior. First, there is enough bicycling that it is possible to acquire a sufficiently large sample of bicyclists. Second, the supportive physical environment makes it possible to study the effect of individual and social factors on bicycling; in other communities, a poor cycling environment can outweigh favorable individual and social factors. In addition, although the physical environment is generally supportive of bicycling throughout the city, there are notable variations (e.g. central Davis has few off-street bike paths), and distances to destinations (e.g. downtown or the high school) differ substantially depending on residential location.

With a team of enthusiastic students, I have undertaken seven studies since 2006 in Davis that aimed to identify key factors influencing bicycling as a mode of transportation. Four studies focused on adults, three on children. Four studies involved large sample surveys, while three employed semi-structured interviews. I provide an overview of the studies and their methods below; more detailed descriptions can be found in the papers cited.

- *Six-city Survey.* The purpose of this study was to explore the relative importance of physical environment, social environment, and individual factors in explaining bicycling behavior. In 2006, we surveyed adult residents of Davis and five other small cities in the western U.S., chosen for their similarities to Davis with respect to size, climate, and topography but differences with respect to bicycling culture and infrastructure. For each city, we purchased a random sample of residents from a commercial provider and recruited participants by mail to complete an on-line survey. We achieved an overall response rate of 12.6%, with a rate of 18.8% in Davis. Analyses of the survey data are published in Emond et al., 2009, Xing et al., 2010, Handy et al., 2010, and Handy and Xing, 2011. Results presented in this paper are for the 335 Davis respondents in the sample.

- *Campus Travel Survey.* The annual Campus Travel Survey is a joint effort by Transportation and Parking Services and the Institute of Transportation Studies at UC Davis. The main purpose of the survey is to assess how the UC Davis population travels to campus, awareness of campus transportation services, and perceptions of mobility options. The 2010 survey was administered online in November to a stratified random sample of 15,704 students, faculty, and staff (of an estimated total population of 40,618). Invitations with a link to the online survey were sent to university e-mail addresses, and 26% of those invited completed the survey. Results presented in this paper are for the 2980 faculty and staff respondents who live in the City of Davis (other communities are at least 10 miles from the campus and thus generally beyond a reasonable bicycling distance). Analysis of the survey data is presented in Miller and Handy, 2012.

- *Formation of Attitudes Toward Cycling.* The purpose of this study was to explore the formation of attitudes towards cycling among adults using a “mobility biography” approach. We recruited participants through advertisements posted in the local newspaper and other means. All participants were required to be English-speaking residents of Davis between the ages of 25 and 65. We conducted semi-structured interviews between July and October 2010 of about one hour in length with each of 54 participants. Participants were asked about their experience with bicycling throughout their lifecourse. Interviews were professionally transcribed and then analyzed for key

themes. Analyses of the interviews can be found in Lee et al., 2013 and Underwood et al., 2013. In this paper, we present selected examples from these interviews.

- *E-bike Early Adopters.* In this study, we qualitatively explored the experiences of early adopters of electric bicycles (e-bikes) in Davis and the surrounding Sacramento region. We used a variety of techniques, including the snowball method, to recruit 27 e-bike owners, all adults, to participate in semi-structured interviews about their experiences in the fall of 2011. We conducted 3 interviews by phone and 24 in person, with the semi-structured interviews lasting between 20 and 45 minutes. Interviews were professionally transcribed and then analyzed for key themes. Interview results are available in Handy et al., 2013. In this paper, we present selected examples from these interviews.

- *Bike-to-Soccer Study.* In October and November 2006, we surveyed parents of players in the local youth soccer league as to their mode of travel to the game and to practices. The two-page survey was administered in-person at Saturday morning soccer games. Survey takers covered 76 games over three weekends. The final dataset includes surveys for 1,084 players, nearly half of all players in the league. The players in the league range in age from 5 to 18. Survey results are published in Tal and Handy, 2008.

- *High School Survey.* In April 2009, we conducted a survey at Davis High School to measure mode share for school trips as well as attitudes toward bicycling. The two-page survey was administered during home period on a selected day, yielding a 75% response rate and 1357 valid surveys. Davis High School has grades 10 through 12, with most students in the age range of 14 to 18. Survey results are published in Emond and Handy, 2011.

- *Kid's Attitudes Study.* In 2009, we launched Phase I of a longitudinal study of the formation of attitudes towards bicycling and driving beginning in childhood. We conducted semi-structured interviews with 20 fourth graders (ages 9 and 10) in Davis and their parents. In 2011, we re-interviewed 14 of the original child-parent pairs and added 11 new pairs for a total sample of 25; the children were now sixth graders (ages 11 and 12). The interviewers lasted about 40 minutes on average, including questions for both the child and the parent. Interviews were professionally transcribed and then analyzed for key themes. We plan to repeat the interviews at two- to three-year intervals. Phase I results are summarized in Maiss and Handy, 2010, and Phase II results in Driller and Handy, 2013.

RESULTS

Although gender differences were not the primary focus of any of the seven Davis bicycling studies, they produced an abundance of quantitative and qualitative data that shed light on differences between women and men with respect to both the amount of cycling and attitudes towards cycling. First I present a variety of findings for adults from bivariate analyses, multi-variable logistic regression models, and qualitative analyses, then for youth.

Adults

In Davis, as in the rest of the U.S., men bicycle more than women, though the differences are not as great. Among Davis residents, half of women reported having bicycled in the last week on an average of 2.78 days, compared to 56.4% of men on an average of 3.31 days (Table 1). The differences in percent bicycling last week or not are statistically significant, however. Among UC Davis employees (faculty and staff), the gender differences for bicycling to campus are starker: women are less likely to report any travel by bicycle to campus, that the majority or the entirety of their travel to campus is by bicycle, or that they bicycled as their primary mode at least once in the previous week.

TABLE 1. Gender Differences in Bicycling - Adults

Davis Residents	Women	Men	p-value
Biked last week	50.0%	56.4%	0.240
Days biking last week	2.78	3.31	0.051
UC Davis Employees			
Any travel to campus by bike	51.8%	57.6%	0.003
Majority of travel to campus by bike	41.7%	50.9%	0.000
All travel to campus by bike	29.1%	40.0%	0.000
Bike as primary mode at least once	50.3%	55.9%	0.003

Convenience does seem to play a role. For UC Davis employees, women are more likely to say that they need to use a car during the day and to have responsibility for picking up children than men; the differences are statistically significant but not large (Table 2). Among women, those who bike are far less likely to need to use a car or to have pick-up kid duty than those who don't bike. In other words, household responsibilities do seem to help explain which women are and aren't bicycling, but they do not seem to explain much of the gender difference in bicycling, at least in the UC Davis sample. Note that other aspects of convenience not measured in the survey might have a stronger contribution to gender differences in bicycling.

TABLE 2. Gender Differences in Bicycling Convenience - Adults

UC Davis Employees	Women	Men	p-value	Women who bike	Women who don't bike	p-value
Need to use car during day	34.6%	31.9%	0.000	23.9%	45.1%	0.000
Pick-up kid duty	17.4%	15.4%	0.003	8.3%	20.8%	0.000

The differences in bicycling comfort for men and women are dramatic both among Davis residents and UC Davis employees (Table 3). Men express greater comfort bicycling on all types of facilities, with the differences increasing with the exposure of the bicyclist to traffic. For example, about 60% of women said they are comfortable riding on a four-lane street with a bike lane, in comparison to nearly 72% of men. Among women, those who bicycle are far more comfortable than those who don't on most facilities, but they are equally unlikely to feel comfortable bicycling on a four-lane street without a bike lane. The patterns are similar for UC Davis employees. The majority of UC Davis employees report agreement or strong agreement with the statement "I am very confident riding a bike," but again the share is higher for men than women and higher for women who bicycle than those who don't.

TABLE 3. Gender Differences in Bicycling Comfort - Adults

Davis Residents	Women	Men	p-value	Women who bike	Women who don't bike	p-value
Comfortable riding on…						
Off-street bicycle path	92.8%	94.9%	0.718	98.7%	86.8%	0.017
Quiet residential street	96.1%	98.9%	0.191	100.0%	92.2%	0.044
Two-lane local street with bike lane	87.0%	92.5%	0.026	96.1%	77.9%	0.004
Four-lane street with bike lane	60.5%	71.8%	0.011	73.3%	48.1%	0.004
Four-lane street without bike lane	5.2%	14.8%	0.000	5.2%	5.2%	0.034
UC Davis Employees						
Comfortable riding on…						
Off-street bicycle path	80.9%	90.3%	0.000	87.2%	74.4%	0.000
Quiet residential street	92.0%	96.8%	0.000	96.7%	87.2%	0.000
Two-lane local street with bike lane	77.5%	89.4%	0.000	88.7%	65.9%	0.000
Four-lane street with bike lane	61.4%	80.1%	0.000	71.7%	50.7%	0.000
Four-lane street without bike lane	11.7%	27.8%	0.000	12.4%	11.1%	0.000
I am very confident riding a bike	63.5%	84.3%	0.000	72.6%	54.3%	0.000

Concerns about potential safety hazards are related to bicycling comfort. Among Davis residents, women are more likely than men to be very concerned about being hit by a car, bitten by a dog, mugged or attacked, or crashing because of road hazards (Table 4). Women who bicycle are less likely to report such concerns than women who don't bicycle. Interestingly, concerns about being hit by another bicyclist are not statistically significantly different for women and men, or for women who bicycle versus those who don't. By far the greatest concern for all groups is being hit by a car.

TABLE 4. Gender Differences in Bicycling Concerns - Adults

Among Davis Residents	Women	Men	p-value	Women who bike	Women who don't bike	p-value
Very concerned about…						
Being hit by a car	25.3%	19.3%	0.025	15.6%	35.1%	0.014
Being hit by another bicyclist	11.2%	7.4%	0.419	6.5%	16.0%	0.177
Being bitten by a dog	5.8%	3.4%	0.078	1.3%	10.4%	0.055
Being mugged or attacked	4.6%	3.4%	0.000	1.3%	7.9%	0.003
Crashing because of road hazards	12.3%	6.9%	0.123	5.2%	19.5%	0.011

In addition to convenience and comfort, some observers have hypothesized that women simply like bicycling less than men. Our data show that this is indeed the case. Among Davis residents, women are less likely to agree and to strongly agree that "I like riding a bike" than men (Table 5). Among UC Davis employees, women are more likely to say that they agree that they like riding a bike, but far less likely to strongly agree that they like riding a bike than men. For both populations, women who don't bike are almost as likely as women who bike to agree that they like riding a bike, but they are far less likely to strongly agree. This is particularly true for women in the Davis population, less than 4% of whom strongly agree that they like riding a bike. In other words, simply liking bicycling is not enough; really liking bicycling is what seems to get women (as well as men) on their bikes.

TABLE 5. Gender Differences in Attitudes - Adults

Davis Residents	Women	Men	p-value	Women who bike	Women who don't bike	p-value
I like riding a bike (agree)	43.1%	45.3%	0.05	42.9%	43.4%	0.000
I like riding a bike (strongly agree)	27.5%	35.2%		50.6%	3.9%	
UC Davis Employees						
I like riding a bike (agree)	42.5%	39.8%	0.000	44.7%	40.2%	0.000
I like riding a bike (strongly agree)	33.2%	44.8%		46.5%	19.5%	

Multi-variable binary logistic regression models show significant differences in the importance of just some of these factors for women relative to men in predicting whether an individual is a bicyclist (defined as having bicycled at least once in the last week) or not while controlling for other factors. For Davis residents, having child pick-up duties was important for both men and women to an equal degree, but in an unexpected way: those with such duties were almost twice as likely to bicycle as those who didn't (see Table 3 in Emond, et al. 2009). Bicycling comfort was a significant factor in predicting bicycling for women though not for men, but safety concerns were not a significant factor for either men or women, while liking biking

was a significant predictor for both men and women. Among UC Davis employees, liking biking was also significant for both men and women, but strongly liking biking had over 7 times the effect of just liking biking (see Table 5 in Miller and Handy, 2012). Comfort and convenience were equally important for men and women, and had much smaller effects than liking biking. These results suggest that while women and men differ on average with respect to bicycling convenience, comfort, and liking, the effect of these factors on their bicycling is largely similar. In other words, gender differences in bicycling occur because women, on average, are less comfortable bicycling and like it less than men, not because comfort and liking are more important to their decision.

Our interviews with Davis residents also highlighted the importance of convenience, comfort, and liking of bicycling for women. In one analysis, we focused on bicycle crashes and their impact on the participant's comfort with and continued desire for bicycling (Lee et al., 2013). Interestingly, while crashes reduced comfort and desire for some women, for women with a strong liking of bicycling they seemed to have little effect. In addition, women who didn't bicycle were affected by hearing about bicycle crashes. The following comments illustrate these points:

> "Once I was not paying attention or something and I ended up twisting the front handlebars and then skidding and scraping my shoulder blade. And that was a little scary, but it was nothing, I was just not being attentive, and both of those things just forced me to be more cautious and attentive. It didn't detract me from riding. No way, I got right back on."
>
> "I fell off my bike once in Madison [Wisconsin], on a fairly busy street and if a car had been coming it would have run over my head. That was kind of traumatic. I wasn't injured or anything, it was just a big scare...but I don't think it stopped me from biking any more or anything like that."
>
> "I've had two major falls. One of them was when I was living in Austin… I fell off my bike and I got so scared that I didn't really want to get on my bike again in Austin after that. I was on a busy, four-lane road and there was no bike lane… I wasn't injured, just scared myself."
>
> "I had a little accident on my bike riding on the gravel in the parking lot. A car came in unexpectedly and scared me, so I slipped on the gravel and fell down and got all scratched up. So that turned me away from bicycling for awhile."
>
> "I was afraid after hearing about all those bike accidents. I think my perception would probably be different if I biked as well ... If I were an experienced biker, what I read in the paper wouldn't so much influence me … But when you don't have that experience, you tend to believe and base your reaction on what you read. I mean, that's what you have to go by."

In these interviews, women also described the ways in which they like bicycling, whether the feel of bicycling itself or the social aspects of bicycling:

> "I feel like I'm flying."
>
> "You can join with your friends to bike together to just to a new place and explore new places… I like [bicycling] because [of] this."
>
> "I think my experience as an undergrad in Davis really shaped my like for biking. Biking was a really fun thing I did… it wasn't just a mode of transportation to campus… I have some really good memories attached to doing social activities on my bike."

Youth

Gender differences in bicycling start at an early age, even in Davis (Table 6). Boys are more likely to usually bicycle to their soccer games, to middle school, and to high school. By middle school, the gap is already over 12 percentage points (as reported in retrospect by high school students); by high school it has increased to 13 percentage points.

TABLE 6. Gender Differences in Bicycling - Youth

	Girls	Boys	p-value
Share biking to soccer games	14.3%	21.4%	0.000
Share biking to middle school	44.3%	56.9%	0.000
Share biking to high school	30.1%	43.4%	0.000

As for adults, differences in convenience, comfort, and liking of bicycling seem to contribute to these differences, though parents and peers are also a factor. In high school, girls and boys differ significantly on factors related to convenience: girls are more likely to say they are rushed in the morning, have lots of stuff to carry, and wear clothes that make bicycling difficulty (Table 7). Boys are more likely to say that they are confident in the bicycling ability, feel comfortable riding on busy streets, and feel comfortable getting places on their own, though the majority of girls also agree on these points. Girls are less likely to say they like bicycling and also less likely to say that they like being physically activity. On the other hand, they are more likely to agree that protecting the environment is important to them, and they are less likely to agree that driving is the coolest way to get to school, attitudes that might encourage more bicycling. Boys are more likely to say that their friends bicycling to school, but few boys or girls admit that they worry what their peers will think of them if they bicycle. With respect to parental influences, the differences between girls and boys are not statistically significant.

Girls who bicycle are more likely to report agreement with statements related to confidence and comfort than girls who don't bicycle. The share of girls agreeing that they like biking is nearly 30 percentage points higher than for girls who don't bicycle. Girls who bicycle also like physical activity more, and they care more about the environment. They are more likely to have friends who bicycle to school, and less likely to say that driving is the coolest way to get to school. The largest difference between girls who bicycle and those who don't is for parental encouragement: 79% of girls who bicycle agree that their parents or guardians encourage them, compared to less than one third of girls who don't bicycle. Girls who bicycle are more likely to say that their parents or guardians bicycle and less likely to agree that they can rely on them to drive them places. However, convenience seems to matter less: the two groups do not differ

TABLE 7. Gender Differences in Attitudes* - Youth

High School Students	Girls	Boys	p-value	Girls who Bike	Girls Who Don't Bike	p-value
Convenience						
I am always rushed to get ready in the morning.	56.7%	48.2%	0.002	52.7%	58.4%	0.165
I have lots of stuff to carry to school.	59.1%	41.5%	0.000	63.2%	57.2%	0.146
The clothes I wear make it hard to ride a bicycle.	17.4%	5.7%	0.000	12.3%	19.6%	0.021
Confidence and comfort						
I am confident in my bicycling ability.	79.6%	88.6%	0.000	92.7%	73.9%	0.000
I feel comfortable bicycling on a busy street with a bicycle lane.	53.0%	69.0%	0.000	69.8%	45.6%	0.000
I feel comfortable getting places on my own.	81.6%	88.5%	0.001	87.8%	78.9%	0.006
Preferences						
I like bicycling.	49.1%	56.1%	0.012	69.8%	40.1%	0.000
I like being physically active.	75.3%	83.1%	0.001	82.4%	72.2%	0.005
Protecting the environment is important to me.	74.9%	60.5%	0.000	81.0%	72.2%	0.160
Social influences						
My friends bicycle to school.	46.9%	53.2%	0.023	61.5%	40.6%	0.000
Driving is the coolest way to get to school.	26.4%	39.9%	0.000	20.0%	29.2%	0.013
I worry what my peers will think of me if I bike to school.	5.6%	7.8%	0.806	4.9%	6.0%	0.000
Parental influences						
One or both of my parents/guardians bicycle frequently.	27.9%	25.8%	0.391	41.2%	22.1%	0.000
My parents/guardians allow me to go places by myself.	84.9%	87.5%	0.183	89.3%	83.1%	0.038
My parents/guardians encourage me to bicycle.	46.5%	44.3%	0.412	79.0%	32.4%	0.000
I can rely on my parents/guardians to drive me places.	43.9%	39.8%	0.142	35.5%	47.5%	0.004

*Percent agreeing or strongly agreeing with the statement.

with respect to being rushed in the morning or having stuff to carry, though girls who bicycle are less likely to say they wear clothes that make bicycling difficult.

A binary logistic regression model of bicycling to high school (or not) were estimated for girls and boys for this paper by Yan Xing using a market segmentation approach. She developed separate models for boys and girls, then used these results as a basis for a pooled model with interaction terms for gender. The final model shows several differences in the factors that matter to girls versus boys (Table 8). Confidence in bicycling ability is associated with a greater likelihood of bicycling for girls but not boys. Girls who are able to rely on parents to drive them places and often go off campus for lunch are less likely to bicycle; these factors do not matter for boys. On the other hand, needing a car and actual bicycling distance are deterrents to boys but not to girls, though both boys and girls are deterred by the perception that they live too far from school to bicycle. Surprisingly, having a parent with a high level of education (a proxy for family socio-economic status) is a strong predictor of bicycling for boys but not girls. For both boys and girls, having parents who encourage them to bicycle is one of the most important factors, as is having a driver's license and access to a car. Liking biking is also an important factor for both boys and girls. It is notable that, with the exception of the parent's educational level, the factors they have in common have larger effects than those that differ, suggesting that, as was true for adults, the differences in their level of comfort or liking are the primary explanation for their differences in bicycling.

TABLE 8. Binary Logistic Regression Model of Bicycling or Not for High School Students

Variable	Coefficient	Sig	Odds Ratio
Constant	-2.273	***	0.103
Socio-demographics			
Driver's license and car access	-1.493	***	0.225
Parent has least Bachelor degree*Male	1.183	***	3.265
Attitudes			
Like to bicycle	0.364	***	1.440
Bicycling ability confidence*Female	0.197	**	1.218
Often go off-campus for lunch*Female	-0.307	***	0.736
Need a car*Male	-0.304	***	0.738
Social environment			
Parents encourage bicycling	0.797	***	2.220
Can rely on parents chauffeuring them*Female	-0.311	***	0.733
Physical environment			
Live too far from school to bicycle	-0.524	***	0.592
Actual bicycling distance*Male	-0.235	*	0.791
Valid N	1064		
Pseudo- R^2	0.375		
Log-likelihood (full model)	428.158		
Log-likelihood(constant only model)	701.299		

***p<0.01; **p<0.05; *p<0.1

Some of the attitudes held by high school girls as revealed in the survey were evident in our interviews with 6th grade girls living in Davis (Driller and Handy, 2013). Although most girls said that they enjoyed bicycling, many of them expressed discomfort with or dislike of certain aspects bicycling. It is notable that girls' concern over appearance was apparent even at this age. These patterns are illustrated by the following comments:

"I love biking. It's really fun."

"I don't really like – well, biking is not my thing."

"If it's in the morning and it's super cold, I don't like [biking]."

"Sometimes when I'm too tired, it's kind of uncomfortable and I'm just really pooped."

"I don't like traffic. It's bad – I'm bad enough as it is that like just on the bike lane. And then in the street, I don't know. No, I don't think I could do that well."

"Because then – I usually like wear a ponytail and if I had to put a helmet on, then it'd just mess it up."

In reflecting on their experience with bicycling during high school, the adult residents of Davis that we interviewed highlighted the social stigma associated with bicycling (Underwood et al., 2013). Although both men and women expressed these views, the effect seemed to be stronger and more lasting for women and more often associated with a sense of fashion that influenced their liking of biking. The following comments are illustrative of these views:

"Once I was in junior high school it was not the cool thing to do, to ride bikes."

"You know, I always liked riding my bicycle as a kid, but when I got to high school it was considered dorky, so then I never rode it in high school."

"In high school biking is not that cool; it didn't seem trendy enough to do."

"People that biked generally speaking were nerdier…big backpacks versus the cars with the purse and the book bag."

"My younger brother rode a bike a lot in high school, but I didn't. It wasn't a fashionable thing to do."

DISCUSSION

Several clear patterns emerge from this exploration of gender differences. First, women bicycle less than men, even in Davis, and the difference starts as early as middle school. Second, women are less comfortable and confident bicycling, and they like bicycling less than men; the same is true for girls. Third, factors related to convenience are more of a mixed bag, perhaps because of

the many different dimensions of convenience. Convenience seems to be more important at the high school level, particularly for girls. Fourth, parents seem to be more important for high school students than peers for both boys and girls. Finally, across all of these factors, comfort with and liking of bicycling are consistently important for women as well as for men.

These results have important implications for efforts to increase bicycling among women and decrease the gender gap between women and men. First, communities must build facilities that are more comfortable for women given their lower level of bicycling confidence. As recent studies have shown, women prefer facilities separated from traffic, such as bicycle paths and cycle tracks, or routes on low-traffic streets, sometimes called bicycle boulevards (Monsere et al., 2012). Second, communities must implement programs designed to increase bicycling comfort and confidence for women as well as girls. Several advocacy organizations across the U.S. now offer courses tailored to women, for example. Third, communities must adopt strategies to increase the convenience of bicycling in a variety of ways. This could range from land use policies that ensure that destinations are within bicycling distance to programs that provide subsidized bicycle trailers to families. Finally, communities must implement promotional programs that move women from simply agreeing that they like bicycling to the "strongly agree" category. Cyclovias and other community events may help on this score. The League of American Bicyclists has outlined a wide range of strategies for getting more women on bicycles (Szczepanski, 2013). Whatever strategies a community choses to implement, it is important they rigorously evaluate the strategies to determine their effectiveness and guide further efforts (Pucher et al., 2010).

Such strategies are largely consistent with at least three of the traditional "4 E's" approach to bicycling planning in the U.S.: engineering, education, and encouragement. To the degree that enforcement, the fourth "E" helps to increase bicycling comfort, it too has a role to play. Another "E" that could make a significant difference, though it has generally received less attention, is equipment (Lovejoy and Handy, 2012). Having the right bicycle with the right gear can help to increase comfort and convenience as well as liking of bicycling. Our qualitative studies especially highlighted the importance of equipment – helmets, bicycles, baskets, trailers, etc. – in several different respects. For example, our interviews with adults in Davis suggest a connection between equipment and fashion, as illustrated by these quotes:

> "…most of the time I wear my hair in a ponytail, and then [wearing a helmet] goofs up your hair. I know it's a silly thing…" [note the striking similarity of this quote to the quote from a 6th grader in the previous section]
>
> "…after going to Copenhagen, and also Amsterdam and seeing women look so lovely on bicycles. And they were not slouched over with their butts up in the air, which is just so unfeminine… that was the first transition I made was a more female oriented bike."

Beyond fashion, which may influence the liking of bicycling, equipment has important implications not just for comfort and convenience but for the very feasibility of bicycling for women, as illustrated by these comments:

> From an e-bike user: "I'm 65, so I don't think people should think age is a barrier. Who would have thought somebody my age would be commuting 20 miles a day on a bike to work?"

> "… a little bit of pride that goes into it, like one time we went to Target. So, I have a two-year old son and so he was on the bike trailer. We went to Target and ended up buying all these storage baskets and bins... My son was carrying like 3 boxes in his lap, and then I had the back of the trailer stuffed full, and then I had like all these things that were precariously in my bike basket. I just felt kind of like proud of myself that I could do all that and get home without dropping anything."

In addition to highlighting the importance of equipment, these last quotes also illustrate the old adage, "where there's a will there's a way." These women had a strong will to bicycle, and they found a way to do it. Living in Davis made that easier, in that good infrastructure and abundant bicycling has created relatively safe and comfortable conditions there. In communities with less supportive bicycling environments, women may be unable to find a way, no matter how strong their will. By investing in bicycle infrastructure and adopting policies and programs to promote bicycling, communities can ensure that women with the will to bicycle have a way to do it. But our Davis research also points to the importance of increasing the will of women to bicycle by addressing the comfort, convenience, and liking of bicycling, and doing so from an early age. By providing the way and promoting the will, communities can increase the proportion of women bicycling and the proportion of bicyclists who are women, to the benefit of all.

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BICYCLE LESSONS, ACTIVITY PARTICIPATION AND EMPOWERMENT

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ABSTRACT
This paper addresses the impact of bicycle lessons for immigrant and refugee women on bicycle use and activity participation, from an equity perspective. Immigrant and refugee women have been identified as one of the population groups most likely to experience accessibility problems and, subsequently, transport-related social exclusion. The bicycle offers considerable potential to increase the mobility of these women. Hence, in the Netherlands and elsewhere, governments and non-governmental organizations have set up bicycle lessons for immigrant and refugee women. The paper discusses the impacts of these lessons on bicycle use and activity participation. It draws on a quantitative survey and a series of in-depth interviews among immigrant women in Amsterdam. The results show that the impacts of the bicycle lessons vary. Some participants use the bicycle for everyday purposes, while others still face constraints preventing bicycle use for regular errands. The impacts on activity participation are limited. At the same time, the lessons have substantially improved women's feelings of self-esteem and self-confidence.

Keywords: bicycle lessons, gender, activity participation, empowerment, Amsterdam

1. INTRODUCTION

In recent decades, the need to travel increased as societies became organized around motorized transport, and especially around the car. Ever since, researchers have studied and discussed the consequences for people that are unable to drive a car for legal, financial or physical reasons (see e.g. *1, 2*). From the end of the 1990s, this debate has been linked to the role of transport in the process of social exclusion (e.g. *3, 4*) and, more recently, fairness in transport provision (*5*), based on the understanding that accessibility problems can be both a cause for, and a result of, social exclusion (*6*). In contrast to the more static descriptions of poverty focusing on material welfare, social exclusion underscores that disadvantage is the result of a process that prevents particular (groups of) people to participate in activities considered normal in society (*7, 8*). This insight has resulted in the coining of the term transport poverty. In line with the distinction between poverty and social exclusion, transport poverty refers to a lack of resources; when the concept of resources is broadly conceived, transport poverty occurs if a person has a lack of access to key opportunities, such as employment, education, health and social support networks (*3*, *9*, *10*). Transport-related social exclusion, in turn, can be the result of transport poverty and occurs if *systematic* problems of access to opportunities lead to significant *impacts* on a person's life, such as unemployment, deterioration of health, or social isolation (*11*).

Over the past ten years, a substantial body of evidence has developed, providing a largely qualitative understanding of transport poverty in a number of Western countries, such as the UK (e.g. *12*), Spain (e.g. *13*), France (e.g., *14*), Canada (e.g. *15*) and Australia (e.g., *16*). This body of research suggests that a substantial share of the population experiences some form of transport poverty. More recently, studies in the Netherlands addressed the role of the bicycle in limiting transport poverty (*17*). The findings suggest that the bicycle plays an important role in people's mobility at the neighborhood and city scale. This makes the bicycle particularly attractive as a means of transportation for women, because of its low cost, its convenience for short distance trips, its flexibility enabling easy trip chaining, as well as the absence of legal barriers for its utilization. As some groups of women have a higher risk to experience transport-related social exclusion, providing them with access to bicycles may be an option to improve and extend these women's mobility options. At the same time, many factors may prevent women from using bicycles, such as topological and climate conditions, the availability of safe bicycle infrastructure, personal safety concerns, or restrictions deriving from gender roles and cultural or religious traditions (see e.g. *18, 19, 20, 21*, and *22*).

One important, but often overlooked, factor inhibiting bicycle use, is a person's inability to ride a bicycle. Like driving a car, riding a bicycle requires training and practice. In countries with a tradition of cycling, like the Netherlands or Denmark, children are usually taught how to ride a bicycle by their parents or caregivers (see e.g. *23*, *24*). But this way of acquiring cycling skills is by no means universal, neither in countries with a cycling tradition nor in countries lacking such a tradition. In countries with a high share of bicycle usage, many children, especially from ethnic minorities, grow up in households without adults able to ride a bicycle in traffic. Learning how to cycle is not an obvious part of growing up in such a setting. In countries with low levels of bicycle ridership, many adults have never learned how to ride a bicycle. For these groups in both countries, organized bicycle lessons, provided outside the common household setting, are a way to acquire the necessary cycling skills to use the bicycle for everyday purposes (see e.g. the Bikeability program in the UK, cycling schools in

Belgium, the CAAC safety training in the US and Escuela BiciMujer (Women's Cycling School) in Chili). Against this background, the goal of this paper is to assess the role of cycling lessons in averting transport-related social exclusion by analyzing the impact of these lessons on the activity participation of immigrant and refugee women in Amsterdam, the Netherlands.

The paper is organized as follows. In Section 2, we briefly describe women's use of the bicycle in the Netherlands and Amsterdam, with a particular attention for the role of the bicycle in the lives of ethnic minorities. In Section 3, we provide a description of the bicycle lessons as they have been provided to immigrant and refugee women in Amsterdam since the early 1990s. We then present a framework that enables us to analyze the impacts of cycling lessons on activity participation (Section 4). For this purpose, we develop a 'ladder of bicycle appropriation'. Then, in Section 5, we present the results of two studies on the impacts of cycling lessons on participants' activity participation. We end with conclusions and a brief discussion (Section 6).

2. CYCLING, GENDER AND ETHNICITY IN THE NETHERLANDS AND AMSTERDAM

On average, women and men have distinctly different mobility patters. Women's travel patterns tend to consist more of trip chains, due to their roles and obligations outside and inside the household (*25, 26*). Combining the roles and obligations may be impossible by public transport, due to discrepancies between personal and transport schedules (*27*). Although cycling may in theory offer women more options in combining their obligations, several studies and statistics show that in almost any country in the world women cycle less than men. Factors that influence the cycling rates of women include a lack of safe cycling infrastructure, a lack of bicycle facilities such as bicycle parking and lockers, concerns around their appearance after cycling (especially at the workplace), a lack of respect for cyclists, combined with fear of harassment and abuse and the unavailability of bicycles and accessories suited for women and children (*20,21, 28, 29, 30, 31*).

In general, studies on transport and gender have shown that cultural constraints may also prevent women from cycling or even travelling all together. Women's frequent and distant travel may be associated with promiscuity and therefore discouraged (*32, 33*). As a result, for many women, the local area is of more significance to them as they live most of their lives bounded by local shops and the school of their children. These gendered mobility patterns can prevent women from participating in society in their own manner. In a Western context, especially women from ethnic minority groups have been identified as one of the population groups most likely to experience accessibility problems and, subsequently, transport-related social exclusion (*12, 34, 35*). They often face multiple disadvantages, such as low education levels, low incomes, limited access to private vehicles, and poor social networks. Also, women tend to experience substantial more time constraints. These disadvantages largely derive from informal institutions, such as gendered social norms about responsibilities for childcare and domestic work (*34, 36*).

In the Netherlands, the bicycle is a mainstream mode of transport and, for many people, an integral part of everyday life. About 27 percent of all daily trips are made by bicycle, a figure that has been relatively stable over the last decades (*28*). The bike is mainly used for travelling short distances up to 5 kilometers, particularly for shopping, commuting and trips to schools and sports facilities. In recent years the distances traveled by bicycle have increased, due to the spatial concentration of facilities and

increased distances between home and places for work, education and other facilities (*37*).

Although there is little difference between men and women in the Netherlands in their average level of bicycle use, there are clear differences when ethnic background is taken into account (table 1). Bicycle use is relatively low amongst non-Western immigrants in the Netherlands, especially among women. Instead of using a bicycle, they tend to travel more on foot or by public transport (*38, 39*). However, in recent years this has gradually changed as bicycle use has increased amongst this group. In 2012 they used a bicycle, on average, for 20% of their daily trips. Although this is still significantly less than native Dutch women (28%), it does show that the bicycle plays an increasingly important role in daily life for this group.

TABLE 1. Use of the Bicycle in Terms of Trips and Travel Distance, for 2012.
Source: Dutch National Travel Survey (adapted)

	Number of trips			Distance travelled in km		
	Total	By bicycle	Bicycle share	Total	By bicycle	Bicycle share
Total	2.64	0.71	26.9%	30.46	2.63	8.6%
Women	2.74	0.78	28.5%	25.57	2.44	9.5%
Men	2.52	0.64	25.4%	35.49	2.83	8.0%
Ethnic group						
Native Dutch total	2.69	0.75	27.9%	31.57	2.79	8.8%
Women	2.82	0.84	29.8%	26.66	2.61	9.8%
Men	2.56	0.66	25.8%	36.57	2.97	8.1%
Western immigrants total	2.51	0.65	25.9%	28.75	2.21	7.7%
Women	2.57	0.70	27.2%	22.38	2.10	9.4%
Men	2.44	0.60	24.6%	35.83	2.33	6.5%
Non-Western immigrants total	2.29	0.49	21.4%	23.40	1.82	7.8%
Women	2.31	0.46	19.9%	20.72	1.48	7.1%
Men	2.28	0.52	22.8%	26.66	2.18	8.2%

Comparable to many other cities in the Netherlands, Amsterdam has experienced in recent decades a substantial increase in bicycle use. The role of the bicycle increased from over 20 % of all trips in 1990 to just over 32% in 2011 (*40*). Three quarters of the residents aged 12 and over own a bicycle and more than half of them cycle daily, mainly on short trips of 1 to 5 kilometers. Although a large part of the population of Amsterdam

has access to a bicycle and use it frequently, still a significant proportion of inhabitants cannot or does not cycle. An extensive survey in 2003 among residents aged 12 years and older, found that 85% of the native Dutch inhabitants owns one or more bicycles, in comparison to 55% of the residents of Moroccon origin, 58% for Surinamese origin, 65% for Turkish or Antillian origin and 75% to 81% for other non-native Dutch residents (*41*). In 2003 this first and second generation non-native inhabitants formed 48% of the inhabitants of Amsterdam and the prediction is that this will rise up to 52% in 2020 *(41)*. The actual use of the bicycle amongst residents of Moroccan, Surinamese, Turkish and Antillean origin is also low compared to the native Dutch: only 40% to 50% uses the bicycle at least once a month. About 16% of the respondents stated that they can cycle but do not own a bicycle. Of these respondents, 29% mentioned that they did not need a bicycle as they could use other means of transportation and 15% mentioned that they did not like cycling. About 6% of the respondents of the survey stated that they had never learned to use a bicycle (*41*).

3. CYCLING LESSONS IN THE NETHERLANDS AND AMSTERDAM

The Netherlands has at least a 30 year history of cycling lessons for immigrant and refugee women. From the 1970s onwards, many women from countries at the Mediterranean and Surinam emigrated to the Netherlands. These countries had at that time, and still, no cycling culture. On the contrary, most girls are being taught that cycling is not a suitable activity for them, as it is associated with masculinity, speed, danger, and (inappropriate) freedom of movement. These are values many parents do not want to their daughters to be associated with (*42*). Once these women arrive in the Netherlands, things may change, as they see so many women, children and elderly riding their bicycles everyday. As a result, the image of what bicycling is and for whom it is meant may start to change.

The main motives to join a bicycle course are a wish to (re)gain quick and easy independent mobility and health reasons. Also, a wish to adapt to local mobility habits is mentioned (*43*). At the same time, there are substantial barriers preventing women to learn how to use a bicycle, most notably the aforementioned cultural barrriers. That is why the most comfortable way to learn, is within a peer group and with role models around. In general this is how cycling lessons are being organised in the Netherlands (*43*).

There is no official data on the number of cycling lessons and participants in the Netherlands, but the estimate for 2003 indicates about 300 locations offering lessons and at least 6000 participants (*43*). Although the availability of resources (like bicycles, training for teachers, and a location to meet) has been a challenge from the beginning onwards, the number of initiatives and participants has probably not changed much over time, partly because of the influx of new immigrants, and partly because of the rising popularity of the bicycle, also among ethnic minorities.

Cycling lessons for adult non-natives in Amsterdam have been organized for over 20 years (*44*). The lessons are organised at the neighbourhood level by the sports department of city boroughs (the level of government below the municipal level), by community centres, women's centres, or schools. Each organization has to find its own trainers, volunteers, course materials and funding. The funding usually comes from different policy domains: sports, recreation, social affairs, poverty policy, social participation and environmental affairs. Participants normally have to pay around € 2,50 per bicycle lesson, although in some places the course is offered for free.

A study carried out by Mobycon (*45*) provides an overview of bicycle lessons in Amsterdam for the year 2009. In that year, cycling lessons were offered in all 14 residential boroughs of the city. A total of 18 organizations offered lessons on 23 different locations. In most cases a course is offered as a 'block' encompassing 10 to 15 cycling lessons, each lesson lasting from 1 hour to half a day. In 2009, a total of 68 blocks was being offered. The lessons are targeted at women, as they show an interest to learn to ride a bicycle through group lessons. As a result all participants were females and the estimate is that about 1500 women participated in one of these courses during the year 2009. At more than half of the locations there is a waiting list for the courses. In other years there have been some experiments with bicycle lessons targeted at men, but those were not popular.

The Mobycon study underscores the differences in what is exactly offered in the cycling courses and how the process of learning to ride the bicycle is being facilitated and trained. At 60% of the locations where cycling lessons were offered , the lessons consist of a combination of theoretical lessons (traffic rules and regulations) and practical lessons (to obtain the ability to ride a bicycle). The remaining 40% of locations focus on practical lessons only. Of all staff involved in the cycling courses only 28% has had any form of cycling specific training. At 40% of the locations none of the staff has had any cycling specific training, at 20% of the locations only some of them had had such cycling training, while at 40% of the locations all staff has had some form of cycling specific training. Although not all locations were equipped with a well-trained staff, all of them provided the participants with bicycles during the lessons, but the quality of those bicycles varied. Less than half of the locations provided bicycles of good quality and suitable for the participants, while at 4 locations none of the bicycles were suitable for the participants, the main problem being too high bicycle frames. From all locations, only five (about 20%) lived up to all standards: they had sufficient staf, the staff had had some form of cycling specific training, both practical and theoretical lessons were provided, and suitable bicycles of good quality were provided to the participants during the lessons.

4. BICYCLE LESSONS, MOTILITY AND ACTIVITY PARTICIPATION

As noted before, mobility is an important prerequisite to participate in today's modern societies. An increase in a person's ability to travel may lead to an increase in opportunities to participate in activities (*46*). Bicycle lessons may contribute to activity participation, as they may increase a person's level of potential mobility, defined as the ease with which a person can move through space (*47*). Kaufman (*48*) and Kaufman et al. (*49*) have extended the notion of potential mobility by introducing the term 'motility'. The concept of motility refers to the way in which an individual appropriates what is possible in terms of mobility and uses this potential for his or her activities. The idea is that individuals need to appropriate means of potential mobility, which then, depending on circumstances and ambitions, can be converted into movement. In the perspective of Kaufman et al. (*49*) motility "encompasses interdependent elements relating to *access* to different forms and degrees of mobility, *competence* to recognize and make use of access, and *appropriation* of a particular choice, including the option of non-action". Each of these interdependent elements affects the motility of an individual. *Access* refers to the range of possible means of transportation that may be available to a person. Competence includes the skills and abilities that enable a person to make use of particular transportation means, including physical, legal and organizational skills. The third element encompasses the degree of *appropriation* of a means of transportation by

an individual, which occurs through the actual use of a means of transportation in everyday activities or 'projects' as Kaufman (*49*) phrases it.

The notion of motility is suitable for understanding the necessary steps for the adoption of the bicycle in the everyday life of immigrant women. The bicycle lessons assist women in acquiring the most crucial competences that are a prerequisite to full appropriation of the bicycle. At the same time they are only one component of that appropriation. The bicycle lessons may not teach women all necessary competences, such as the skill of map-reading or wayfinding that may be necessary to use the bicycle for travel to destinations not visited before. The bicycle lessons also have no direct impact on women's access to a suitable bicycle, as bicycles are only available for use during the lessons. Women will have to acquire access to a bicycle by purchasing or borrowing a bicycle. Finally, it is up to the women themselves to use the bicycle for everyday purposes, so it becomes a full-fledged part of the set of transportation means available to them. Full appropriation of the bicycle requires the regular use of the bicycle for everyday errands.

The full appropriation of the bicycle thus expands women's motility. Increased motility, in turn, may imply an increase in women's potential to participate in out-of-home activities. This can come about in two ways. First, when women use the bicycle instead of another means of transport like walking or public transport, they may actually reduce their travel time and/ or costs. Women may then use these savings, certainly if they are substantial, to engage in other out-of-home activities or to extend the duration of existing out-of-home activities. In terms of time-geography: increasing motility implies enlarged time prisms for carrying out activities. Note that these benefits may occur even if the spatial reach of the women does not increase due to the appropriation of the bicycle. This may be true because the same area can already be reached by public transport, but at a higher cost in terms of time or money (*49*).

Second, the improvement in motility may actually increase the area that can be reached. This may occur because cycling is a substantially faster way of movement than walking, while public transport is inefficient and only serves a limited set of destinations. It may also occur because the bicycle may bring distant public transport stops within reach, making new destinations accessible within a given time window (*50*). In these cases, women may actually substantially expand the set of destinations that can be reached within their available time. Women may subsequently make use of these new opportunities and engage in new out-of-home activities that were previously out of reach. In terms of time-geography: increasing motility may result in an increase in the potential path area of a person.

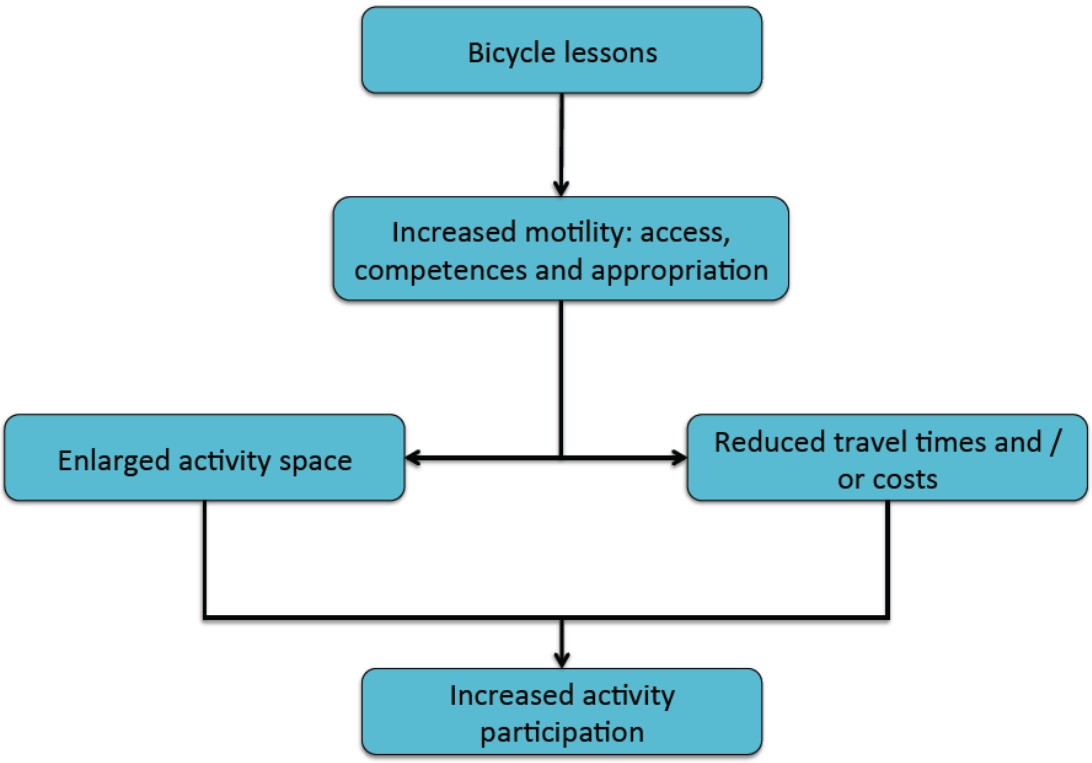

FIGURE 1. The relation between bicycle lessons and activity participation.

The relation between bicycle lessons, motility and activity participation is briefly summarized in figure 1.

The assessment of the impact of bicycle lessons on activity participation requires a further specification of the process of bicycle 'appropriation'. Based on the notion of motility, three important steps towards full appropriation can be distinguished. The first step encompasses acquiring the competences to use the bicycle. This includes the practical skills of cycling, but also knowledge of traffic rules, navigation and wayfinding skills. The second step consists of securing access to a bicycle. This requires not only the purchase of a bicycle or a reliable arrangement to borrow a bicycle from friends or relatives. It also includes the ability to repair the bicycle when needed or the necessary budget to cover the costs of repair by a professional. The third and final step encompasses the actual use of the bicycle in everyday practices. It is through this use that the bicycle has become a serious transportation option.

These three steps can be presented as a 'ladder of bicycle appropriation', from an absolute beginner, the lowest rung of the ladder, to an accomplished cyclist at the highest rung (figure 2). An absolute beginner, someone who is not able to cycle, has not appropriated bicycling at all. When acquiring more skills, knowledge and hence confidence, the participant of the bicycle lessons climbs the ladder. First, she is able to ride in a park, or on quiet streets, later on she practises in busier streets. Higher on the ladder, a person is not only competent to use the bicycle, but has also secured access to a suitable bicycle. One rung higher on the ladder, a person not only owns a bicycle, but also has the skills to repair the bicycle herself or knows where this can be done. Still higher on the ladder, a person is using the bicycle for everyday errands. First, a women may use the bicycle for trips without children or luggage, while later moving yet another rung on the ladder to being able to cycle with children (on their own bicycle or in a seat on the back rack of the woman's bicycle) or to take shopping goods on the bicycle. At the

level of full appropriation a person is an accomplished cyclist: she is able to cycle on the streets, actually owns a suitable bicycle and uses the bicycle for all sorts of practical purposes. In the situation of a (young) mother it also means that she is able to take her children on the bicycle.

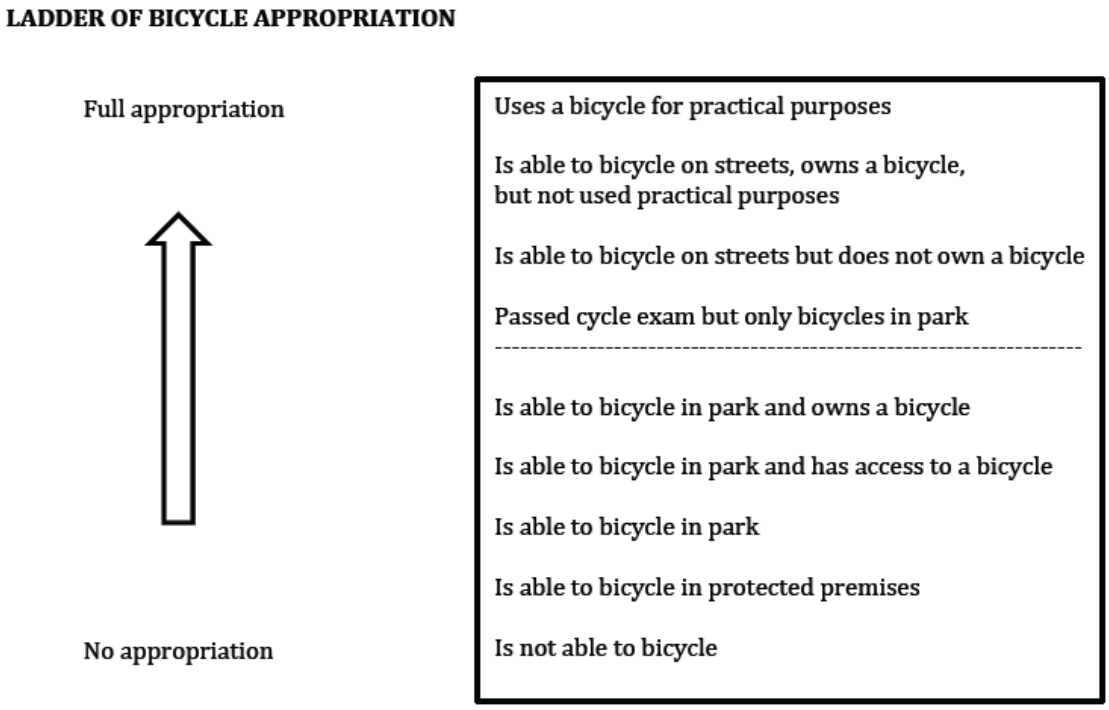

FIGURE 2. Ladder of bicycle appropriation; from an absolute beginner to an accomplished cyclist[1].

5. IMPACTS OF CYCLING LESSONS

We draw on two studies to gain an understanding of the impacts of cycling lessons on women's activity participation. The first study consists of a before-after survey among ethnic women (*51*). The second study consists of exploratory in-depth interviews with 19 women who participated in cycling lessons (*52*). Both studies were conducted in Amsterdam.

Results of the before-after survey

In the city borough of Amsterdam Nieuw West a survey was carried out amongst participants of the cycling course in 2011. Participants were enlisted for a survey at the start of the course and for a survey at the end of the course. A total of 206 women participated in the survey at the start, while 174 women participated in the survey at the end. In total 83 women filled out both forms, wich provides insight into the effects of the cycling lessons on their activity participation.

Before turning to the impacts of the bicycle lessons, we briefly describe the profiles of the participants in the cycling lessons based on the sample of 83 women, noting that their profiles are roughly comparable to the larger group of respondents. The group of 83 women is rather diverse. The majority of the respondents is between 30 and 49 years old (79.5%), the youngest being 24 and the oldest being 66. The women

[1] The cycle exam is not an official exam. Most organizations in Amsterdam that offer bicycle lessons undertake an informal exam, in which basic cycling skills are tested.

have immigrated from 17 different countries, in particular from Morocco (42% of participants), Turkey (17%), Surinam (6%) and India (5%). The average height of the women is 1.61 meters; 8 cm smaller than the Dutch average, which is relevant as this means that the frame of a regular (and thereby relatively cheap) bicycle will be too high and thus unsuitable for many of these women.

Most of the 83 women indicated that they had no previous experience on the bicycle (72 women), while 11 women had some experience. The expectations regarding the lessons were high: more than half of the women hoped to be able to ride the bicycle with a child in a seat on the back rack (55%). Before partaking in the course, the women primarily walked or used public transport to get around. About 72% uses public transport to travel around the city and 90% goes to the local shopping centre on foot. Roughly one third of the women holds a drivers license, which gives an indication of how quickly a participant might learn the rules of the road for cyclists and how familiar she is with participating in traffic conditions.

The results from the before-after survey show that many women indeed did learn how to cycle. After the course 61 of the 72 women (85%) who were absolute beginners, are able to cycle independently. Although almost all women used to walk to their local shopping centre, or sometimes used public transport, virtually all of them express the ambition to use a bicycle instead. . Most of the 61 women that can cycle independently now, typically used public transportation to go to the city center.. 50 of them state that they will now use a bicycle to get there. The bicycle thereby largely replaces walking and public transportation as the mainmode of transport of these women. The 11 women who already had some experience with cycling, are all able to cycle independently now. Six of them who would usually walk to the local shopping center state that they now want to use a bicycle instead, and seven express the ambition to use a bicycle to visit the city centre.

The results of the survey show that the bicycle lessons have substantially increased the cycling skills of the participants, from an absolute beginner to being able to cycle independently. Although from the survey questions it is not completely clear under what traffic conditions this holds true, the cycling skill level has surely risen. The lessons have been less successful in teaching women how to bicycle with children. Roughly half of the participants stated they wanted to learn to cycle with a child on the back rack. Of this group, only 24 women indicated at the end of the lessons that they actually dared to do so. This means that although most women did acquire the basic cycling skills, the majority of them is not yet ready for trips in which they have to escort child(ren). Another aspect of the appropriation, acces to a suitable bicycle, seems to be problematic. Of the 72 absolute beginners at the start of the course, 54 women stated that they wanted to buy a bicycle. At the end of the course, 52 women still had this wish; apparently they did not yet have a suitable bicycle. All 11 women that already had some experience at the start of the bicycle lessons and can cycle independently now, also still want to buy a bicycle.

Taken together, the motility of the participants of the bicycle lessons has increased, in the form of an increase in cycling skills. In contrast, their access to a suitable bicycle has not increased. It is not clear from the survey results how likely it is that the access component will increase in the short term. The women's ambitions to use the bicycle for various purposes, suggests that the bicycle lessons have the potential to reduce women's travel times and costs and to enlarge their activity space, possibly leading to an increase in activity participation. In the following, we discuss the in-depth interviews with a selection of women that participated in bicycle lessons, which

provides us more insight in whether this potential is actually translated into increased levels of activity participation.

Results from in-depth interviews

Separate from the survey in the borough of Amsterdam Nieuw West, a more exploratory study on the effects of bicycle lessons in Amsterdam was carried out, also in 2011 (*52*). This study explored the effects of the cycling lessons, using the device of the ladder of bicycle appropriation, in order to get a more in-depth insight. The respondents encompassed 19 women, of whom eight passed the bicycle lessons, ten still participated in the course, and one woman quit the course for health reasons (figure 2). The majority of the respondents is between 35 and 55 years old. All of them are immigrant and refugee women from non-western countries, mostly from Morocco. Almost 80% of the women have (small) children, of which over a third of them are single mothers. All women were individually interviewed at community centres, schools and health centres, where the bicycle lessons took place.

Comparable to the results in the survey, the results from the in-depth interviews show that most women who have participated in bicycle lessons have substantially increased their cycling skills. Due to the bicycle lessons, roughly nine out of ten participants are able to ride the bicycle in a park or on quiet streets and are ready to continue practising in traffic conditions. The goal of the in-depth interviews was to explore to what extent women actually used the newly acquired skills in their everyday life. As we will see, the actual increase of the motility of the participants also depends on the other components of motility: acces and appropriation. Also the time available to participate in (extra) activities plays an important role.

In figure 3 the level of appropriation of the respondents is shown. We see that the level of the women that were participating in the bicycle lessons at the time of the interview varies between 'Can not cycle' and 'Can cycle in park and has a bicycle'. Although the skill levels vary, the ambitions of the participants are identical. All hope that in the (near) future they will be able to use the bicycle to go to activities, do their shoppings or take their children to activities. They all expect that this will save them time. When asked whether they expect to start participating in extra activities, as their activity space might increase and they might gain time, most respondents state that they will not have the time to participate in extra activities.

TABLE 2. Overview characteristics of respondents. Source: Wolters, 2011 (adapted)

Characteristics	Number	Percentage	ion
Stage	8	42.1%	Passed bicycle exam
	10	52.6%	Currently taking bicycle lessons
	1	5.3%	Quit lessons
Country of origin	9	47.4%	Morocco
	2	10.5%	Turkey
	2	10.5%	Surinam
	2	10.5%	Ghana
	1	5.3%	Afghanistan
	1	5.3%	Egypt
	1	5.3%	Irak
	1	5.3%	Pakistan
Year of birth	3	15.8%	1959 or earlier
	6	31.6%	1960 - 1969

	6	31.6%	1970 - 1979
	3	15.8%	1980 - 1989
	1	5.3%	Unknown
Household type	3	15.8%	Single person household
	6	31.6%	Single-parent family
	9	47.4%	Couple with children
	1	5.3%	Couple without children
Education level	2	10.5%	No education
	6	31.6%	Primary school
	2	10.5%	Secondary school
	5	26.3%	Secondary vocational
	3	15.8%	Higher vocational/ academic
	1	5.3%	Unknown
Employment	4	21.0%	Employed
	15	79.0%	Unemployed
Year of immigration	2	10.5%	1979 or earlier
	8	42.1%	1980 - 1989
	4	21.1%	1990 - 1999
	5	26.3%	2000 - 2009

The level of appropriation of bicycling for the eight respondents that already passed the bicycle exam is on the upper rungs of the ladder, as illustrated in figure 3. Yet, the differences are significant. One respondent, her fictitious name is Samira, only cycles in the park, as she got scared to ride in the streets after falling off the bicycle. She is a 42 year old married woman with 4 children aged 5 to 18 years. She lives in the Netherlands since 1980; she has no formal education, but does have a driver's license. She works 5 times 2.5 hours a week; her husband is jobless for 4 years. Samira finished the bicycle lessons 2 years ago and she started to use the bicycle. However, at some day the road on which she cycled was slippery and she fell. Therefore she will only cycle in the park when the weather is nice. Otherwise she is afraid to fall and she finds it difficult to cycle in traffic. Also, she does not dare to ride the bicycle with the children. In order to move around Samira mainly uses the car. She drives the 5 and 12-year-old children to primary school, does her shoppings by car and also her commute.

LADDER OF BICYCLE APPROPRIATION

Uses a bicycle for practical purposes	4 ('Leila')
Is able to bicycle on streets, owns a bicycle, but not used practical purposes	1 ('Gladys')
Is able to bicycle on streets but does not own a bicycle	2
Passed cycle exam but only bicycles in park	1 ('Samira')
Is able to bicycle in park and owns a bicycle	1
Is able to bicycle in park and has access to a bicycle	3
Is able to bicycle in park	5
Is able to bicycle in protected premises	1
Is not able to bicycle	1

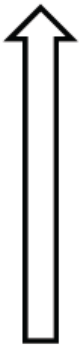

FIGURE 3. The level of bicycle appropriation for the 19 respondents of the in-depth interviews

Two respondents are able to cycle in regular traffic, but do not own a bicycle. One of these respondents indicated her bicycle was stolen and she does not have another one yet. The other lacked the financial means to acquire a bicycle. One rung higher on the ladder is another respondent. She is able to cycle in the streets and owns a bicycle, but only uses the bicycle for leisure and uses public transport and walking to go to work and do shopping. Her fictitious name is Gladys and she is a single mother with a 16-year-old son. She arrived in the Netherlands in 1992 and her educational level is primary school. She has a full time job. Half a year ago she finished the bicycle lessons and Galdys immediately bought a bicycle. She uses it to do her shoppings and to go to church. The bicycle is quicker and a good exercise for her legs, as she suffers from osteoarthritis (a rheumatic disease). When the weather is nice she likes a leisurely ride with her neighbour. Still, her main form of transportation is public transport, as her workplace is too far to cycle to.

Half of the respondents who passed the exam can be positioned at the highest rung of the bicycle appropriation ladder: following the bicycle lessons, they use the bicycle for practical purpuses. Leïla is the fictitious name for a 30-year old single mother of two children aged 8 and 10. She arrived in the Netherlands with her former husband in the year 2000. She has a University education. She finished the bicycle lessons about four years ago. Leïla was very happy when she had learned to ride the bicycle and bought one immediately afterwards. She started to practise with a 'cycle-friend', a cycling buddy. Leïla is on the highest step of the appropriation ladder. Before she started to bicycle, Leïla used to take public transport or walked. Now she travels to almost all of her destinations on the bicycle, also together with her children. She finds that the bicycle is faster, easier and that it is less heavy to take goods on the bicycle. It also saves her money, she does not have to wait for the tram, and it is a form of sports. Because she wants to share all the advantages of the bicycle with women who cannot cycle yet, Leïla

is now volunteering in the bicycle lessons.

When we have a closer look at all four respondents that actually use the bicycle for practical daily transportation, we see that they use the bicycle to go to activities in which they already participated, like doing voluntary work. Three of them use the bicycle to go shopping and one participant brings the children to activities on the bicycle. Others do not bring their children to after school activities as they do not participate in those activities, or there are no children that need to be accompanied.

All four respondents now use the bicycle to go to their personal activities, instead of walking or using public transport. It is cheaper and saves them time. From the analysis of the activity participation of these respondents, it becomes clear that this does not necessarily mean that they have increased their activity participation. Only two respondents participate in more activities compared to the period before the bicycle lessons. Yet, this is not so much because they learned how to bicycle, but more because of changing circumstances: both women have more time to participate in activities as their children are a bit older and go to school during the day. Therefore they have time for more personal activities such as voluntary work. Other factors (mentioned by the respondents) that negatively influence an increase in activity participation are health issues, a lack of knowledge about where activities are offered, language barriers, and lack of financial resources.

6. CONCLUSIONS

The results of the survey and the in-depth interviews amongst (former) participants of the bicycle lessons confirm that the competences learned during the lessons can contribute to a higher use of the bicycle and to an increased activity participation. But for a substantial share of the participants the bicycle lessons alone do not increase motility or activity participation. It is a challenge for many to acquire a bicycle and to actually ride in traffic. The women who do succeed to fully appropriate the bicycle and use it for daily transportation save time and money, but that does not necessarily mean that they start to participate in more activities outside of the home. The household and the upbringing of children take up a lot of time and women's ambition is not automatically to spend the time saved on extra (out-of-home) activities.

Apart from the effect of saving time or budget, an important effect of the lessons is that many of the respondents have made new contacts and 67% of the respondents of the survey feel mentally stronger. Also 60 % of the women feel more independent. Effects mentioned by several respondents of the in-depth interviews are that through the bicycle lessons, the respondents got to hear about more activities. These responses suggest that the equity and social aspect of the bicycle lessons is just as important as the technical part. The act of learning to ride a bicycle is still as empowering for women as it was over a century ago:

"Let me tell you what I think of bicycling. I think it has done more to emancipate women than anything else in the world. It gives a woman a feeling of freedom and self-reliance. I stand and rejoice every time I see a woman ride by on a wheel… the picture of free, untrammeled womanhood" (Susan B. Anthony, North American women's rights activist, 1896).

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Gender and the growth of cycling in a megacity region: Emerging evidence from London

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Abstract

Cycling's multi-decade secular decline in London levelled off in the 1990s, and in the 2000s there has been sustained growth. A range of policy interventions and physical/operational changes to the network have encouraged cycling, and the current policy ambition is for cycling to continue growing from 2 per cent of journeys to 5 per cent by 2026.

Little is known, however, about gendered aspects of London's cycling 'boom', and it is this research gap that we address. Drawing on British National Travel Survey data centred on 1998 (1996 through 2000) and 2008 (2006 through 2010), we characterise women's distinctive patterns of cycling in London, and show that, although men still outnumber women as cyclists, women have been disproportionately responsible for London's increasing cycling activity.

Key words

Gender, bicycling, London

1.0 Introduction

Across a wide range of geographic and social contexts, cycling is seen by transport policy makers as a desirable form of personal transport and worthy of encouragement. London is no exception, with two successive mayors in the 2000s having publicly committed to delivering a 400% increase in cycling's mode share (from 1% to 5% of all journeys) from 2001 levels by the year 2026 (*1*).

Specific policy initiatives have included junction re-design, new cycle lanes, travel planning, tax incentives, and a large-scale bikesharing system. As can be seen in Figure 1, the growth in cycling since 2001 has been broadly in line with the policy goal for 2026.

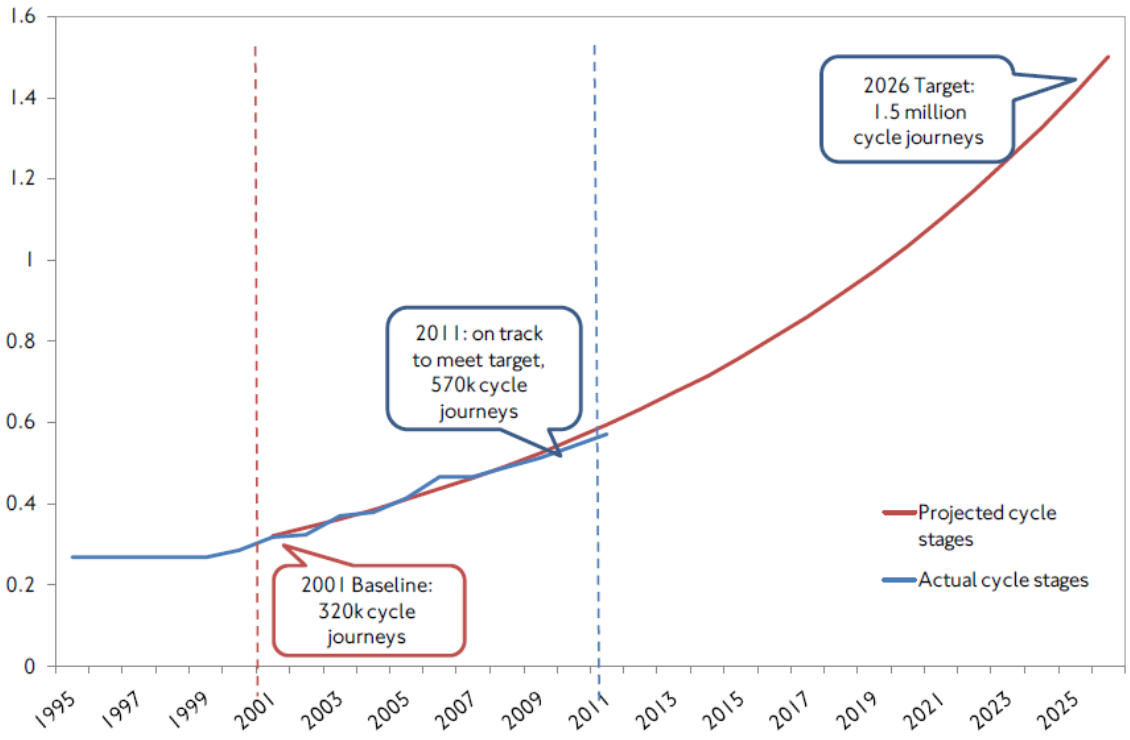

Figure 1: Comparison of recent growth in cycling and growth trajectory required to meet the 2026 target of 5% modal share (reproduced from [1]).

his paper characterises the gendered aspects of the recent growth in cycling in London. Section 2 discusses relevant background, and Section 3 presents the main results. Section 4 concludes the paper with a discussion of the implications of this study's findings.

2.0 Background

Cities around the world are pushing the agenda for more urban cycling as an active mode of transportation. Many supporting strategies are implemented, frequently in

combination: infrastructure investment, bike sharing, public awareness campaigns, etc. For society, cycling is usually considered to be a green mode that can help deal with emissions leading to climate change, and at the same time improve energy efficiency and public health. For individual cyclists, this mode is seen as one of the quickest (in terms of journey time), most reliable (relatively unaffected by congestion), least expensive, and a way to keep fit.

Despite the societal and individual benefits of urban cycling, this mode is subject to major constraints:

- Cycling still represents a very small modal participation – less than 3% of journeys to and from work in most U.S. cities (*2,3*).
- Cycling is perceived as an unsafe mode, which is confirmed by accident statistics.
- In addition to safety, other important challenges faced by urban cycling include infrastructure, air quality, weather and cultural aspects(*4*).

A key dimension that has attracted attention in recent years is *gender differences* in the practice of cycling. In many places, cyclingis less prevalent among women than among men (although exceptions exist such as the Netherlands and Belgium (*4*). In North America, even in cities with a relatively high population of cyclists women do not routinely exceeda third of the total (this means that, in such cities, at least 2/3 of cyclists are men). The situation is somewhat similar in Australia, in which the participation of women in cycling for transport and recreation is also approximately half that of men. Unlike in Germany and a number of Scandinavian countries, this general pattern is also found in Greater London (*5*).

This gender differences have attracted some attention but very little in countries like England where cycling is expected to continue growing as a form mode of transportation. A 2013 Parliamentary Inquiry noted that despite Britain having lower rates of cycling than continental-European peers, *'there is nothing in the nature of the British temperament, or the way in which local economies function, which makes it impossible to see substantial double figures of [cycling] mode share'* (*6*). It noted that in Cambridge there is near-gender-balance amongst cyclists, but the only suggestion for increasing women's cycling levels was dedicated funding for promotion targeted at women.

Among the main factors, collision risk appears to be one of the most significant deterrents for women cycling. It has been argued that women are generally more risk-averse than men(*7*). Women are more sensitive to vehicular traffic exposure, surface

conditions, winter, and in general to the risk of injury (8,9).Several recent studies have also demonstrated that women prefer biking in certain environments and certain types of facilities:consistent with gender differences in risk aversion, women commuter cyclists preferred to use paths with maximum separation from motorized traffic (*10,11*). However, very little research has also focused on investigating the link between women's cycling and the individual, socio-demographic, cultural and economic determinants of participation.

From a gendered studies perspective, ideally this would require taking into account a wider set of social, demographic, cultural and economic variables than is commonly available to transport researchers. But it would also require examining the sources of *assumptions* about the nature of how women's and men's household roles relate to bicycle travel demand, and of the resultant *decisions* taken by transport authorities to provide (or not provide) support for bicycling.

At the heart of such an analysis would be an appreciation that standard transportation system indicators such as trip rates and travel times, analysed by gender, are insufficient. Indeed it could be argued that the predominant preoccupation of transport professionals with peak-hour congestion is mostly irrelevant to women who would meet some of their household responsibilities, and/or access to employment, by bicycle. This is because some types of employment, notably part-time (or multiple part-time) employment in the health, education and personal service subsectors remain predominately the work of women. The temporal and spatial characteristics of such employment, coupled with typically disproportionate responsibility for escorting children and grocery shopping, are likely to restrict the viability of bicycle use (*12*). Furthermore, the consequences of transport system changes to relieve congestion may favour peripheral shopping centres to an extent that induces the closure of neighbourhood shops and leisure facilities, to the detriment of bicycle access, and even to personal safety and security.

In a more general sense, the link between women's household roles and transport is often problematic to detect because in most countries women, more than men, perform many activities of economic importance but for which their labour is unpaid. These activities are therefore "off the radar" of official labour market statistics.

The research context is thus one of highly variable data availability and quality. At the current stage of transport and gender studies, a combination of fairly large sample national or regional travel survey data and a limited number of specialised surveys of cyclists is typically the best approach to overcome the relative rarity of cyclists in the population. The choice of variables that come closest to the understanding of roles,

such as household structure (especially the number of young children, and the number of heads of household), detailed journey purposes, and the temporal and spatial distributions of cycling, is crucial.

Regardless of the difficulties, more research is needed to determine what policies and strategies are likely to be most effective in promoting cycling in cities like London. This research can help identify the factors and the characteristics of groups that can be targeted in order to increase the participation of women. In the longer term, we are interested in translating what is learnt about roles and bicycle travel into designs for built environments and facilities that can improve both the perception and the reality of cycling.

3.0 Results

For this study we employ data from the British National Travel Survey (B-NTS), a large-scale and nationally-representative survey that has been undertaken periodically since the 1960s and continuously since the late 1980s (*13*). The instrument package includes both a detailed interview and a seven-day travel diary completed by all household members (including children). We focus on the London sub-sample of the B-NTS, and compare results from two 5-year bands ('earlier' being 1996 – 2000 and 'later' being 2006 – 2010), with sample sizes of n=3,359 and n=9,016 adults (18+) respectively. Although children's travel is included in the B-NTS, this study focuses exclusively on adults' travel. It is worth noting that the geography of Greater London is quite varied in comparison to the municipal boundaries of North American central cities, ranging from the City of London (where the financial district is located) through inner neighbourhoods of Victorian-era terraced homes to 20th Century suburbs and including some semi-rural outlying areas with agricultural land uses.

The advantages of using large-scale household survey data like the B-NTS are that the sample is representative of the population at large (in this case Londoners), the data collection protocol is subject to rigorous quality control, and the data include very rich descriptors of respondents' socio-demographics and a week's worth of their travel. Less resource-intensive (when measured in units of cost per observation) ways of observing cycling, such as traffic counts, are conversely limited by the lack of any detailed information about the cyclists or why they are cycling. A general weakness of large-scale travel survey data for this type of application, however, is that relatively few observations are made of lightly-used methods of transport (such as cycling in London), which places constraints on the ability to identify statistically significant patterns. Further, a specific limitation of the B-NTS is that privacy restrictions prevent publication of the microdata with fine-grained spatial information, and therefore the dataset provides limited opportunity to relate characteristics of the urban environment with cycling levels.

In the rest of this section we present this study's empirical results, based on a series of descriptive statistical analyses and a binary logistic regression model for participation in cycling.

3.1 Top-level statistics

The B-NTS shows the number of cycling journeys per Londoner to have increased by 49% from 1996/2000 to 2006/10, to an average of 18.6 journeys per person per year. Women's rate of cycling is below men's, though cycling journeys per women have more than doubled (110% growth between 1996/2000 and 2006/10) whereas men's cycling journeys per capita have increased at a rate of 31%. In 2006/10 women were responsible for 31% of all cycling journeys by Londoners, as compared to 24% in 1996/2000. (All time-trends discussed in the preceding paragraph are significant at $p<0.05$).

3.2 Depth and breadth of cycling

As we observe a week's worth of B-NTS respondents' travel behaviour, we define 'cyclists' as anyone that cycled at least once during their diary week. By this method we find that 3.9% of adult Londoners were cyclists in 1996/2000, a figure that increased to 5.1% in 2006/10. This increase is very statistically significant, but the growth in the number of cycling journeys per cyclist per week was not significant (6.2 in 1996/2000 v. 7.0 in 2006/10: $p=0.13$). Thus we can conclude that the growing *breadth* of cycling is predominantly responsible for the overall growth, rather than the growing *depth* of cycling.

Table 1 shows this analysis for men and women separately. The share of female cyclists increased significantly over time, but the growth was not quite statistically significant for men. Average journeys per women cyclist increased more than men's, but neither of these time trends is statistically significant.

Finally, when we compare men and women (both in 2006/10), we see that the 'gender gap' in the share of adults that are cyclists (2.9% of women v. 7.5% of men) is statistically significant ($p<0.01$), but the gender gap in cycling journeys per cyclist is not ($p=0.40$). We can conclude that differences in the *breadth* of cycling between men and women are more responsible than differences in the *depth* of cycling (journeys per cyclist) for men's overall higher rate of cycling journeys per capita. Once we know that a person is a cyclist, no gender differences in frequency of use were found.

Table 1: Share of adults that were cyclists and cycling journeys per cyclist, by men and women

Measure	Gender	1996/2000	2006/10	Significance
Share of adults that were 'cyclists'	Women	1.7%	2.9%	p<0.01
	Men	6.3%	7.5%	p=0.11
Cycling journeys per cyclist per week	Women	5.9	7.3	p=0.23
	Men	6.2	6.8	p=0.30

Overall unweighted sample sizes: men in 1996/2000: 1,606, women in 1996/2000: 1,845, men in 2006/10: 4,356, men in 2006/10: 4,983. Unweighted sample sizes of cyclists: men in 1996/2000: 102, women in 1996/2000: 34, men in 2006/10: 315, women in 2006/10: 133

3.2 Cycling journey lengths

Figure 2 shows average cycling journey lengths for men and women in the late 1990s and late 2000s. Average cycling journey lengths are in the range between 2 and 4 miles, and whilst men's journey lengths have consistently been longer than women's on average, this difference is shrinking over time. The average cycling journey by men was 48% longer-distance in 1996/2000 than the average women's cycling journey, which decreased to a 31% difference in 2006/10.

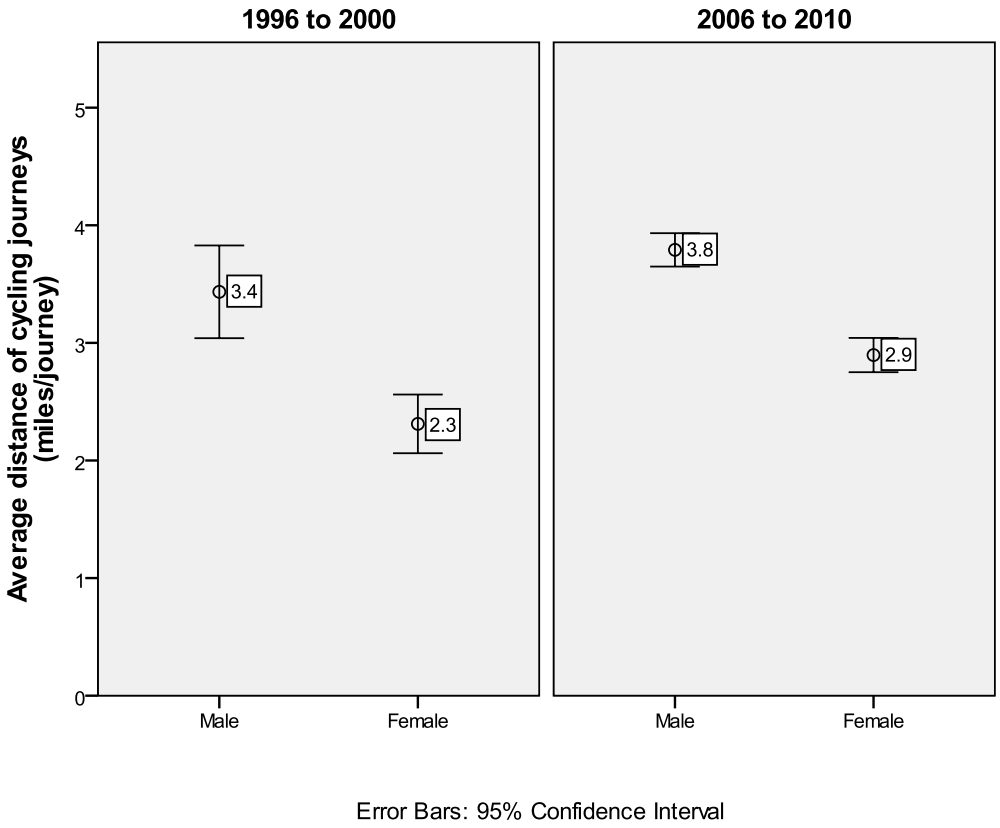

Figure 2: Average cycling journey distances, for men and women

Figure 3 demonstrates gender differences in average journey length when journeys are classed into commuting and other journey types. It can be seen that women's cycling commutes have become much longer-distance over time, lengthening from an average of 2.9 miles/journey in 1996/2000 to 4.3 miles/journey in 2006/10 – now equalling the average distance of men's cycle commutes. In 2006/10, there was no difference between the genders in the average distance of cycling journeys for commuting, but men's journeys for all other purposes combined were 57% longer on average.Therefore, the previous differences in distances can be explained not by differences in commuting, but by other types of trips.

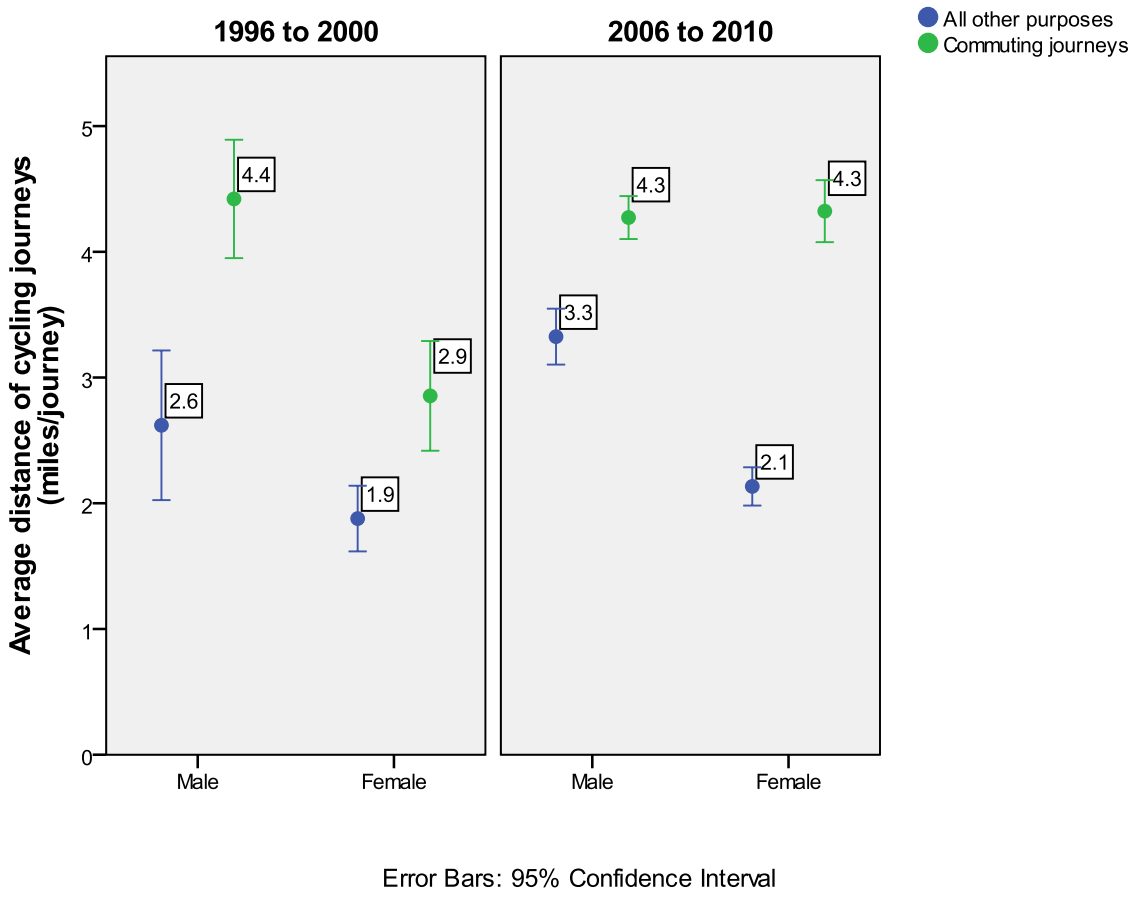

Figure 3: Average cycling journey distances for men and women, by commuting and other purposes

3.3 Journey purposes

Figure 4 looks more closely at gender differences in the cycling journey purposes. Commuting is the journey purpose that accounts for the largest share of both genders' cycling journeys, though it forms a smaller share of women's (34% v. 49% for men, in 2006/10). Journeys that are made in the course of work are, however, a larger share of women's cycling (9% for women v. 4% for men). The journey purposes that form a statistically-significantly larger share of women Londoners' cycling journeys than men's are:

- Business (9% v. 4%)
- Shopping (15% for women v. 10% for men)
- Personal business (11% v. 6%)
- Entertainment/public activities (10% v. 4%)

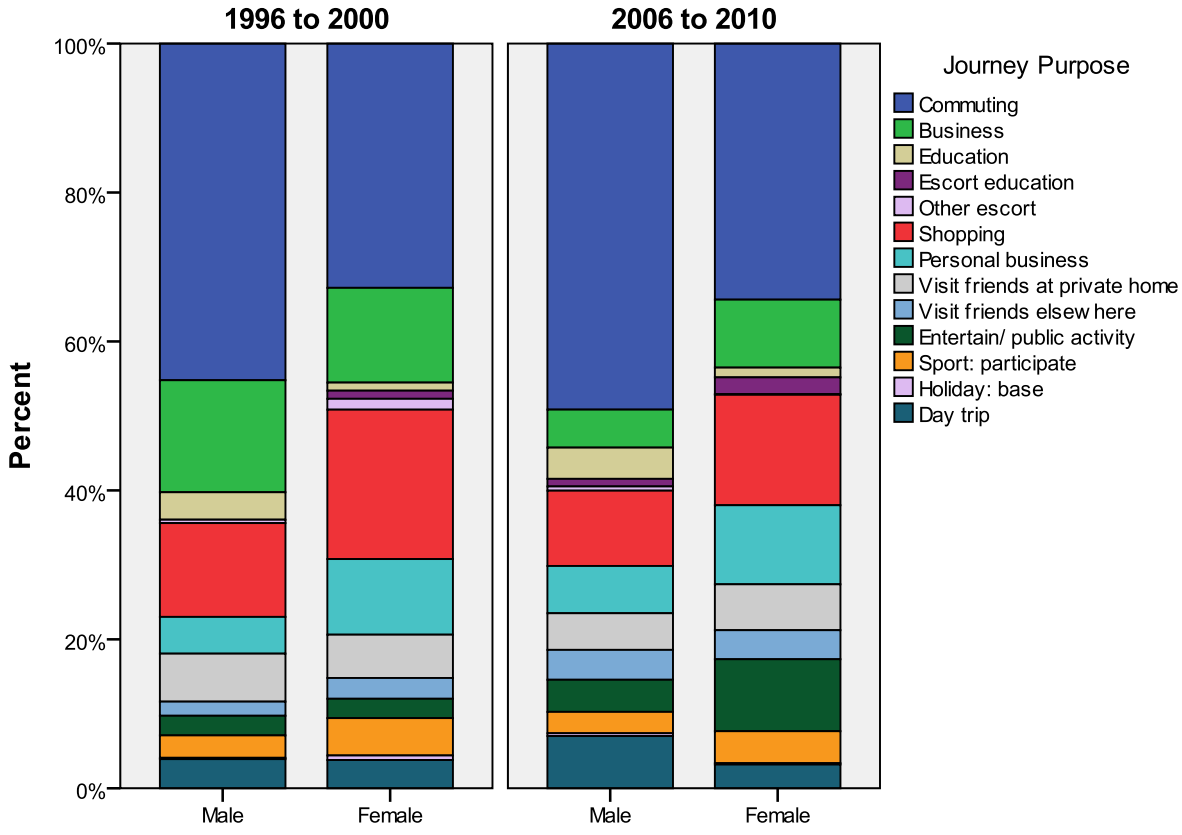

Figure 4: Distribution of cycling journeys by journey purpose, for men and women

3.4 Seasonality

Counts of cyclists in London show pronounced seasonal variation, with cycling activity much more prevalent in the warmer months (1). Figure 5 shows the rate of bicycling journeys per man and per woman when travel diaries that were recorded during the May to September period are considered separately from those recorded between October and April. The B-NTS shows higher rates of men's cycling during the warmer months than the cooler months in both 1996/2000 and 2006/10, but the differences are not statistically significant. For women, cycling in the warmer months was not statistically significantly different from the cooler months in 1996/200, but in 2006/2010 this had changed and women's cycling during the warmer months was significantly higher. From the late 1990s to the late 2000s women's cycling during the warmer months grew three times more quickly than in the cooler months (+153% v. 50%), and in the case of the cooler months the increase is not statistically significant.

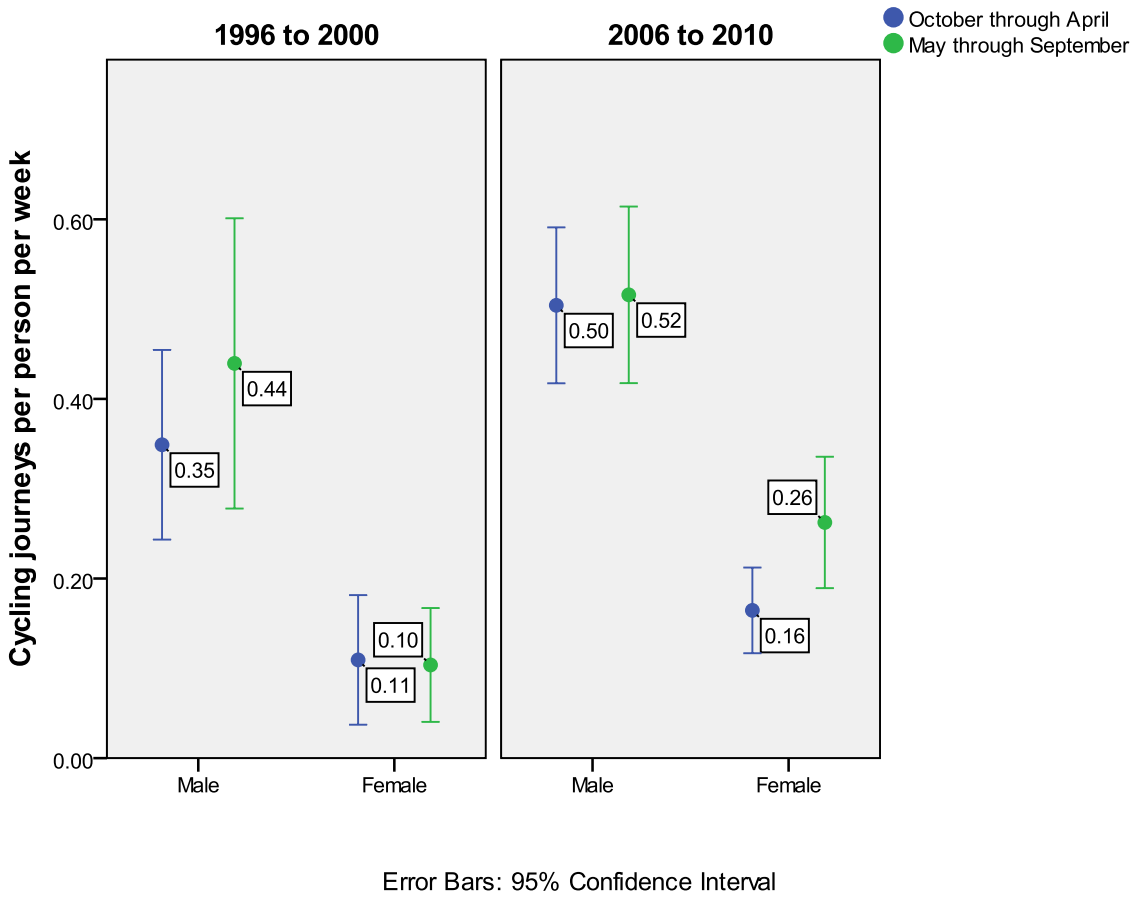

Figure 5: Average number of cycling journeys per person per week, for men and women

3.5 Party size

The B-NTS records travelling party size for all trips, and Figure 6 shows how this differs for men's and women's cycling journeys. In both time periods, women's cycling journeys were more likely than men's to be accompanied by others, but these gender differences are not statistically significant. For both genders, the time trend has been an increase in the share of cycling that is accompanied, but this trend is not significant for women.

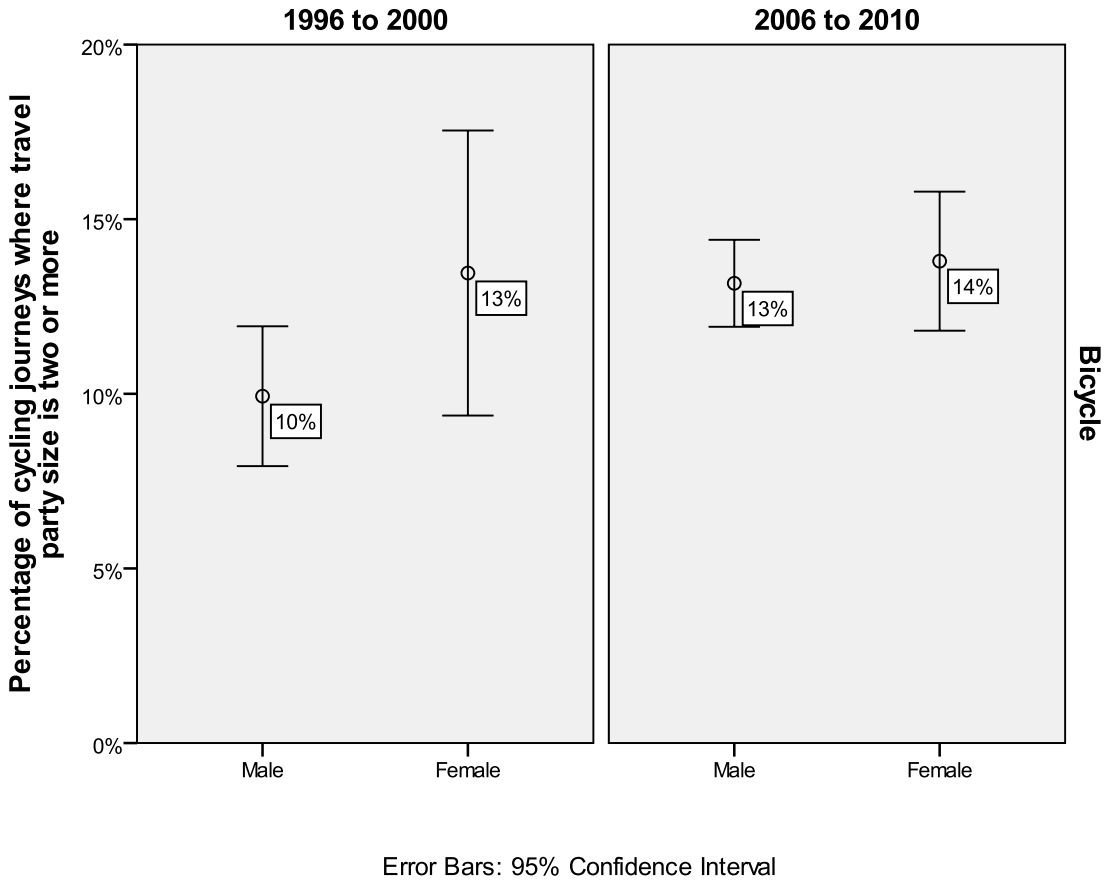

Figure 6: Percentage of cycling journeys that are accompanied by at least one other cyclist, for men and women

3.6 Profiles of male and female cyclists

In this section we examine the profile of men and women that cycled during their B-NTS travel diary week, bringing in a range of socio-demographic characteristics.

As can be seen in Table 2, the average age of both men and women cyclists are in their late 30s, with neither the time trend nor the difference between the genders statistically significant. In both time periods, women cyclists lived in higher-density neighbourhoods than men, and for both genders the residential density of cyclists may have increased over time – but neither the

gender difference nor the time trends are statistically significant. When men and women are combined, however, the time trend of increasing residential density amongst cyclists is significant ($p<0.01$). This is consistent with results from London showing that the number of cyclists in Central London has grown very quickly since the late 1990s (roughly tripling) whereas cycling levels in Outer London has been basically flat (*14*).

The personal incomes of male cyclists may have increased somewhat over time (the difference is not significant, $p=0.12$), but women cyclists incomes appear to have fallen ($p=0.06$). Though the latter finding is nearly statistically significant, caution is called for as the 1996/00 data contain just 34 observations of women cyclists.

If one considers the aggregate income earned by other household members (i.e. cyclists' household income minus their personal income), this has increased by about £8,000 for both genders. Amongst men this change was statistically-significant ($p<0.01$), whereas it was not for female cyclists ($p=0.15$).

In 2006/10, male cyclists had statistically-significantly higher personal incomes than female cyclists (£32,161 v. £20,736, $p<0.01$), but female cyclists lived in households with higher levels of 'residual' income earned by the non-cyclist members (£23,905 v. £35,532, $p<0.01$), many of whom will be male partners. So, it may be concluded that gender differences in income levels among the population at large are also present in the much smaller set of adults that are cyclists.

Table 2: Average age and income characteristics of cyclists, for men and women. Standard errors are in brackets.

	Women, 1996/2000	Women, 2006/10	Men, 1996/2000	Men 2006/10
Average age	38.0 (3)	39.4 (1)	39.6 (1)	38.8 (1)
Average residential density of postcode district of residence (persons/hectare)	53.1 (4)	62.0 (2)	50.4 (2)	60.6 (1)
Average personal income (earned by cyclist)	£28,408 (£4,251)	£20,736 (£1,810)	£28,138 (£2,323)	£32,161 (£1,468)
Total average income earned by other members living in households of cyclists (not the cyclist)	£27,374 (£4,933)	£35,532 (£2,690)	£15,846 (£1,838)	£23,905 (£1,444)

Figure 7 shows further socio-demographics of men and women cyclists.

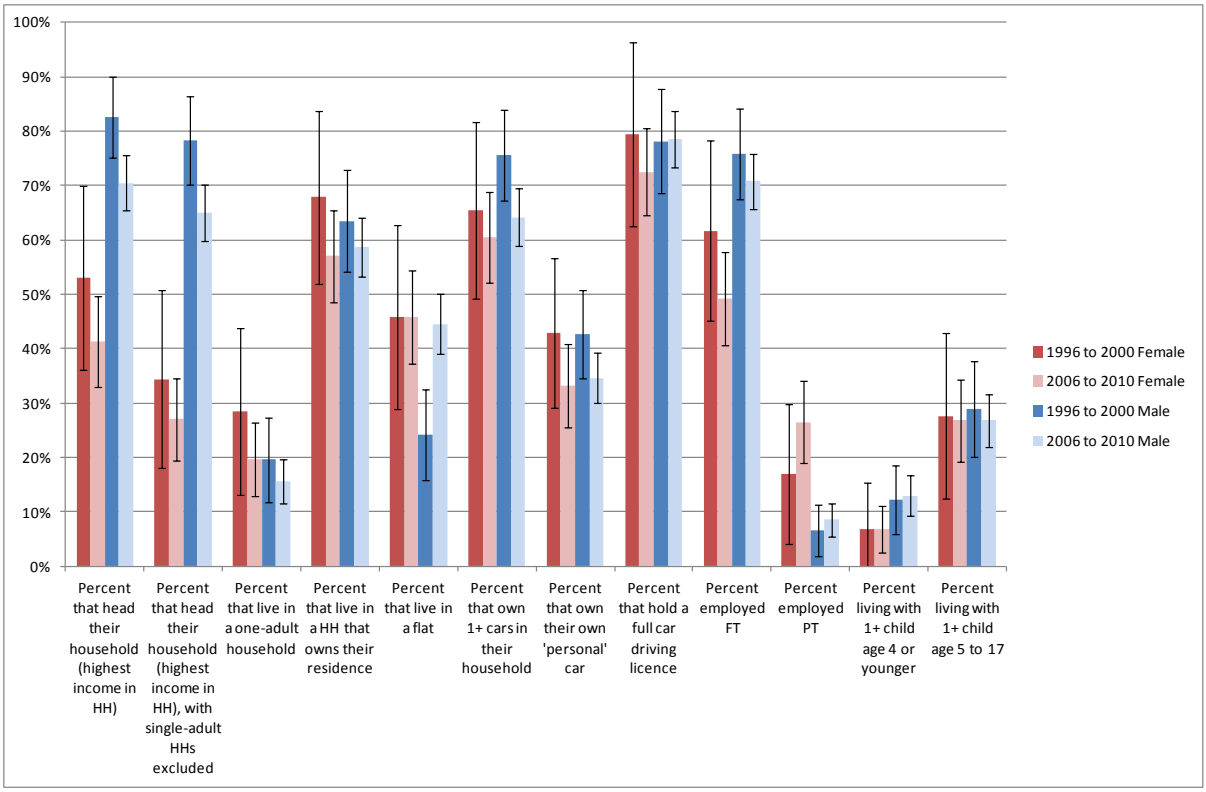

Figure 7: Selected socio-demographic characteristics of cyclists, for men and women

We see that a smaller percentage of female than male cyclists are the highest-income-earner in their household, and that the difference becomes more pronounced when cyclists living in single-adult households (where the sole adult by definition earns the highest income) are excluded. Male cyclists have over time become less likely to earn the highest-income in their household, but it is of note that this is not reflected in an increase in the share of women cyclists that are the highest-income-earner in their household.

We found that in both 1996/2000 and 2006/10 a higher share of female than male cyclists live in single-adult households, and that for both genders the time trend is indicatively downwards. Neither the gender difference nor the time trends are statistically significant, however, and the downward time trend in the proportion of cyclists living in single-adult households is insignificant ($p=0.17$) even when both genders are combined.

No significant differences between the genders were found in the share of cyclists living in an owned residence (as opposed to rental housing). There was a significant increase in the share of male cyclists living in flats (apartments), but there was no change in the share of women cyclists that live in a flat (46% in both time periods).

In both the late 1990s and late 2000s the share of male cyclists living in a car-owning household (76% v. 64%) was higher than the figures for female cyclists (66% v. 60%), but the gender difference was not significant in either period. There has also, among both genders, been a

corresponding drop in ownership of a personal car (defined as a car that the cyclist drives more than anyone else drives it). The drop in personal car ownership is not statistically significant when the genders are evaluated separately, but it is nearly so (p=0.06) when they are combined.

When we look at the percentage of cyclists that hold a driving licence, we see no clear time trends (a statically-insignificant decrease for women, and a statistically-insignificant increase for men). One hypothesis for the growth in cycling in London is that it is linked with the decreasing rate of driving-licence holding amongst both male and female Londoners under age 30 (*15*). However, the results of this analysis do not support that hypothesis as no significant growth in the share of cyclists that do not hold a licence was found and the average age of both male and female cyclists was stable at roughly 39 years.

Male cyclists are more likely to be employed full-time than female cyclists (Fig. 7) and are less likely to be employed part-time (both findings are statistically different only in 2006/10), a pattern that is also reflected in the population at large (beyond cyclists), as captured in the NTS sample. For both genders, the B-NTS data show decreases in the percentage of cyclists who are working full-time, and increases in the percentage of those working part-time, though the time trends are not statistically significant. When the genders are combined, the decrease in full-time employment amongst cyclists is nearly significant (p=0.08). The overall rate of full-time employment amongst adult Londoners in the NTS sample remained steady at 48% between these two time periods, hence we can conclude (subject to the significance level of 0.08) that cycling is increasing fastest amongst people that are not in full-time employment.

We see that women cyclists in both time periods are less likely to have young children (defined here as age 4 or younger) in their household. The gender difference in 1996/2000 is not close to significant (p=0.37), but is in 2006/10 (p=0.07). A larger share of [adult] cyclists live in households with older children (between ages 5 and 17). No major differences between men and women cyclists were observed.

3.7 Model of cyclist status

The descriptive statistical analysis was followed up with a multivariate analysis, where the dependent variable was the binary indicator of whether or not a person was observed to cycle at all during their NTS travel week. Four binary logistic regression models were estimated, one each for men and women in 1996/2000 and 2006/10. Gender is typically specified in this type of analysis as an explanatory variable that accounts for *ceteris paribus* gender differences, and sometimes interacts with a subset of other explanatory variables. However, in order to investigate heterogeneity between the genders, in this study we estimated separate regression models for men and women independently.

Goodness of fit (r^2) was modest, ranging between 0.05 and 0.12, suggesting that factors other than those captured in these models account for much of the variation in whether people cycle or not. (Goodness-of-fit was better for the models of women's cycling than men's cycling). Likelihood ratio testing for all four models rejects the null intercept-only specification (p<0.01

for all four models). Therefore, whilst these regression models account for a relatively small proportion of the variance in whether or not people cycle, on the basis of the likelihood ratio test results we may reasonably use them to characterise the correlates of cycling in London.

Table3: Parameter estimates from binary logistic regression models of whether or not a person cycled at least once during their B-NTS diary week.

	Women 1996/2000		Women, 2006/00		Men, 1996/2000		Men, 2006/10	
Pseudo r^2 (McFadden's)	0.12		0.08		0.06		0.05	
Unweighted sample size	1,845		1,606		4,356		4,983	
	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value
Intercept	*-6.370*	<0.001	*-4.489*	<0.001	-3.095	<0.001	-4.398	<0.001
Personal income (GBP/year)	*6.54E-06*	0.005	*2.37E-05*	0.005	-4.97E-06	0.303	*8.32E-06*	0.001
Income earned by other HH members (GBP/year)	3.90E-06	0.591	-4.44E-06	0.053	-1.02E-05	0.127	1.58E-06	0.541
Residential density	4.47E-03	0.564	4.81E-03	0.051	-1.68E-03	0.704	2.61E-03	0.336
Holds a full car driving licence	1.181	0.082	*0.682*	<0.001	0.244	0.410	*0.573*	<0.001
# cars in HH	0.023	0.955	*-0.500*	<0.001	*-0.701*	0.001	*-0.475*	<0.001
Employed PT	0.775	0.273	*0.610*	<0.001	0.677	0.155	0.376	0.109
Employed FT	0.797	0.225	0.172	0.247	*0.733*	0.032	-0.045	0.805
Presence of kids 4 or under in HH	-0.763	0.284	*-0.342*	0.022	-0.332	0.311	-0.185	0.280
Presence of kids 5 to 17 in HH	-0.063	0.905	0.037	0.757	0.307	0.236	0.090	0.533
Travel diary took place between May and September	0.395	0.285	0.162	0.082	0.277	0.175	0.081	0.471
Has any travel difficulties	-0.802	0.443	*-1.214*	<0.001	*-2.549*	0.015	*-1.086*	0.004
Age 18-34	0.210	0.786	*0.651*	0.001	0.357	0.395	*0.877*	<0.001
Age 35-59	-0.028	0.971	*0.831*	<0.001	0.390	0.345	*1.081*	<0.001
Age 60+	Reference variable							
Single adult HH	0.388	0.565	*0.579*	0.001	0.104	0.795	*0.592*	0.006
2-adult HH	-0.036	0.944	*0.463*	<0.001	0.124	0.650	*0.562*	<0.001
3+ adult HH	Reference variable							

The effect of one's personal income is positively linked with cycling for women in both time periods, but the effect grew weaker by the late 2000s. This is consistent with the result, shown in Figure 7, that there is a growing proportion of women cyclists that are not in full-time work. For men, the effect of personal income was not significant in the late 1990s, but was, like for women, positive and significant in the 2006/10 period. For women the effect of income earned by others in the household was negative (but not significant) in the late 1990s, and flipped signs (and became statistically significant) to become positive in the late 2000s.

Perhaps counter-intuitively, holding a driving licence is *positively* associated with cycling for both men and women; these effects are significant in the 2006/10 period but not the earlier one (the effect for women is close to significant, p=0.08).

The gender differences in the effects of working either part-time or full-time (versus not being in market employment) are not significant. For women, part-time work is positively and significantly associated with cycling only in 2006/10.

We see that for men in both time periods the likelihood of being a cyclist falls as household car ownership increases, and the same was found for women but only in the late 2000s.

The presence of young children (age 4 or younger) did not have a significant effect on men's cycling, but was negatively linked with women's cycling in the late 2000s. We found no significant effects associated with the presence of older children (age 5 to 17) in one's household.

We also found that the effect of a travel diary taking place in the warmer months (May through September) is positive in all four models. The effect is however not statistically significant, with the exception that for women in 2006/10 it is nearly so (p=0.08).

Respondents to the B-NTS are asked to indicate whether they have any travel difficulties. This was included as a binary variable, and it was found, unsurprisingly, that having travel difficulties is statistically negatively linked with a lower propensity to be a cyclist. The exception to this was for women in the late 1990s where it was insignificant.

Age was specified as a categorical variable, with three classes (up to age 34, 35 – 59, 60+). No significant effect of age was found for women in the late 1990s, but for women in the 2006/10 period and men in both time periods the two lower age groups were associated with significantly higher propensity to cycle than the 60+ age group. For the latter three models the *ceteris paribus* positive effect was largest for adults in the 35 – 59 age group, but the differences with the 18 – 34 age group were not significant.

The final variable included in the model is the number of adults in a person's household (in categories of 1, 2, or 3+). No significant effects were found in 1996/2000, but in the more recent time period statistically-significant positive effects of being in a one- or two-adult

household were found (relative to living in a 3+ adult household), and this held for both men and women.

4.0 Discussion and conclusions

This paper reports on the gendered patterns of cycling in Greater London, providing a comparative analysis of the late 2000s and a decade earlier. It examined within- and between-gender differences over time. Over the decade under study cycling levels increased sharply, particularly amongst women, but nevertheless men continue to represent the majority of cyclists in London. It contributes to the growing body of literature addressing gender issues in cycling, which have important policy implications as both London and many other cities actively seek a step-change in cycling levels. These findings are particularly pertinent in both Britain and North America (though not some continental European cities) where women cycle at much lower rates than men.

The following inferences about adult cyclists for the late 1990s and the late 2000s are of particular significance for further analysis, and for comparisons with other city regions:

- Despite men still outnumbering women as cyclists, women were disproportionately responsible for London's increasing cycling activity. This is principally because the number of cyclists increased by a much faster rate for women than it did for men, rather than growth in the number of cycling journeys per female cyclist. There were 3.7 adult male cyclists for every adult female cyclists in the late 1990s, but of the growth over the subsequent decade half of the 'new' adult cyclists were female. Of further note is that both men and women that cycled at all were seen to make an average of about 5 to 7 cycling journeys per week; the gender gap is largely in the number of cyclists rather than their intensity of cycling.

- The characteristics of women's cycling journeys suggest that those for commuting are becoming more similar to those of men over time. For all other journey types, men's journeys remained substantially longer, on the average, than those of women. A speculation that can in principle be addressed with travel diary data is that the average length of women's non-commuting journeys is much influenced by the a relatively high number of short, local trips, and the higher percentage of shopping and personal business trips made by women perhaps reflecting the traditional division of labour in the household. These are interesting echoes of results reported elsewhere (e.g. [*16*]) that require further investigation.

- The proportion of journeys for either commuting or work-related purposes has remained quite similar over time for women, but slowly diminished over time for men and so has brought their proportion closer to that of women. There is again a parallel to explore with car use: a number of travel surveys indicate that the proportion of car travel that is not work-related has risen in recent years (*15*), and this may reflect

changes in household logistics and role allocation associated with the progressive entry of women into the labour force.

- Cycling activity by women grew much more in the warmer months than in the cooler months, an effect not seen among male cyclists. This invites further analysis: it does not seem that cycling performed together with children is an explanation, because the proportion of active cyclists in households with children under 4 is very low (and appears to be lower amongst women than men). One hypothesis requiring investigation is that men's propensity to cycle may be less affected by inclement weather.

- We did not find significant gender differences associated with others accompanying cyclists on their cycling journeys. While this may not be surprising, different definitions of accompaniment, especially for those with children in their care, should be applied to travel data sets that have sufficient detail and contextual coverage.

- The multivariate analysis shows that women's personal income is positively linked with cycling, but that this effect has become smaller over time. The same may be true with being employed, particularly full-time (women cyclists are more likely to be in full-time employment than non-cyclists, but the proportion of women cyclists that work full-time seems to have fallen over time). It seems that growth in women's cycling is being led by women on lower incomes and those less likely to be in market employment. How much of the explanation is to be found in adaptations by women who transition to part-time employment or non-employment is not clear, and further research is required to confirm and explain this finding.

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