

## Does Gender Matter in Daily Urban Mobility? Exploring Travel Perceptions, Attitudes, and Behaviours



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### ABSTRACT

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Gender can determine mobility habits and patterns in everyday life. Yet, different mobility needs of men and women are often ignored in the urban transport systems analysis and planning. Different attitudes and perceptions can determine the transport mode choice as well as the basic characteristics of a person's trip. Integrated transport and urban planning require taking into account these differences for reasons of inclusivity. This paper identifies gender differences in travel perceptions, attitudes and behaviours using inferential statistical analysis of questionnaire surveys conducted in the city of Thessaloniki, Greece, and discusses the policy directions to enhance gender mobility equity. The results are cross-checked with international literature to explore the role of local culture in explaining gender gaps in urban mobility.

## 1. INTRODUCTION

In recent years, particular emphasis has been put on and many efforts are being made globally to develop urban transport systems that adapt and serve the travellers' needs. However, in many cases the specific needs of different groups of people are not taken into account. One of the characteristics that significantly differentiates travellers' perceptions, attitudes, behaviour and by extension their needs is the gender.

Important differences can be observed between the mobility patterns of the two genders with regards to: a) commuting to work [1], b) non-work trips [2], c) long-distance trips [3]. One of the most significant differences is that females have much more complex activity patterns and trip chains [2, 4]. Despite the fact that these complex trip chains require a flexible transport mode, it seems that in most cases females are more dependent on public transport [5] and males are more dependent on car use [6, 7]. The dependence of males on car use leads them to think public transport as an alternative only when restrictions are placed on car use, while females seriously consider public transport as an alternative and expect efficient services [8]. Integrated public transport systems could be a solution that meets females' needs and according to the results of a survey, which was carried out in New Zealand, females are more likely to make multi-modal transfers, especially when the waiting time is limited and an adequate safety level is provided [9]. Regarding walking for transport and recreation, there is no clear evidence whether it is more prevalent among males or females, since the results of

previous surveys are ambiguous [10-12].

The above-mentioned mobility differences among the two genders derive from the different social roles (e.g., females usually have more varied obligations which include employment, household works, caregiving) and norms (patriarchal power), which have been established for many years [4, 13, 14]. For that reason, in developing countries, where the roles of males and females are more distinct, it is expected to be observed greater gender mobility gaps [15-17]. More intense gender mobility differences can be also found in areas with lower socioeconomic status [18]. It is also noteworthy that even in developed countries, males and females are differently affected by life course events. For instance, having children mainly affects mothers' mobility patterns rather than fathers' [13, 14].

In addition to the differences in daily urban mobility patterns observed due to gender roles and norms, there are also other differences in their daily trips, which are attributed to the different psychology and physical strength of the two genders. These differences concern risky behaviours and vulnerability during their trips. Overall, males appear to be riskier and less concerned about the impact their perilous behaviour may have (e.g., aggressive driving) [19-21]. This risky and reckless behaviour of males in some cases makes them more vulnerable to road accidents, comparing to females [22, 23]. However, in other cases not related to risky behaviour, women appear to be more vulnerable during their trips (e.g., sexual harassment). Fear of being aggressed is significantly more powerful for females, for instance when waiting in a desolate public

transport stop or during walking in a parking lot with limited human activity [24]. This fear of females is very important, since it can significantly affect their trip characteristics, such as the transport mode choice and route choice [25]. Females, especially those of older ages, are also more vulnerable in terms of pedestrian falls, as Elvik and Bjørnskau [26] prove in their survey.

Gender equality is one of the goals of the 2030 Agenda that must be pursued in order to optimise the planning and design of certain sectors, including mobility. It is also an essential element that should be considered in the development of smart cities. A city can be defined as smart if it adopts an innovative style of governance, a collaborative approach with the population and various service providers to design urban policies aimed at improving the quality of life of citizens and promoting environmental, economic and social sustainability. Although civic participation and inclusion should be distinctive features of smart cities, gender inequalities are often overlooked both in the academic literature and in the implementation of smart strategies. A study conducted by Nesti [27] focused on how and why gender inequalities can emerge in a smart city, proposing a set of tools for gender mainstreaming in smart city governance and possible areas of intervention to reduce gender inequalities in smart cities.

In the present paper it is attempted to identify and gather gender mobility differences and gaps, which are associated with transport mode choices, trip characteristics, public space perceptions and active mobility. What is more, the impacts of

the economic crisis manifested in Greece from 2010 onwards on mobility behaviour are explored. While the research [28] highlighted the significant impacts of this crisis on citizens' daily habits in terms of trip frequency and mode choice with regard to household income, in this paper we focus on gender differences. In this way, a comprehensive picture of the role that gender has today in the perceptions, attitudes, and behaviours of commuters in Greece, is being formed. Recognizing differences in the case of Greece leads to the development of a constructive discussion on possible transport policy implications.

## 2. METHODOLOGY

The paper seeks to develop a storytelling about the role of gender in issues related to mobility. This storytelling is based on numerous researches (see Table 1), which have been conducted in the city of Thessaloniki, Greece. The researches, which are included in the paper exploit data collected from questionnaire surveys that explore mobility perceptions and attitudes. In order to facilitate the storytelling about the role of gender in daily urban mobility, the presented research is distinguished in two main axes (pillars), namely transport mode choice and trip characteristics with focus on the impacts of economic crisis on urban mobility behaviour, and public space and active mobility.

**Table 1.** Attributes of the utilized surveys

Thematic pillar	Topic	Data collection technique	Sample size	Examined population	Implementation year
Transport mode choice and trip characteristics	Trip characteristics and the impact of economic crisis	Questionnaires	853	Total population of Thessaloniki	2014
Public space and active mobility	Pedestrians perceptions in pedestrians-cyclists shared spaces	Questionnaires	300	Total population of Thessaloniki	2017
	Attitudes towards cycling	Questionnaires	300	University students of Thessaloniki	2019

All the presented researches use Thessaloniki, Greece as study area. Thessaloniki is the second largest city in Greece and its population according to the 2011 census is 790,824 inhabitants at urban level and 1,107,6688 inhabitants at metropolitan level. It is located in northern Greece and more specifically in the Region of Central Macedonia. The city of Thessaloniki plays an essential role in the wider area, since it is an important transport hub, as well as gathers multiple economic, educational and administrative activities. Regarding transportation in the city of Thessaloniki, it is worth mentioning that the use of a private car is predominant [28], and the quality of services provided by public transport is insufficient [29, 30]. The inadequacy of public transport services is mainly attributed to the absence of urban rail transit (a metro system is currently under construction and planned to be completed until 2024). Bicycle usage rates are particularly low, especially for mandatory trips, as the bicycle network is not coherent, and the city's environment is not geared towards safe and comfortable cycling. Nevertheless, some actions in the direction of sustainable mobility have been implemented in recent years (traffic calming measures, pedestrianizations, controlled parking system) and it is estimated that this will continue and will be intensified in the future. Thessaloniki hosts a large number of university students, with 4 of the

country's largest universities, including the Aristotle University of Thessaloniki, which is the largest university in the Balkans with more than 70,000 students and 2,000 faculty members. For each questionnaire survey, it was sought (and it was achieved) the completion of at least 300 questionnaires as it is considered a satisfactory limit for a population of approximately 1,000,000 people [31, 32]. The random sampling method was selected in all cases.

The collection of the data was followed by descriptive and inferential statistical analysis, with the main aim of identifying if any differences in perceptions, attitudes and behaviours between the two genders. Depending on the nature of the variable being investigated for a possible correlation with gender, the appropriate statistical test was applied. More specifically the following tests were used: a) chi-square, b) Mann-Whitney U, c) t-test. The null hypothesis indicates that the examined variable is independent from the gender. The p-value is presented for each attempted statistical test and it is indicated when the null hypothesis is being rejected at 90%, 95% or 99% confidence level. The results for the city of Thessaloniki are compared with results of relative studies that were found in the literature, so as to ascertain whether any differences observed on the basis of gender are valid in all cases or concern countries with specific characteristics. The

paper concludes with a constructive discussion, which aims at shaping policies that promote equality and justice in transport planning.

### 3. RESULTS

#### 3.1 Mobility behaviour during the economic crisis

Different socio-economic groups have different mobility needs constraints and behaviour [33]. Socio-economic characteristics of individuals explain a good part of the mobility behaviour and mobility choices [2]. Directives of the E.U. highlight the fact that research should give more importance to socio-economic aspects of urban mobility and especially to the differences between genders [34] as part of mainstreaming policies. Also, the socio-economic conditions can have a significant impact on travel choices, especially in times of economic crisis [35]. The above was validated by a questionnaire-based survey carried out from April to May 2014 in the city of Thessaloniki [28]. The objective of the survey was to investigate the type and quality of changes in the mobility behaviour caused by the persistent economic and social shock in Greece manifested in 2010 onwards. The sample consisted of 853 randomly selected city centre users (residents, workers, students and visitors on typical working days), 399 (47%) males and 454 (53%) females. The survey participants were asked about current and retrospective information concerning their travel behaviour during (2014) and before the emergence of the crisis in Greece (2010). In this section the main findings of the survey regarding urban mobility behaviour and trends by gender during the crisis, but

also the impacts of the economic crisis on the trip characteristics before crisis are presented. The main research questions were the following: Did the impact was the same for both genders? And, which gender has been influenced to the most and how?

Literature has pointed out that differences between genders are reflected on the trip purpose [36]. As presented in Table 2, there is indeed a significant difference in trip purpose distribution by gender during the economic crisis. It is observed that the most pronounced difference concerns the trips for work and shopping. While work is the most cited trip purpose for both genders, males travel more for work than females do (42.3% for males, 36.3% for females), while females travel more for shopping (18.9% against 10.3% for males).

Table 3 presents the mode preference by gender before and during the economic crisis. The Chi-2 test result demonstrates that there is a high statistical difference in the modal split between, both before and during the economic crisis. Before the crisis, the males used mostly the car as a driver (44.6%) and the motorcycle (13.3%) while females travel mainly as car passenger (12.3%) and by bus (42.7%) or by taxi (5.1%). It is worth mentioning that the male participants of the survey have significantly higher rate of driving license (90%) than the females (63%). Moreover, the rate of the male having a job occupation is slightly higher than that of the females (60% of the males of the sample were employees or businessmen against 55% of the females). It could be concluded that males show a preference for modes providing flexibility and independency (i.e., travel as a car driver). Finally, the results show that while more females than males choose to walk, the number of female cyclists is trivial.

**Table 2.** Trip purpose by gender during the crisis

Gender	Trip purpose					
	Work	Education	Shopping	Personal Business	Leisure	Other
Male	42.3%	6.5%	10.3%	11.5%	28.6%	0.8%
Female	36.3%	6.4%	18.9%	10.8%	26.7%	0.9%
Total	39.2%	6.4%	14.9%	11.1%	27.6%	0.8%

Chi-2 p=0.02\*\*  
 \*\*\*significant at 1%; \*\*significant at 5%; \*significant at 10%

**Table 3.** Modal split by gender before and during the crisis

Time period	Gender	Modal split						Chi-2 value	p value
		Car driver	Car passenger	Bus	Taxi	Moto	Walk and Bike		
Before crisis	Male	44.6%	1.0%	27.1%	1.0%	13.3%	13.0%	135	0.00***
	Female	23.4%	12.3%	42.7%	5.1%	1.5%	15.0%		
	Total	33.3%	7.0%	35.4%	3.2%	7.0%	14.1%		
During crisis	Male	26.8%	1.3%	36.3%	0.5%	16.5%	18.6%	88	0.00***
	Female	16.3%	5.9%	55.7%	0.7%	2.4%	19.0%		
	Total	21.2%	3.8%	46.7%	0.6%	9.0%	18.7%		

\*\*\*significant at 1%; \*\*significant at 5%; \*significant at 10%

It is noteworthy that during the crisis, both genders reduced car use as a driver (-17.8% for males and -7.1% for females), and increased public transport use (+9.2% for males and +13% for females), walking and cycling (+5.6% for males and +4% for females) for downtown trips compared to the pre-crisis period. Males also increased the motorcycle use (+3.2%), while females decreased the taxi use (-4.4%) and travel as a car passenger (-6.4%) in the same period. The higher the absolute value of the Chi-square, the greater is the difference between genders concerning the modal split distribution. We observe that the Chi-square value decreases during the crisis,

meaning that while the difference between males and females is still statistically significant (p<1%), the gap has been reduced (before the crisis: Chi-2 value=135, during the crisis: Chi-2 value=88). This gender gap attenuation of travel mode choice could be mainly explained by the decrease of male car drivers as well as of female car passengers and taxi users compared to the pre-crisis period. The percentage differences between male and female car drivers, car passengers and taxi users were respectively -21.2%, -11.3, -4.1 before the crisis against -10.5%, -6.7, -0.20 after the crisis. In general, the effects of the economic crisis are proving more effective in

limiting car use compared to any sustainable mobility measure that has been implemented in the past into the city [37].

Spatial factors as the shape of the city, the topography of the transport network and the level of accessibility are also affecting travel choices [36]. Literature on gender differences highlights that living in the suburbs can accentuate transport inequalities between males and females [38, 39]. The analysis presented in Table 4 is based on the place of residence, dividing the sample between the participants living in the central urban areas (municipality of Thessaloniki) and the

suburban municipalities (no statistical test applied here due to the low number of observations in some cases). The results demonstrate an emerging pattern. In both areas of residence, males prefer mostly to drive, while females travel more by bus, in accordance with the findings presented in Table 3. What is interesting is that the difference in modal share is significantly more important for the group living in the periphery of the municipality of Thessaloniki. In these areas public transport is less present, the dependency on the car is more pronounced, and females seem more penalized by this dependency.

**Table 4.** Modal split by place of residence and by gender during the crisis

Place of residence	Gender	Modal split					
		Car driver	Car passenger	Bus	Taxi	Moto	Walk and Bike
Urban area of Thessaloniki	Male	13.8%	0.5%	38.3%	0.0%	15.8%	31.6%
	Female	10.3%	2.4%	46.0%	0.9%	1.9%	38.5%
	Total	12.0%	1.5%	42.3%	0.5%	8.5%	35.2%
Suburban area of Thessaloniki	Male	39.4%	2.0%	34.5%	1.0%	17.2%	5.9%
	Female	21.6%	9.1%	64.3%	0.4%	2.9%	1.7%
	Total	29.7%	5.9%	50.7%	0.7%	9.4%	3.6%

**Table 5.** Illegal driving behaviour by gender during the crisis

	Car/motorcycle traffic violations							
	I park illegally		I violate traffic lights		I violate bus lanes		I violate bike lanes	
Gender	Yes	No	Yes	No	Yes	No	Yes	No
Male	66%	34%	26%	74%	37%	63%	25%	75%
Female	54%	46%	14%	86%	29%	71%	20%	80%
Total	61%	39%	21%	79%	34%	66%	23%	77%
Chi-2	p=0.01***		p=0.00***		p=0.05**		p=0.16	
	***significant at 1%; **significant at 5%; *significant at 10%							

Another important aspect of daily mobility that seems to differ between males and females is how each gender conceives traffic related violations as a car or motorcycle driver [40]. From Table 5 arise that the observed differences by gender are statistically significant for illegal parking, for traffic light and bus lane violations, except for the bike lanes infractions. Males are more prone to undertake an illegal driving behaviour. Furthermore, the traffic violation rate for both males and females seem to be dependent on the gravity of the infraction. The most frequently reported is illegal parking, which can be considered as a minor violation. On the contrary, the traffic lights violation has the lowest reported rate, as it is considered a serious driving infraction.

**Table 6.** Public transport ticket validation by gender during the crisis

Gender	Ticket validation frequency	
	Not always	Always
Male	23%	77%
Female	13%	87%
Total	18%	82%
Chi-2	p=0.01***	
	***significant at 1%; **significant at 5%; *significant at 10%	

Moreover, from Table 6 it is demonstrated that males are more likely to use public transport without validating their ticket. However, this illegal behaviour is not related to the perceived quality of the offered transport service. In fact, both genders declared with equal percentages that the quality of service is moderate (50%), bad (24%), or good (26%).

### 3.2 Public space and active mobility

One of the main transport policy objectives, especially in Europe, is the promotion of active modes for daily commuting [41], due to their significant advantages in terms of health, well-being, environment and economy [42-48]. For achieving this aim, it is essential to understand pedestrians and cyclists' perceptions and attitudes, in order to design places and infrastructures, which fulfil their needs.

The lack of available space in the built environment and the desire to develop safer routes for cyclists, in many cases results in designing infrastructures, which are shared by pedestrians and cyclists. This solution is also preferred in many cases in the city of Thessaloniki and for that reason a questionnaire survey addressed to pedestrians took place during July and August, 2017, aiming to examine their perception about comfort and safety while walking, as well as their perceived level of service (LOS) in shared-use infrastructures [49, 50]. LOS is a quantitative measure that is commonly used for assessing transportation infrastructure; it takes values from A (the ideal condition for the user) to F (the worst condition for the user). 136 (45.3%) males and 164 (54.7%) females participated in this survey. The results presented in Table 7 show that males and females perceive very similar levels of comfort and safety and no statistically significant difference can be observed. Despite the similar perception of comfort and safety in pedestrians-cyclists shared use infrastructures, the perception about the LOS is significantly different for the two genders, since males tend to assign a higher LOS in the specific infrastructures as it can be seen in Table 8.

**Table 7.** Pedestrians' perceived comfort and safety in pedestrians-cyclists shared spaces by gender

Pedestrians' perception about comfort and safety in pedestrians-cyclists shared spaces										
Gender	Comfort					Safety				
	Absolutely satisfied	Pretty satisfied	Neutral	Somewhat satisfied	Not at all satisfied	Absolutely satisfied	Pretty satisfied	Neutral	Somewhat satisfied	Not at all satisfied
Male	30.9%	36%	22.1%	7.4%	3.7%	28.7%	38.2%	22.1%	7.4%	3.7%
Female	34.1%	37.2%	23.2%	4.9%	0.6%	34.1%	32.9%	26.2%	5.5%	1.2%
Total	32.7%	36.7%	22.7%	6%	2%	31.7%	35.3%	24.3%	6.3%	2.3%
Mann-Whitney U					p=0.292	p=0.407				
***significant at 1%; **significant at 5%; *significant at 10%										

**Table 8.** Pedestrians' perceived level of service in pedestrians-cyclists shared spaces by gender

Pedestrians' perceived LOS in sidewalks and pedestrian streets						
Gender	A	B	C	D	E	F
Male	2.9%	14%	27.2%	40.4%	13.2%	2.2%
Female	1.8%	7.9%	20.1%	46.3%	20.7%	3%
Total	2.3%	10.7%	23.3%	43.7%	17.3%	2.7%
Mann-Whitney U			p=0.006***			
***significant at 1%; **significant at 5%; *significant at 10%						

**Table 9.** University students' attitudes regarding interventions aiming to promote cycling by gender

Gender	Interventions aiming to promote cycling																							
	Bicycle lanes				Bicycle parking spots				Road surface improvement				Signs for cyclists				Road lighting				Connection with other modes			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Male	81%	18%	1%	0	22%	44%	32%	2%	41%	43%	16%	0	34%	44%	19%	3%	30%	44%	25%	1%	15%	32%	45%	8%
Female	92%	7%	1%	0	27%	54%	19%	0	54%	40%	5%	1%	62%	30%	7%	1%	45%	42%	13%	0	20%	44%	34%	2%
Total	86%	13%	1%	0	24%	50%	25%	1%	48%	41%	11%	0	48%	37%	13%	2%	38%	42%	19%	1%	17%	38%	39%	5%
Mann-Whitney U	p=0.004***				p=0.008***				p=0.005***				p=0.000***				p=0.001***				p=0.002***			
***significant at 1%; **significant at 5%; *significant at 10%																								
* (1: very important, 2: important, 3: slightly important, 4: not at all important)																								

Regarding attitudes towards cycling, a questionnaire survey which was addressed to university students carried out during February and March 2019 [51, 52]. 300 university students participated in the survey, 149 (49.7%) males and 151 (50.3%) females. From the responses in the questionnaire survey, it can be stated that the vast majority of the sample (68%) do not cycle in the city of Thessaloniki, while only 2% cycle more than 25 kilometres within a week. Table 9 presents university students' responses regarding the importance of interventions (1: very important, 2: important, 3: slightly important, 4: not at all important) that could improve cycling in an urban area and encourage commuters to use a bicycle more frequently. It can be understood that both male and female students are mainly concerned about the development of bicycle lanes, which can form a safe and comfort bicycle network. However, females assign greater importance to all the interventions in comparison with males. Especially, for traffic signs and road lighting, an essential difference can be observed between the two genders.

#### 4. DISCUSSION AND CONCLUSIONS

The article has shown that there are significant differences in mobility behaviour and inequalities in travel patterns and access to transport between genders in Greece. The findings concern Thessaloniki, the second largest city in Greece, and

cover all the important aspects of daily urban mobility as the transport mode choices and trip patterns, the travel attitudes and preferences in times of economic crisis, the relation between active mobility and public space.

Concerning the urban trips characteristics, it appears that optional trip purposes like shopping, leisure and personal business are more frequent for females than for males. Socially, this result supports the long-lasting gender roles constructed by society and culture, males the breadwinners and females the caregivers. Furthermore, males are more car and motorcycle dependent, while females travel more as car passenger and by bus or taxi. Males' control over car use in car owning households restricts females' access to private transport [38]. This gender division of transport is accentuated for females living in the suburban areas of Thessaloniki. This finding is in accordance with research [39] in Stockholm. Suburban residents proved to be more car dependent and given that females face more difficulties to have full access to car, they are penalized by a forced use of public transport which is often characterised by a low level of accessibility in the outskirts. Nevertheless, as females have more complex mobility patterns [2, 3, 53], the car use as driver could help them to better negotiate the complexities they face when seeking to link home and work. Another interesting aspect which also distinguishes genders is illegal travel behaviour. It is observed that in Thessaloniki, males are more prone for traffic violations. The studies [40, 54] fully confirm these findings.

Regarding sustainable mobility behaviour choices, females are very rare bicycle users in the city of Thessaloniki. The less frequent cycling of females is also found in other studies carried out in Australia [55], Canada [56], United States [57], Albania and Kosovo [58] and Belgium [59]. But this is not always the case, as in countries where cycling culture is more developed, and bicycle has higher modal split, there are no differences based on gender [60]. Moreover, interesting are the results of a study, which used data from the 28 member states of the European Union and concluded that in countries with higher scores on the Gender Equality Index, the participation of females in cycling for commuting is greater [61]. The development of a coherent bicycle network is the most useful intervention for achieving cycling promotion both for males and females. This result agrees with the study [62], which was conducted in Denmark, and finds out that the existence of bicycle lanes is the most important factor for cycling regardless of age and gender. However, from our results it is shown that females assign greater importance to all possible interventions for cycling promotion and the gender differences highlight the increased needs of females to start commuting with bicycles, which are also identified in the study [57].

Concerning walking, more females than males prefer to walk in the city centre and there is a clear tendency of females than males to perceive lower LOS in pedestrian infrastructures. This conclusion totally agrees with the results of a study carried out in China [63]. On the other hand, the examination of gender differences in the evaluation of sidewalks located in Kuala Lumpur, Malaysia, concludes that there are no significant differences between males and females [64].

This research also highlights the changes in gender mobility behaviour because of the economic crisis which deeply affect Greece from 2010 onwards. Despite the unquestionable overall negative social impacts of the crisis, there have been some “collateral benefits” concerning the adoption of sustainable mobility behaviours by both genders. It was demonstrated that males and females have reduced car use as a driver or passenger and they shifted to public transport, walking and cycling for downtown trips.

Both genders made the necessary trip frequency and travel expenses adjustments (decrease or increase) to cope either with the general income reduction, either with the fact that they were forced to have a second job. Nevertheless, females proved to be more resilient to crisis in terms of expenses due their preference on public transport. It is noteworthy that the gender gap in mobility behaviour is reduced under the effect of crisis. However, this was not achieved due to the implementation of any gender equity policies but rather because males decreased car use for the benefit of other transport modes.

The aforementioned analysis could spark some policy guidelines in the framework of gender mainstreaming. Gender mainstreaming is defined as “efforts to scrutinize and re-invent processes of policy formation and implementation across all issue areas to address and rectify persistent and emerging disparities between men and women” [65]. Using this policy framework objective and based on our findings of daily mobility issues, three axes of intervention can be identified: knowledge enhancement, offer of tailor-made mobility services and urban mobility planning responding to gender needs [34].

Firstly, specific studies need to be conducted to identify the extent of inequalities as well their sources. There is indeed a

lack of knowledge regarding gender inequalities and needs [66]. Even though the surveys presented in this paper were not originally conducted with the objective to highlight gender differences, they offer valuable information about gender differences in Thessaloniki. In general, the results of these surveys provide evidence that females in Thessaloniki are facing mobility challenges and that they are in a disadvantaged position in relation to males, due to household internal constraints (mode choice and availability) and infrastructure constraints (facility to use bike, walk safely). Specific studies need to be conducted to identify the position of females in terms of mobility needs. UK is a great example of implementation of this kind of policy [34]. From 2000 onwards, the UK statistical authority keeps track of the evolution of gender mobility differences through household travel surveys every two years. A future household travel survey for Thessaloniki could be an opportunity to integrate stated and revealed preferences questions that could highlight gender inequalities and opportunities.

While the supply of good public transportation can be the focus of many policies, most of the times it does not respond to females’ needs [34]. In Thessaloniki, as our results demonstrate, the public transportation system, which is comprised only by bus lines, is perceived as inefficient by females. More spacious buses, with reserved space for strollers for example, are more suitable for females who travel with children. Elevated stops facilitating the entrance to vehicles are important issues to be faced. The under-construction metro system might facilitate such trips in the city centre. A more flexible mobility solution might be more appropriate for females. Innovative mobility solutions like car sharing or demand responsive transport services specific for females (like the pink taxi in Bolzano, Italy) can help them travel more easily and safely [34, 67]. However, first of all, policy makers need to be aware of these needs [38]. Women targeted surveys fits in this logic.

The development of high-quality public transport services (multimodal network integration, spatial coverage and accessibility, travel time, frequency, reliability, comfort, safety and security, information and affordable pricing) could support more gender-equal mobility behaviour and economic independence of females [2, 39, 67]. In terms of integrated urban and transport planning, the new metro line of Thessaloniki could be the opportunity for the implementation of Transit Oriented Development (TOD) projects around the Metro stations. The main objective of TOD projects will be to enhance the advantages of the compact form of the city of Thessaloniki and connect them with the urban public transport in order to improve local quality of life, reclaim public realm, strengthen spatial and social coherence, restructure land uses, reset urban densities, promote mixed land-use reinvent mobility behaviour and enhance accessibility [68].

Additionally, the development of high-quality public transport services could create a great potential for successful Mobility as a Service (MaaS) schemes. MaaS is a novel urban mobility concept, that relies on information and communication technology (ICT) for integrating digitally various mobility services [69]. It is believed that MaaS can significantly contribute in achieving sustainability targets, since travellers have the possibility to combine optimally different transport modes without relying solely on private cars [70]. Thus, MaaS can also assist in bridging gender-related gaps, by providing an efficient and car-free way of travelling, that can also deal with the complex trip chains that

females in many cases have.

Future research will include a deeper analysis about factors which are related to commuters' psychological diathesis; and how these factors are differentiated between the two genders. In addition, the recording of the mobility patterns will continue to be carried out in the next years, and through these patterns it will be investigated whether the changes observed due to the economic crisis are solidified or restored to the previous situation.

#### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are not publicly available, but they can be provided upon reasonable request to the corresponding author.

#### COMPLIANCE STATEMENT

Informed consent was obtained from all who were involved in the study.

#### CONFLICTS OF INTEREST STATEMENT

The authors declare no conflict of interest.

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