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Active mobility perception from an intersectional perspective: insights from two European cities

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Abstract

The investigation of active mobility perception for different classes of users is crucial to include all mobility needs and increase the accessibility of these modes. Elements like the perception of safety, security and the shape of the urban environment (e.g., provision of cycle paths) are to be considered while analyzing the different mobility choices between men and women. The current study focuses on the answers of a survey among representative samples of the population of two European cities, namely Valencia and Turin. Data collected in these similarly structured 'bike friendly' sites are compared following an intersectional approach based on gender and age. The results showed, for example, that, in general, cyclists are somewhat affected by safety issues, especially in terms of sharing space with motor vehicles. Or that women are less satisfied with the level of safety during walking. When considering bike-sharing, women seem more responsive to adding a dedicated space for children to start using this mode. The analysis of the results helps in providing interesting indications and suggestions for transport planning.

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1. Introduction

Understanding all needs is essential to build more effective mobility plans that integrate new mobility solutions into an inclusive and fair transport system. In fact, social exclusion does not happen because of the absence of opportunities but because of a lack of access to them (Preston and Rajé, 2007). Focusing on the gender equity, transport

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policies still do not respond equally to women's and men's mobility needs even if research affirms the importance of inclusive mobility as an essential factor for the progress of societies ((Thynell, 2016); (Gauvin et al., 2019)). The mobility needs can differ between men and women; the first ones usually have a linear travel route while the second ones often have interruptions in the home-work path due to other commitments. Women's mobility is generally more complex than men's, involving other stops as schools, hospitals, or supermarkets (Jain et al., 2011).

All these elements could impact the mode choice: the current paper aims to cast light on what happens for the so-called active transport, which "incorporates all modes of transport relying on human power for propulsion". Walking and cycling account for 20-40% of all journeys made in the EU (Hunkin and Krell, 2019). These transport options can play an important role also in the actual context of sustainable mobility, as underlined, for example, by Saif et al. (2019): "the sustainability of transportation, environmental condition of an area, public health and economic condition of residents can be raised by shifting from private transport to the public transportation, walking and cycling". Regarding sustainability issues, women are more troubled than men and are recognized as more likely to adopt sustainable travel behaviors (Alonso-Almeida, 2019)(Lodovici et al., 2012). They are also more favorable to transport behavior changes and to adopt solutions supporting a sustainable transport sector (Scholten and Joelsson, 2019).

Lodovici et al. (2012) state that women are more likely to use public transportation than men, but on the other hand, are not recognized as frequent cyclists ((Kawgan-Kagan and Popp, 2018), (Benedini et al., 2020), (Sottile et al., 2019)). The reasons behind this can be the different roles assigned to them by society, such as going shopping or taking care of the children that do not facilitate cycling. Bourke et al. (2019) suggest developing or improving cycling networks connecting shops, services, and schools within local neighborhoods to increase female cyclists' rate. Besides, women are more afraid of sharing public space with cars and other cyclists; therefore a clear separation between bicycles and motorized traffic may be a valuable solution for women to consider using it (Chataway et al., 2014). For example, as presented by Benedini et al., 2020, a specific class of users, such as women, find bicycle lane separation more critical than other users. Unattractive cycling environments prove strikingly more discouraging to women than men (Grudgings et al., 2018). Moreover, women perceive this mode of transport as not very useful for long distances because of the risk of arriving sweaty at their destination (Kawgan-Kagan and Popp, 2018). To plan a gendered sustainable transport planning, the female cyclists should be considered as potential users, not as a minority group, taking into account, for example, that they are more likely to make trips with a heavy object or that the birth of a child is associated with a decrease of use (Prati, 2018).

Souza et al. (2018) investigated women's perspectives for pedestrian mobility planning, recognizing the increasing relevance of addressing gender studies in cities' urban dynamics. Safety is also an essential aspect of the walking mode. Women often modify their behavior to feel safe, for example, avoiding walking at night if they are alone or talking on the phone while walking to feel safer (ITF, 2018). According to Hidayati et al. (2020), the gender differences in walking's perceived safety are correlated with spatial configuration and socio-cultural constructs. In general, fear for personal security can have substantial consequences on women's travel patterns (Stark and Meschik, 2018). Their results revealed that walking presents the highest percentages of frightening incidents, while cycling shows the least incidents of all travel modes.

Furthermore, bike-sharing is increasing globally, but the gender gap is important, and the bike share users are disproportionately male (Wang and Akar, 2019). Women also seem to be more influenced by the environment and the infrastructure of this recent transport mode (as the spatial characteristics of bike-share stations or the length of off-street bike routes). At the same time, the bicycle proposed by the provider can lead women to refuse to join this service because, for example, of its weight (Ma et al., 2020) or the absence of baby saddles (Zhang et al., 2015).

In 2020, the COVID-19 pandemic strongly impacted people's main routine and mobility habits. To reduce the risk of contagion, governments and local authorities implemented restriction measures to moderate the transfer in general and the use of public transport in particular. This has led, instead, to increased walking activities followed by biking also for women users (Carboni et al., 2021), although not in shared mode (Padmanabhan et al., 2021), probably due to the fear of contamination caused by the uncertainty of sanitizing the vehicles (Nikiforiadis et al., 2020).

The current work is part of the H2020 European project TIInnGO (Transport Innovation Gender Observatory), aiming to create a framework and mechanism for a sustainable game change in European transport concerning gender and diversity (Pirra et al., 2021). Intersectionality is relevant in TIInnGO project: it aims to advance the understanding of gender and mobility by including more variables, which show how transport resources depend not only on age, income, and location but also on safety issues and time factors. Indeed "intersectionality can thus identify the multiple

factors that leads to diversities within groups of women and men and their travel behaviors, choice of transport mode and the barriers to access transport” (Levin et al., 2020). According to Symington (2004), the intersectional analysis aims to reveal multiple characteristics, exposing the different types of discrimination due to the combination of identities (e.g., older woman, rural young woman). Moreover, the intersectional approach allows a ‘bottom-up’ approach to research, analysis and planning.

The methodology presented in Section 2 includes the survey design and the main focus on active mobility perception. The case study (Section 3) looks at responses from two similarly structured 'bike friendly' European cities. Finally, some indications and suggestions for city planning based on this analysis are reported in Section 4.

2. Methodology

A survey has been designed to investigate the differences between different users’ mobility patterns, to measure perceptions of the mobility and transport system and their satisfaction in European cities. The survey was based on focus group analyses and a detailed literature review conducted to collect information on female mobility needs, to gain new knowledge of possible barriers and potential improvements that would help transport operators improve the services offered to various users, mainly women (Pirra et al., 2021).

Following the approach of TInnGO, the survey was designed based on an intersectional perspective to identify the multiple factors that influence mobility patterns and mode choice. To perform an analysis with this dimension, information was collected regarding different characteristics of the respondents, such as age, gender, income, and ethnicity. However, in the following analysis, we will mainly focus on the first two features listed.

The questionnaire includes four main parts starting with the information for the user’s profile. The second section investigates mobility habits, with questions about the most used travel mode for different activities and analysis on the mobility offer. The next part of the survey explores the passenger experience focusing on two main elements affecting the gendered mobility choices: safety and security perception and the quality of service/infrastructure provision. The former element is investigated at all the trip stages (access, egress, on-vehicle), due to its relevance to mode choices (Pirra et al., 2021). This section of the survey also proposes a certain number of statements to evaluate the satisfaction levels with the transport infrastructure and the mobility service related to the most used transport means, asking the level of agreement on a 5-point Likert scale. The data collected in this part of the questionnaire are analyzed in more detail in the current work to identify user satisfaction levels’ determinant aspects and how these vary between women and men of different age groups and between the cities (see Section 3). The last part of the survey aims to explore the intention to use new mobility services to enhance accessibility to transport to gather new knowledge that could support operators in successfully improving their mobility offers to various kinds of users.

In this study, a deeper analysis of the issues related to active modes, also in its shared offer, is proposed by focusing on specific questions investigating their use and the perception of safety, which is a critical factor in women’s mobility choices. Women's perception of insecurity can be explained in part by exposure to higher levels of violence as transport users, thus influencing their modal choice (Pirra et al., 2021).

The data were analyzed using statistical tests to evaluate differences in the satisfaction levels related to different aspects of mobility using soft modes between groups with various characteristics, classified according to gender, age, and the combination of age and gender. The tests used assumed a null hypothesis of no difference between groups. A parametric test, T-Test, was used to analyze gender in two categories (men and women), and non-parametric tests (Mann-Whitney and Kruskal-Wallis) investigated the differences of perception and satisfaction between respondents grouped in 14 different groups by age and gender.

3. Case study

The designed survey has been distributed between December 2020 and January 2021 in different European cities, sites of TInnGO Hubs. The current analysis focuses on two cities similar in size and number of inhabitants, namely Valencia and Turin. The former is among the most bike-friendly cities in Europe, while the latter is currently adopting solutions to encourage non-motorised vehicles. Valencia is the third biggest city in Spain and is characterized by a population of around 800,000 inhabitants. Concerning modal share, active transport modes account for 45% of trips: most of these are made by walking (40.9%). Bike sharing is present and widely spread, with 3.43 bikes/1000

inhabitants supported by over 156 kilometers of cycle paths and a historical center where vehicles are not allowed to exceed 30 km/h (Kalakou et al., 2018). Turin has a population of around 870,000 inhabitants. The modal transport split shows that the majority of trips are made by private vehicles (43%), with similar values for public transport and walking (23% and 25% respectively) and low numbers for bicycling (only 4%). Various bike-sharing systems are present, both free-floating and station-based, with a respective offer of 1.9 and 1.5 bikes/1000 inhabitants (Ciuffini et al., 2020). An operator is also sharing bikes with pedal assistance. An increase in the cycling infrastructure has been observed since the beginning of the pandemic, reaching an offer of 207 km of cycle and pedestrian-cycle paths.

Table 1 and Table 2 focus on extraction from the data collected initially (422 respondents in Turin and 443 in Valencia, representative samples of cities' population) based on people declaring the use of active modes and having completed the survey's satisfaction sections of at least one transport means among bike, owned or shared, and walking. The observation of the age and gender characteristics of this restricted group of people shows different trends in the totals, with common trends in both cities: few users of the sharing mode, with a higher proportion of women; for the use of own bicycles and walking, the two cities show two different trends.

Table 1. Sample characterization of active modes users.

No. of respondents		Turin			Valencia		
		Owned bikes	Shared bikes	Walking	Owned bikes	Shared bikes	Walking
*more choices were possible							
Professional* status	Paid employment - Working in an office/plant	28	15	131	18	8	155
	Paid employment - Working remotely	6	6	22	3	1	19
	Paid employment - Parental leave	0	1	1	0	0	2
	Paid employment - Lay-off	0	0	5	1	0	7
	Self-employed	11	6	36	0	0	9
	Non-paid work	0	0	0	0	1	7
	Student	7	5	21	7	8	41
	Homemaker	2	1	14	3	1	25
	Retired	16	2	50	3	3	70
	Unemployed	5	1	14	2	1	35
	Prefer not to answer	2	0	4	0	0	0
Living with dependents*	No	59	25	237	33	20	303
	Yes	20	13	68	6	3	80

Table 2 Number of active modes users divided by classes based on gender and age for the two cities.

# answers	Turin						Valencia					
	Owned bike		Shared bike		Walking		Owned bike		Shared bike		Walking	
	M	W	M	W	M	W	M	W	M	W	M	W
18-24 years	2	7	1	4	11	12	4	6	1	7	13	38
25-34 years	8	9	5	7	25	23	2	6	1	5	14	34
35-44 years	9	7	5	7	29	31	5	6	2	1	33	44
45-54 years	4	6	3	1	32	37	2	2	2	0	43	36
55-64 years	10	4	1	1	25	27	2	1	1	0	29	21
65-74 years	7	2	0	1	18	13	2	1	2	1	42	20
>75 years	3	1	1	1	14	7	0	0	0	0	13	3

Total	43	36	16	22	154	150	17	22	9	14	187	196
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4. Results

The use of active modes was assessed according to trip purpose and gender (Table 3). In Valencia, women declare to use more active means when compared to men in their commuting and other purpose. In contrast, Italian male respondents have said to use these means in higher percentage for all trip purposes: exceptions are those cycling with shared bike for running errand and walking to reach job place or university.

Table 3 Modal choice and trip purposes: active modes and gender focus

	Turin						Valencia					
	Owned bike		Shared bike		Walking		Owned bike		Shared bike		Walking	
	M	W	M	W	M	W	M	W	M	W	M	W
Going out for dinner	65%	35%	50%	50%	49%	50%	0%	100%	0%	100%	48%	52%
Job/University	50%	50%	59%	41%	39%	61%	33%	67%	20%	80%	38%	62%
Running an errand	66%	34%	43%	57%	50%	49%	48%	52%	50%	50%	49%	51%
Shopping for groceries	75%	25%	60%	40%	52%	48%	38%	63%	33%	67%	49%	51%
Visiting a close relative/friend	71%	29%	60%	40%	61%	39%	50%	50%	43%	57%	45%	55%
Visiting shopping centre	60%	40%	67%	33%	49%	51%	20%	80%	33%	67%	43%	57%

Table 4 focuses on the questions proposed to assess the satisfaction related to safety, security, and the urban environment's shape. The average rating values are shown (Likert scale 1-5, totally unsatisfied – totally satisfied), revealing differences in the two cities and providing valuable insights for the policymakers. Respondents from Turin uncover an overall lower satisfaction than those from Valencia, which confirms being an active modes-friendly city. Focusing on each sample separately, Italian bikers are somewhat affected by safety issues and are concerned by sharing the space with other vehicles, primarily motorists. Instead, the provision of information before the journey is appreciated, mainly from Turin shared bike users. When looking at the infrastructure, Italian people walking are rather critical when asked about the quality and maintenance of pavement, whereas the coverage of both pedestrian routes and cycle lanes is rather well-rated, mostly by shared modes users. Similar trends are observed in the Spanish. It is worth noticing the overall high satisfaction of respondents using bike sharing, considering the location of docks, the number of vehicles and the information provided for cyclists.

The parametric T-test is applied with the scope of verifying if the mean value of the two datasets (namely women and men samples) are significant different from each other (columns 4 and 6 in Table 4). Regarding bike-sharing statements, the analysis did not show significant differences between the two genders. In Valencia, women are less satisfied with safety on the streets while walking. On the other hand, in Turin it does not seem that women walkers have similar perceptions compared to men, but they are more satisfied for biking conditions.

The intersectional approach is proposed in Fig. 1. The average level of ratings for the three group of questions presented in Table 4 is investigated separately, considering the 14 classes defined in Table 2. Valencia is characterized by a decreasing satisfaction trend in people walking when their age increases (irrespective of gender), while significant discrepancies can be seen for the other two modes. However, as observed in Table 2, a reduced number of users is found in these cases, so the feedback is somewhat biased. Women in the range 25-34 are the most satisfied shared bike users, while men cyclists aged 55-64 travelling with their own means are those less fine with the aspects investigated through the survey. The intersectional investigation in Turin reveals differences except for the walking experience, which assesses at similar values, approximately equal to 3.0. The most satisfied own bike riders are men older than 75 and women in the age range 55-64, while the lower rating is declared by male adults aged 45-54. Considering the low numbers of shared mode users older than 55, it could be interesting to observe as the higher satisfaction is found among the women using this service, mainly the youngest ones.

Table 4. Level of satisfaction for walking and biking modes in the two cities (+ Higher average for women vs men, - Lower average).

I am satisfied with ...		Turin		Valencia	
		Avg.	W vs M	Avg.	W vs M
Owned bike	the speed of motorised vehicles in mixed traffic	2,4	+	2,6	
	the level of information provided for cyclists during the journey	2,6		3,1	
	the sharing space with pedestrians	2,6		3,0	
	the ability to carry bicycles in public transport vehicles	2,6		2,9	
	the level of information available before my bike journey	2,8		2,9	
	the sharing space with cars, motorcycles and other vehicles of this type	2,4	+	2,6	
	the cycle safety during the trip (at junctions, at crossings)	2,5		3,1	
	the easiness of connections with other modes of transport	2,6		3,1	
	the cycle parking availability and conditions (security, availability, etc.)	2,4		2,8	
	the ability to park bikes at stations	2,7		3,2	
	the coverage of cycle lanes across the city	2,7		3,8	
	the behaviour of motorists towards cyclists	2,2		2,6	
	the conditions of cycle lanes (cleanliness, quality of pavements, the width)	2,7	+	3,2	
Shared bike	the location of bike stations (location of docks fit my needs)	3,1		4,0	
	the speed of motorised vehicles in mixed traffic	2,7		2,7	
	the sharing space with motorised vehicles	2,7		2,8	
	the sharing space with pedestrians	2,8		2,8	
	the level of information provided for cyclists during the journey	3,1		3,3	
	the cost of use of shared bicycles	3,1		3,4	
	the level of information available before your bike journey	3,3		3,7	
	the easiness of connections with other modes of transport	3,1		3,4	
	the information provided in the app I use	3,4		3,7	
	the coverage of cycle lanes across the city	3,1		3,5	
	the behaviour of motorists towards cyclists	2,6		2,8	
	the cycle safety during the trip (at junctions, at crossings)	2,8		3,2	
	the conditions of cycle lanes (cleanliness, quality of pavements, the width)	3,0		3,5	
the number of vehicles available	3,1		3,7		
Walking	the access to public transport stops (stations, bus stops, ...)	3,4		3,7	
	the coverage of pedestrian routes	3,3		3,6	
	the maintenance and quality of pavement	2,5		3,1	
	the information for pedestrians on signposts and maps (for example: remaining waiting time on crosswalks)	2,8	+	3,3	
	the easiness and security of connections between different modes of transport	3,1		3,5	
	the level of safety walking on the streets	3,0		3,4	-
	the location of subways and overhead walkways	2,9		3,2	
	the security offered by pedestrian walkways (for example: offer a clear passage)	3,1		3,5	



Fig. 1 Level of satisfaction of active modes in Turin (a) and Valencia (b) by classes based on gender and age

Finally, Table 5 shows the questions about future trends that received the most discordant responses according to gender in the two cities. Women in Valencia think that the availability of shared bicycles with space dedicated to children is important. Confirming what is reported in the literature (Section 1), women in Turin are more concerned about sustainability issues; however, this does not apply in the other city.

Table 5. Future trends investigation about share modes and sustainability (+ Higher average; - Lower average for women vs men).

Future trends	Turin	Valencia
Share modes Availability of bicycles with space dedicated to children		+
Sustainability I rarely worry about the effects of pollution on myself and my family	-	
I do what I can to contribute to reducing global climate changes, even if it costs more and takes time	+	
I choose the modes of transport considering the impact on the environment	+	

5. Conclusions

The current paper investigates the use of active mobility in two European cities and the proposal of an intersectional perspective approach based on gender and age. According to the literature analyzed, the active mobility perception for different users' classes is crucial to include all mobility needs and increase the accessibility of these modes of transport. By exploring these aspects and analyzing the results, interesting indications and suggestions for transport planning are obtained. Indeed, bicyclists are somewhat affected by safety issues and concerned about sharing space with other vehicles, especially motorized vehicles and their behavior. Therefore, a clear separation between bicycles and different traffic kinds may be essential for women to consider using it. In Valencia, for example, women are dissatisfied with the level of safety during walks and this aspect should also be taken into account by transport planner. Considering bike sharing, Spanish women seem more sensitive to adding a space dedicated to children to start using this mode.

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