Do women perceive pedestrian path attractiveness differently from men?

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Abstract

The objective of this work is investigating on differences in pedestrians' perceptions in terms of gender. Specifically, we want to verify differences between male and female in perceiving aspects characterizing pedestrian paths and influencing their satisfaction, perceived service quality, and behavioural intentions. We propose a methodology based on Partial Least Squares Structural Equation Modelling (PLS-SEM) approach. From the model calibration we derived different coefficients for male and female, representing the importance that each category of users gives to the various aspects characterizing the paths. Data were collected through a sample survey addressed to pedestrians walking on paths placed in an urban area of the southern Italy. We discovered interesting findings about gender differences. In general, females are more sensitive than males concerning many important aspects such as environmental aspects in terms of air pollution and noise, or personal security from robbery or theft, or presence of furnishing along the path and cleanliness of the environment. On the other hand, male consider more the continuity of pedestrian path and the condition of the walking surface, as well as the nuisance due to the vehicle flow. In terms of similarities in perceptions, male and female equally appreciated the comfort due to the presence of trees providing shade along the path. The findings from the model could be useful for planners, who should invest on those aspects considered as important by both the categories, but also on the aspects that determine an inequality between male and female. As an example, since women do not feel secure along those paths, planners could improve this aspect in such a way as to make paths attractive to both women and men, as well as the aspects considered more relevant for men, to incentivize pedestrian mobility.

Keywords: Pedestrian path; sustainable mobility; behavioural intentions; gender differences; PLS-SEM.

Highlights

Investigating on pedestrians' perceptions while walking can help to improve their satisfaction and consequently the quality of the pedestrian environment.
PLS-SEM represents a suitable tool for evaluating the relationship between pedestrians' perceptions, service quality of the paths used by pedestrians, and their behavioural intentions.
Male and female opinions are investigated for discovering gender differences in perceptions of service quality.
The proposed methodology allows interesting differences between male and female to be discovered.
Practitioners can derive important suggestions from the analysis for defining strategies to improve the pedestrian environment.

1. Introduction

In order to implement efficient and equitable transport policies, the differences in travel behaviour by gender have to be considered and addressed (Ng and Acker, 2018). Gender differences in transport use were recognized since the last decades in terms of travelled distance, number of made trips, transport mode, driving behaviours and risk perceptions. A study conducted in UK for promoting gender equality in transport shows that men are more likely than women to make trips as a car driver, while women are more likely to make trips as a car passenger or public transport users (Hamilton et al., 2005). Men are still more likely than women to be a road casualty, and gender differences were recognized also in driving behaviours and risk perceptions (González-Iglesias et al., 2012; De Joy, 1992). Recently, gender differences emerged as well in transit service quality perceptions (e.g. Allen et al., 2020) and active mobility use (e.g. Higgins and Ahern, 2021; Festa and Forciniti, 2019). Concerning differences in public transport, Allen et al. (2020) discovered that men are more satisfied with the public transport service and more inclined to recommend it to their peers, maybe because women have higher expectations than men when travelling by public transport, having more requirements concerning attributes such as security, comfort, and cleanliness. The study by Mandhani et al. (2021) reveals that male consider passenger ease, whereas female consider service availability as most influential factors in explaining overall SQ. More specifically, women are less concerned about passenger ease and seamless connectivity, as compared to men. Further, 'safety and security' is considered as the most crucial factor. Regarding active mobility, and specifically cycling, the work by Higgins and Ahern (2021) shows that women are less likely to cycle than men for many reasons (e.g. uniforms, traffic concerns, physical efforts of cycling, effects on personal appearance). We can state that preferences, perceptions and behavior in the use of transportation systems in general vary between male and female, and that it is important to investigate these differences in order to develop specific planning strategies aiming at making transportation systems more attractive for specific users' categories. Starting from these issues, this work aims to verify gender differences in perceptions of pedestrian paths, and to discover how perceptions about the various aspects of the paths can differently affect satisfaction with the whole path, service quality, attractiveness and intention to reuse the pedestrian path.

The analysis of the quality of pedestrian paths started from the concept of Pedestrian Level of Service (P-LOS), which was derived by the antecedent concept of Level of Service (LOS) (Transportation Research Board, 2000), but P-LOS determination is much more complicated than LOS for motorized vehicle (Landis et al., 1997). If originally few variables such as pedestrian delay and space requirements were introduced in the P-LOS, some other ones concerning pedestrian, traffic and geometric characteristics were considered over the years, as reported in Tan et al. (2007) or Marisamynathan and Vedagiri (2019). Successively, more qualitative aspects were introduced, such as safety and comfort (e.g. Bian et al., 2009; Bivina and Parida, 2019). In these studies, researchers added the collection of pedestrians' perceptions to the collection of the geometric and operational parameters such as space at corners and delays, traditionally adopted for calculating LOS. The opinions of pedestrians have become ever more relevant because the use of a facility or an infrastructure, like the use of a service, is closely linked to the approval of the direct users. For this reason, also in the field of pedestrian mobility the most recent literature has been oriented to the evaluation of pedestrian facilities based on the collection of pedestrians' perceptions. In Talavera-Garcia and Soria-Lara (2015) a review of the several factors analysed in pedestrian mobility publications is reported.

Some studies investigated pedestrians' perceptions by deriving from pedestrians only their level of overall satisfaction with path, which becomes the dependent variable of the proposed models, while the independent variables are objective path characteristics measured on the field (e.g. Kim et al., 2014; Choi et al., 2016). On the other hand, some papers investigate pedestrians' perceptions in detail, by requesting to pedestrians their level of satisfaction also with specific attributes and not only the overall path, aiming at determining how satisfaction with a specific aspect affect overall satisfaction. These studies have proposed or adopted different kinds of methodologies for analysing

data, with the general common objective of determining the factors mostly influencing pedestrians' satisfaction (e.g. Lee et al., 2021; Vallejo-Borda et al., 2020a, 2020b). Some studies focused on pedestrians' perspective concerning pedestrian-bicycle shared spaces (e.g. Kang and Fricker, 2016; Nikiforiadisa and Basbas, 2019).

Our work fits into the category of studies investigating on pedestrians' perceptions with the aim to determine the aspects mostly influencing the overall satisfaction through a methodology based on the use of a partial least squares structural equation modelling (PLS-SEM) approach. The aim of the work is to analyse pedestrians' perceptions by differentiating between male and female, in order to discover the diversity of perceiving the pedestrian paths in terms of gender; at this aim, two different models were calibrated simultaneously for the two different groups of pedestrians. Still few studies have investigated this issue, and our work wants to enrich the literature of the sector with findings that could be very useful for researchers and practitioners. The major part of the studies already investigating gender differences were based on LOS analysis or simple statistical analysis of pedestrians' opinions, and they highlight in general that women are less satisfied than men and are more sensitive to important issue such as security while walking. We retain that adopting an adequate and sophisticated methodology can help in understanding gender differences and highlighting the differences in perceptions between male and female. Next section is a section of literature review, oriented to the analysis of studies investigating the differences in the use and perceptions of the pedestrians' facilities in terms of gender. The successive section aims to describe the case study supporting the work. In section 4, we propose the methodology and present the structure of the PLS-SEM, with the results of the models, while section 5 focuses on a deep discussion of the findings. Finally, a brief conclusive section is reported.

2. Literature Review

The literature has discovered interesting and important differences between male and female in the use and perceptions of pedestrian facilities. Among the studies analysing LOS, Tan et al. (2007) investigated the relationship between the pedestrians' subjective perceptions and the quality of the physical facilities in 12 sidewalks along Chinese urban roads. They argued that factors mainly affecting LOS include pedestrian's perceptions about the obstructions along the sidewalk, bicycle and vehicle traffic flows, sidewalk width, and interferences from other pedestrians. The research investigated pedestrians feeling of comfort and safety when they were walking on the sidewalk, and considered 6 degrees of perception to be chosen (pleasant, reasonable, acceptable, poor, unpleasant, unsuitable). Authors provide also some considerations concerning gender differences. Particularly, they state that female feel more uncomfortable than male for two main reasons: male and female have different physiological features (i.e. male have higher physical force and walking speed than female, and female feel more likely uncomfortable because of tiredness); male and female have different psychological features (i.e. female focus more on the details, while male focus on the whole imagination).

A review proposed by Banerjee et al. (2017) aimed to highlight pedestrian flow characteristics and level of service over different pedestrian facilities placed in all part of the world (America, Australia, Europa and Asia). The differences emerge, first, in terms of behaviour; as an example, on the various types of pedestrian facilities, it was observed that male pedestrians walk at higher speed in comparison to their female counterparts. Concerning facilities such as stairways, for female ascending or descending is relatively less easy, and escalators can provide more easy accessibility and comfort to them. In crosswalk male pedestrians had shorter waiting times than female pedestrians to cross from one side of the road to the refuge (Hamed, 2001), and cautiousness was found to be more amongst female pedestrians while crossing (Mako, 2015). The review provides only one study attempting to analyse differences in pedestrians' perceptions, and specifically the work by Arshad et al. (2016). In this work, a questionnaire survey was described and a simply statistical data analysis was made to investigate whether gender differences influences the pedestrian perception and satisfaction level at three sidewalks located within the Kuala Lumpur

City Centre, Malaysia. The authors highlighted that there was significance difference that can be observed in the male and female satisfaction level. More specifically, they argued that female pedestrian gave almost similar mean satisfaction level value for all sidewalks, although both male and female pedestrian agreed that all sidewalks in the study location were lacking in terms of safety. To the authors' knowledge there are very few studies investigating how the differences in pedestrians' characteristics such as gender or age influence pedestrians' perceptions and satisfaction.

We found studies investigating on the influence of pedestrians' characteristics in walkability. As an example, Moura et al. (2017) proposed an assessment of walkability in Lisbon, Portugal, based on seven key-concerns (Connectivity, Convenience, Comfort, Conviviality, Conspicuousness, Coexistence and Commitment) weighted to reflect their relative importance for distinct pedestrian groups (adults, children, seniors and impaired mobility pedestrians) and trip purposes (utilitarian or leisure); they found clear differences in walkability scores for the pedestrian groups. On the other hand, Jensen et al. (2017) focused on gender differences in walkability in Salt Lake City, USA; they found that women were much less common on low walkable streets, and therefore street improvements might enhance gender equity. Another study investigating on gender differences was proposed by Parida and Parida (2011), who examined factors in different land uses in Delhi, India, such as sidewalk width, sidewalk surface, obstruction, security, and comfort, and verified differences in perceptions by analysing importance and satisfaction rates. The mean weights assigned by the two groups of users were almost similar for all attributes except security and comfort, to which female attach more importance than male. Women seemed to be more satisfied than men in terms of physical factors, but more dissatisfied in terms of security. Kang and Fricker (2016) proposed a study focused on a pedestrian-bicycle shared space in four Chinese cities aiming at analysing the factors that influence pedestrians' attitudes towards sharing a space with bicyclists; they found that male more accept bicyclists than female, because they may feel less vulnerable. Lee et al. (2021) investigated gender differences in pedestrian satisfaction and subjective perceptions of the safety, convenience, and comfort in the city of Changwon, South Korea. They discovered differences in subjective perception according land use (i.e., commercial and residential areas) and street types (i.e., non-separated sidewalk and separated sidewalk). They found also that male were satisfied more than female. Also Jensen (2007), who analysed pedestrian and bicyclist satisfaction on roadway segments in Copenhagen, Denmark, registered a higher level of satisfaction for men as regards women.

Our work has been inspired to recent studies proposed by Vallejo-Borda et al. (2020a, 2020b) who analysed pedestrians' perceptions about pedestrian path characteristics in Bogota, Colombia. Anyway, they did not analyse the influence of pedestrians' characteristics in perceiving the quality of the pedestrian environment. Our work wants to provide a contribute to the literature studying pedestrians' perceptions by differentiating between male and female, with the objective to help practitioners in developing planning strategies aiming at making pedestrian facilities attractive both for male and female, in order to reach a social equality in the use of transportation in general, and of pedestrian facilities in this specific case.

3. Case study

3.1. The walkways

Four pedestrian paths of an urban area of the southern Italy were selected as case study. Our study context is quite peculiar. It is composed of two medium-sized cities, Cosenza and Rende, which represent a sole urban area and will have an only one administration in the next future. The configuration of the two cities is such that people moving from Rende to Cosenza and *vice versa* do not realize crossing the boundaries of the two cities. The city of Rende includes also a large campus accommodating the University of Calabria. So, the whole population of the urban area includes also the students living there, who are resident in the origin towns. In the urban area about 100,000 resident inhabitants live (about 65,000 residents in the city of Cosenza, and about 35,000 in the city

of Rende), but we have to add to the residents also more than 25,000 students of the University of Calabria, who live in the urban area. The urban centre develops from north to south towards the area where the campus of the University of Calabria is located. Mobility of the urban area is characterized by a very large percentage of trips made by private car (about 80%), and consequently low percentages of trips by sustainable modes (public transport about 5%, and active mobility about 15%). The analysed area lacks of a real vision of an integrated transportation system where public transport and the other transport modes should be combined. Moreover, the only public transport system is represented by bus lines. In the most recent years, a certain attention has been directed towards the soft mobility, through the realization of pedestrian and cycling paths, but there is still much to be done, and just for these reasons, we chose to deepen this issue through the proposed work. As shown in Figure 1, the selected routes allow the pedestrian connection from the historical centre to the campus, which is one of the main points of interest of the whole area. The paths cross neighbourhoods with different urban configurations and mainly suited to residential and commercial activities.

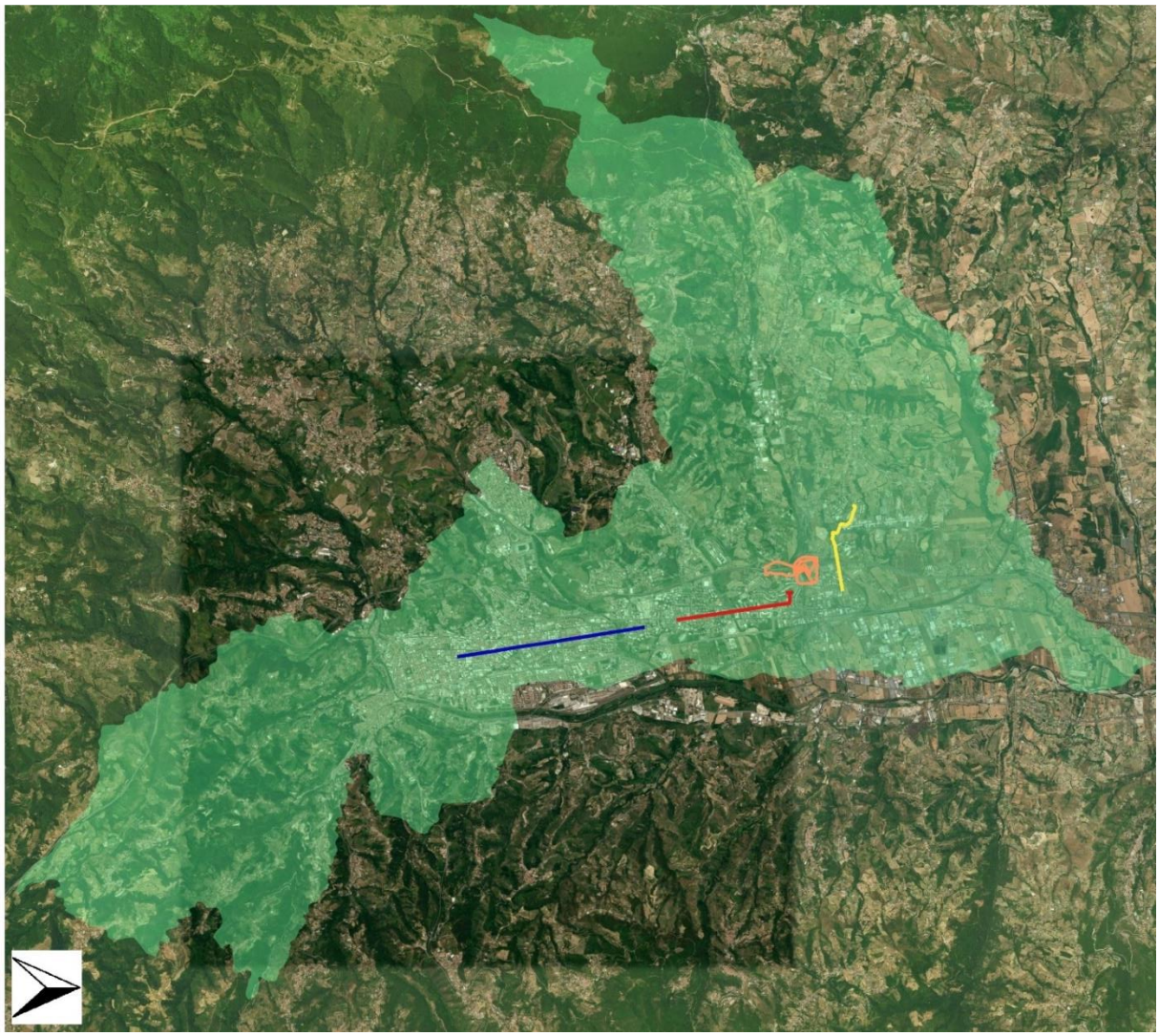


Fig. 1. Pedestrian paths location: path 1 (blue), path 2 (red), path 3 (orange), path 4 (yellow).

Pedestrian paths differ in terms of width, pavement, and other characteristics. The walkways have a length varying from 1.4 to 2.2 kilometres and a width from 1.8 to 3.0 metres. The sidewalk covers the entire length of the paths, except for walkway 4 where 35% of the path is not provided side by side with the sidewalk. Path 1 is characterized by a large number of crosswalks and bus stops, and a considerable number of shops per kilometre. Differently, the number of crosswalks and bus stops

are minimal along the other walkways, although path 4 is characterized by a very high number of shops per kilometre (Table 1).

Table 1. Characteristics of the four pedestrian paths.

	Path 1	Path 2	Path 3	Path 4
Length [km]	1.4	2.2	1.8	1.7
Width [meters]	3.0	2.5	2.0	1.8
Sidewalk [km]	1.4	2.2	1.8	1.1
Crosswalk [No./km]	24.7	11.3	7.1	7.6
Shops [No./km]	15.6	2.7	0.0	36.2
Bus stops [No./km]	4.2	0.0	1.7	1.8
Bikeway [km]	1.4	2.2	1.5	0.0
Lighting	every 20 meters	every 20 meters	every 40 meters	every 25 meters
Type of area	Residential, commercial	Residential, commercial	Residential	Residential, commercial

On path 1 (Google Maps coordinates: 39.310888, 16.253759 - 39.324244, 16.250958), the pavement is partly made of a mixture of cement and red gravel, and partly of red concrete slabs. The lighting is adequate, and the path is quite equipped, although the route would need some maintenances (Figure 2a). Along the path, there are trees of different types, fountains for the distribution of drinking water, benches and seats. In addition, some points are positioned along the route to carry out free body exercises (benches, bars, etc.) together with signs advising the exercises to be performed and the total route. On one side along the entire pedestrian path, there is also a bikeway.



Fig. 2. (a) Path 1 - Viale G. Mancini; (b) Path 2 - Viale Principe; (c) Path 3 – Villaggio Europa; (d) Path 4 - Quattromiglia.

Path 2 (Google Maps coordinates: 39.329476, 16.249460 - 39.346320, 16.246230) is made up of one side lane entirely equipped with sidewalk and a bike lane for each direction of travel. As path 1, this walkway has been recently built; therefore, the pedestrian paths are in good condition, with paved sidewalks, lighting, green spaces, benches, waste bins. Path 2 allows a quick connection between the most important residential neighbourhoods of the northern urban area. It runs alongside

two vehicle lanes; the route has level access roads to the lanes intended for cars, horizontal and vertical signs, and is entirely lined with flowers and trees. The flooring of the walkway is made of natural stone, which is waterproof, anti-slip and anti-freeze, resistant to loads and atmospheric agents as well as to sudden changes in temperature, with a low propensity to mould and stains. Warm light street lamps and benches are frequent along the path, but there are no public toilets (Figure 2b).

Path 3 (Google Maps coordinates: 39.342798, 16.238917- 39.350784, 16.237747) is located inside a peripheral residential neighbourhood. The pavement is made up of a layer of fine-grained bituminous conglomerate (wear mat) coloured in red. Warm light street lamps are rare along the path; therefore, the lighting is not sufficient. The route is free of obstacles (grills, benches, fountains, bus stop, etc.) and without public toilets and commercial premises. In some sections of the pedestrian path, there is also a 1.5 km long bikeway (Figure 2c).

Path 4 (Google Maps coordinates: 39.354163, 16.242449 - 39.355651, 16.227092) connects neighbourhood rich in residential and commercial activities with the University campus of the urban area; it is characterized by a marked heterogeneity regarding construction materials, walking surface, commercial activities, equipment arranged along the path. This is the sole path without specific facilities for cycling, although university students used this path also for reaching the campus by bike (Figure 2d).

3.2 Data collection

We conducted a survey for collecting pedestrians' perceptions of the walkways. Participants were randomly selected from the population of people walking on the selected paths. Face-to-face interviews were addressed to pedestrians stopped by the interviewers who asked them to answer questions; when a pedestrian did not wish to answer the questionnaire, the interviewer took this into account. The survey was performed from 8:00 a.m. to 9:00 p.m. in the period of September-October 2019 (Bellizzi et al., 2019). At the same time, the average daily pedestrian flow was counted on the walkways. For calculating the sample size, we referred to the walking share of the total daily trips made by the inhabitants of the urban area. We considered the walking share rather than the whole population resident in the city because our survey is addressed to the users of the pedestrian paths, and not also to the potential users. Finally, a sample of 220 pedestrians was selected, from a minimum of 48 to a maximum of 68 pedestrians per path. Considering a 95% level of confidence, and a margin of error of 5%, the minimum sample size would be higher than our 220 samples. Really, we conducted more than 220 interviews, but we had to reject some of them because of incongruence and incompleteness of the data. Anyway, the dimension of the sample assures a margin of error of about 0.06, rather than the usual error of 0.05 (5%). Given that the acceptable margin of error usually falls between 4% and 8% at the 95% confidence level, we can consider as representative our sample of 220 pedestrians. Sample response rates were quite good, ranging from 35% for the walkway 4 to 56% for the walkway 3 (Table 2). Response rates were calculated by considering people stopped by the interviewers and people who completed the questionnaire. During the counting of flows, data collectors made a note of the gender of people walking on the paths, and interviewers stopped people by trying to respect the distribution between males and females.

The questionnaire is structured in different sections where data regarding the general perceptions of the whole path, and perceptions in a specific point of the path were requested. In addition, the questionnaire includes socio-demographic characteristics (such as age, gender, employment and marital status, place of residence and number of family members), and questions regarding trip origin and destination, travel time, trip frequency and purpose. The factors considered relevant by pedestrians were selected consulting experts and focus groups. A pilot study was applied before launching the main survey (Vallejo-Borda et al., 2020a).

Firstly, the overall satisfaction about the walkway was requested by using an 11-point verbal scale ranging from 0 (totally unsatisfied) to 10 (totally satisfied). Afterwards, pedestrians were requested

to express their comfort level concerning some aspects, and their degree of nuisance due to presence of certain elements along the whole path or in a specific point. Also in these cases, an 11-point scale was adopted ranging from 0 (totally uncomfortable or absence of nuisance) to 10 (totally comfortable or high degree of nuisance).
Additional questions refer to the degree of protection perceived in a specific point of the path and the evaluation of some aspects, by using an 11-level verbal scale, where 0 corresponds to very bad and 10 to excellent. An evaluation of the current service quality of the pedestrian path is also requested, by using the same scale. At this point of the questionnaire, pedestrians have all the elements to answering a question about the overall service quality, because they already answered to all the questions concerning the various specific aspects that contribute to the broad construct of pedestrian service quality. So, they are able to give a general opinion about service quality, as they have a clear idea of all the aspects determining service quality.
Lastly, we request a level of agreement/disagreement regarding the following statements: "I would prefer not to walk on this pedestrian path", "Walking on this pedestrian path is comfortable", and "Walking on this pedestrian path is pleasant". An 11-point Likert scale ranging from 0 (totally disagree) to 10 (totally agree) was adopted.
We used 11-point Likert scales as provided for in the original version of the questionnaire (Vallejo-Borda et al., 2020a, 2020b). This type of scale is widely used in the literature (de Oña et al., 2013, 2015, 2018; Díez-Mesa et al. 2018). As found by Lozano et al. (2008), the reliability of Likert scales decreases as the number of response options is reduced. In addition, respondents prefer formats with a larger number of response alternatives, because they can more clearly express their point of view (Muñiz et al., 2005).

3.3 Sample characteristics and perceptions

Table 2 highlights the differences of the sample among the walkways. The differences in the use of the analysed walkways are especially due to their position inside the city.
First of all, the distribution of the samples between male and female differ among the various paths; path 1 is more frequented by male and path 4 by female, while for the other two ones the sample is spread almost equally in terms of gender. Anyway, our total sample (51% of female *vs* 49% of male) reflects the actual proportion in terms of gender of the population resident in the urban area, inhabited by 48% of male and 52% of female. In addition, the population of the university students is composed of more females than males (57% for female vs 43% for male), as per path 4 where only students walk. Although there is a slight under-representation of females as regards males of this specific group representing 20% of the inhabitants in the analysed urban area, we did not need to make any adjustment for bias.
Concerning age, we can see that path 4 is frequented by young people, being a path used by students for reaching university; it is also the most frequently used in general, as we can observe by the average daily pedestrian flows reported in table 2. All the statistics for this path confirm that the sample is composed only by students, while the other three paths are frequented by people belonging to different categories. More specifically, path 1 and 2 are prevalently used by young employed male, single or married, walking for sport training and shopping, while path 3 is mostly used by older retired person, prevalently single but with a relevant percentage of widowers, who use the path for sport training or other secondary trip purposes; the path is also used by resident students for reaching the local school.
The sample is mainly composed of students and employed persons, who walk prevalently for studying or sport training, and with a certain frequency.
Preliminary statistics regarding the perceptions of pedestrians about the walkways were calculated. From an analysis of the single walkways, it emerged that path 2 and 3 are quite appreciated, registering an average overall satisfaction higher than 7. Conversely, path 1 and 4 are less satisfactory than the other paths. The degree of comfort is satisfying for pedestrians walking on path 2 and path 3. Specifically, the pedestrians walking on path 2 mainly appreciated the comfort in

terms of presence of other pedestrians; whereas the users of path 3 appreciated the comfort due to the presence of the shade of trees. On the contrary, path 1 and path 4 are best evaluated in relation to the degree of nuisance due to bicycles. The degree of nuisance due to vehicles is higher for path 4. Unlike the other paths where there is a clear separation between the pedestrian route and the vehicular lanes, on path 4 vehicles pass very close to pedestrians and there are few marked pedestrian crossings. The degree of comfort related to aspects such as temperature, lighting, cleanliness, was judged with the lowest values by the users on path 4. The same considerations can be made for the degree of protection. Also in this case, path 4 has the lowest ratings. In the evaluation of construction aspects of the path, it emerged that path 4 is evaluated as the worst. Analysing the individual evaluations, it is possible to make further considerations. The path width evaluation assumes roughly the same values for path 1, path 2 and path 3. The users of path 3 gave low marks to the evaluation of the condition of the walking surface. All the other evaluated aspects have low marks for path 1 compared to path 2 and path 3.

Table 2. Characteristics of the sample.

		Path 1	Path 2	Path 3	Path 4	All
Interviewed pedestrians [No.]		48	54	50	68	220
Response rate [%]		55	40	56	35	47
Av. pedestrian flow [No./day]		296	362	292	1351	1722
Gender	Female [%]	35.4	48.1	54.0	61.8	51%
	Male [%]	64.6	51.9	46.0	38.2	49%
Average age [years]		46	39	50	24	41
Employment status	Employed [%]	41.6	46.3	22.0	0.0	25.5
	Student [%]	6.3	37.0	36.0	100.0	49.5
	Unemployed [%]	18.7	7.4	8.0	0.0	7.7
	Retired persons [%]	29.2	9.3	34.0	0.0	16.4
	Other [%]	4.2	0.0	0.0	0.0	0.9
Marital status	Single [%]	31.3	35.2	40.0	79.4	49.1
	Engaged [%]	12.4	16.7	6.0	20.6	14.6
	Married [%]	54.2	38.8	32.0	0.0	28.6
	Divorced [%]	2.1	7.4	2.0	0.0	2.7
	Widower [%]	-	1.9	20.0	0.0	5.0
Trip purpose	Work [%]	20.8	3.7	6.0	0.0	6.8
	Study [%]	4.2	11.1	28.0	95.6	39.5
	Sport training [%]	50.0	57.4	34.0	1.5	33.2
	Shopping [%]	25.0	22.2	10.0	2.9	14.1
	Other [%]	0.0	5.6	22.0	0.0	6.4
Frequency	Many times a day [%]	20.8	1.8	16.0	51.5	24.5
	Once a day [%]	27.1	27.8	42.0	33.8	32.7
	Once a week[%]	29.2	50.0	28.0	7.4	27.3
	Once every 10 days [%]	4.2	13.0	10.0	2.9	7.3
	Rarely [%]	18.7	7.4	4.0	4.4	8.2

These differences emerged also by considering the mean values calculated for each group of attributes characterizing the paths. In general, from the values reported in table 3, we can observe that the level of comfort is very scant in terms of presence of public toilets and also odour, while for the other aspects pedestrians are barely satisfied, registering values between 5 and 6. By analysing the rates expressed for the various elements that can represent a nuisance during the walking, we can observe that pedestrians are mainly annoyed by the presence of vehicles, and less by bicycles. Pedestrian do not feel much protected along the walkways, in fact they expressed low degrees of protection especially against theft or robbery, adverse weather, and stray dogs. Other characteristics of the paths, evaluated from bad to excellent, received rates around 5, so pedestrians are neither satisfied nor unsatisfied.

Table 3. Preliminary statistics about pedestrians' perceptions (average values of evaluation rates).

Questions	Abbreviations	Path 1	Path 2	Path 3	Path 4	All
Degree of comfort due to the presence of other pedestrians	ComPed	6.4	6.7	6.8	5.5	6.3
Degree of comfort due to the presence of public toilets	ComToil	0.6	3.3	3.9	1.6	2.3
Degree of comfort due to the presence of shops	ComShop	5.1	6.3	6.0	5.8	5.8
Degree of comfort due to the presence of the shade of trees	ComShade	4.9	6.6	7.2	3.3	5.4
Degree of comfort due to the presence of street vendors	ComVend	2.4	5.4	5.1	3.7	4.1
Degree of nuisance due to flow of bicycles	BikeFlow	4.6	6.0	5.6	1.6	4.3
Degree of nuisance due to high-speed bicycles	BikeSpeed	4.9	6.6	6.3	1.4	4.6
Degree of nuisance for bicycles going in the opposite direction to mine	BikeOpp	4.4	6.9	6.3	1.6	4.6
Degree of nuisance for bicycles passing me	BikePass	4.3	6.7	6.4	1.8	4.6
Degree of nuisance for elements that obstruct the passage	ObstrPass	3.4	5.5	5.6	4.6	4.8
Degree of nuisance for parked scooters	ParkScoot	2.5	4.9	5.7	2.5	3.8
Degree of nuisance due to the width of the traffic lane	LaneWidth	3.5	4.8	4.4	4.4	4.3
Degree of nuisance due to the number of vehicular lanes	LaneNum	3.5	5.0	4.5	4.6	4.4
Degree of nuisance due to vehicle flow	FlowVeh	4.5	6.4	5.7	6.9	6.0
Degree of nuisance due to truck and bus flow	FlowTruck	4.1	5.7	5.8	7.6	6.0
Degree of nuisance due to vehicle speed	FlowSpeed	5.8	7.2	6.8	7.2	6.8
Degree of nuisance due to pollution	FlowPoll	6.5	7.3	6.8	8.3	7.3
Degree of nuisance due to noise	FlowNoise	5.8	7.6	7.0	8.3	7.3
Degree of comfort by temperature	ComTemp	4.9	6.9	7.0	3.8	5.6
Degree of comfort for lighting	ComLight	6.7	6.7	6.4	4.4	5.9
Degree of comfort due to odor	ComOdor	5.0	6.1	5.5	3.4	4.9
Degree of comfort for the environment near the walkway	ComEnv	5.5	6.5	6.9	3.9	5.6
Degree of comfort for cleaning	ComClean	6.3	6.4	6.1	2.9	5.2
Degree of comfort for landscape	ComLand	5.1	6.8	7.0	4.1	5.7
Degree of protection against theft or robbery	SafeTheft	4.9	3.6	4.9	3.1	4.0
Degree of protection from accidents on the pedestrian path	SafePath	5.8	4.9	5.6	3.3	4.8
Degree of protection against accidents with vehicles	SafeAcc	5.3	5.0	5.6	3.4	4.7
Degree of protection from adverse weather	SafeWeath	3.0	3.2	4.7	2.3	3.2
Degree of protection from stray dogs	SafeDogs	4.9	2.9	4.5	1.9	3.4
Evaluation of the width of the pedestrian path	ComWidth	6.3	6.6	6.5	3.1	5.4
Evaluation of the continuity of the pedestrian path	ComCont	5.8	6.4	5.8	2.6	5.0
Evaluation of the condition of the walking surface	ComSurf	6.1	6.1	5.4	2.7	4.9
Evaluation of the furnishings	ComFurn	5.3	6.4	6.4	2.2	4.9
Evaluation of the tree presence	ComTree	5.4	6.9	7.2	3.2	5.5
Evaluation of the architecture of the facades	ComFacade	5.1	6.5	6.4	3.7	5.3
Evaluation of access to public transport	ComPT	3.9	6.1	6.6	5.3	5.5
Evaluation of the demarcation of the pedestrian path	ComPath	6.0	6.7	6.3	3.6	5.5
Walking on this pedestrian path is comfortable	SQCom	6.1	6.4	6.5	3.0	5.3
Walking on this pedestrian path is pleasant	SQPleasant	6.2	7.1	6.9	3.3	5.7
Evaluation of the current service quality of the pedestrian path	SQPath	5.4	6.8	6.4	2.6	5.1
Evaluation of the degree of satisfaction in using the pedestrian path	SAT	5.8	7.4	7.1	5.3	6.3
I would prefer not to walk on this pedestrian path	BI	3.7	4.4	3.7	5.3	4.4

Finally, even if pedestrians judge as barely pleasant and comfortable walking on the various paths, and they are sufficiently satisfied with them, they would not prefer to walk on these paths.

4. Methodology and results

4.1 Model formulation

The collected data were analysed in order to highlight statistical gender differences in pedestrians' perceptions. The sample of interviewed users included two subsamples (male and female) which were assumed to be independent. The presence of statistically significant differences between the perceptions of male and female was tested by carrying out the analysis of variance (ANOVA). In particular, the Fisher F-test was performed for each variable for evaluating the variation between groups and testing the differences among means. For the ANOVA F-test, the null-hypothesis to be rejected implies that perceptions on pedestrian paths do not depend on gender. Statistically significant differences between the means were recorded for 19 questions, out of a total of 37 questions introduced in the survey. This means that there are differences in pedestrians' perceptions about these 19 aspects between female and male. The difference between female and male are not significant in relation to comfort due to the presence of public toilets and to the presence of shops. A possible explanation is that along all the paths there are not public toilets and there are few shops. No significant differences were found for degree of nuisance due to bicycles that pass the pedestrians or go in the opposite direction, for degree of nuisance due to elements that obstruct the passage and parked scooters, and for degree of nuisance due to vehicles speed. Regarding the degree of comfort, in the evaluation of temperature, lighting, closed environment and landscape, the difference in the rate given by female and male are not significant. Gender are not relevant in the evaluation of degree of protection from accidents and from adverse weather; and in the evaluation of the width of the pedestrian path, of the architecture of the facades, of access to public transport and of demarcation of the pedestrian path.

In terms of comfort, women are less satisfied than men concerning various different aspects like odour, cleanliness, shade of trees but also characteristics of the walkways such as condition of walking surface or presence of furnishings. Also, the presence of other pedestrians is an aspect which leads to a decrease of comfort for female. On the other hand, the presence of bicycles causes more nuisance to male than female, who are instead more annoyed by the presence of vehicles that cause also problems of pollution and noise. Finally, female feel less safe and protected than male.

Table 4. ANOVA F-test for the pedestrians' perceptions (M, male and F, female)

Variables	M	F	F-test	p-values
ComPed	6.56	6.05	3.594	0.059
ComShade	5.65	5.06	2.864	0.092
BikeFlow	4.59	3.92	3.371	0.068
BikeSpeed	4.92	4.21	2.903	0.090
LaneWidth	4.03	4.57	3.219	0.074
LaneNum	4.13	4.70	3.297	0.071
FlowVeh	5.52	6.42	7.976	0.005
FlowTruck	5.49	6.43	8.610	0.004
FlowPoll	7.02	7.59	4.149	0.043
FlowNoise	6.78	7.81	12.992	0.000
ComOdor	5.16	4.64	2.864	0.092
ComClean	5.60	4.85	5.309	0.022
SafeTheft	4.50	3.58	5.214	0.023
SafeAcc	5.04	4.53	2.808	0.095
SafeDogs	3.94	2.87	6.217	0.013
ComCont	5.37	4.56	6.108	0.014
ComSurf	5.32	4.51	6.763	0.010
ComFurn	5.16	4.58	2.880	0.091
ComTree	5.77	5.21	2.841	0.093

In the next step of the methodology, these 19 questions were considered as variables in the modelling approach (Table 4).

An Explorative Factor Analysis (EFA) was conducted for understanding the relationships among pedestrians' perceptions about path characteristics (i.e. the questions included in the survey) and for defining sets of variables that are highly interrelated, known as factors. These factors correspond to concepts that cannot be directly observed and adequately described by a single measure (Hair et al., 2010). EFA was performed by considering the whole sample of pedestrians in order to obtain the same factors for both male and female models.

Several attempts of EFA were made by eliminating the variables that seemed weakly correlated with the others. The final EFA was performed considering 17 variables, which were grouped into five factors (Table 5). Kaiser-Meyer-Olkin measure of sampling adequacy is higher than 0.8, and Barlett test of sphericity is statistically significant and therefore, sufficient correlations exist among the variables (Barlett, 1954; Kaiser, 1970). The factor loadings of the variables considered in each factor are all greater than 0.5. The total variance explained by the five factors is 77.7%. Factor 1 (Com) consists of comfort variables; factor 2 (Flow) of variables relating to the degree of nuisance due to the vehicular flow; factor 3 (Lane) concerns the degree of nuisance related to the presence and characteristics of lanes for the circulation of vehicles; factor 4 (Safe) is related to safety and security aspects; and factor 5 (Bike) is defined by variables relating to the interaction of pedestrians with the flow of bicycles (Table 5).

Table 5. Explorative Factor Analysis (EFA).

Factors	Variables	Factor loadings				
		F1	F2	F3	F4	F5
Com	ComSurf	0.871	-0.117	-0.120	0.069	0.132
	ComCont	0.860	-0.214	0.030	0.034	0.120
	ComFurn	0.837	-0.045	-0.054	0.224	0.280
	ComClean	0.815	-0.102	-0.014	0.199	0.169
	ComTree	0.660	0.004	-0.058	0.184	0.381
	ComOdor	0.611	-0.285	0.159	0.283	0.058
Flow	FlowNoise	-0.143	0.868	0.145	-0.208	-0.040
	FlowPoll	-0.167	0.843	-0.002	-0.291	0.035
	FlowTruck	-0.262	0.684	0.430	-0.018	-0.170
	FlowVeh	-0.038	0.638	0.559	-0.073	-0.091
Lane	LaneNum	0.013	0.141	0.923	-0.051	0.004
	LaneWidth	-0.015	0.139	0.917	-0.052	0.040
Safe	SafeTheft	0.097	-0.218	-0.082	0.867	-0.061
	SafeDogs	0.191	-0.070	-0.053	0.770	0.158
	SafeAcc	0.378	-0.249	-0.011	0.640	-0.017
Bike	BikeSpeed	0.312	-0.074	-0.014	0.033	0.913
	BikeFlow	0.305	-0.054	0.027	0.024	0.907

The factors were named taking into consideration how the questionnaire was designed. Anyway, a useful comparison was made with the factors defined in similar literature studies. In the study of Vallejo-Borda et al. (2020), EFA returns seven factors. Some of them are very similar to the factors derived from our EFA. Specifically, they defined one factor including aspect related to the perception of sidewalk characteristics (sidewalk width, condition, furniture, trees, signage, and public transit access); another one regards weather, lighting, odour, environment, cleanliness, and landscape present on a sidewalk. A third factor concerns road width, number of vehicular lanes, HGV flow, vehicular speed, and noise. A fourth factor considers the interaction with other pedestrians and the perceived stress on the infrastructure, while another factor relates to interactions with bikes in terms of speed and flow. A sixth factor explains safety and security on a sidewalk, and a last factor regards amenities such as restrooms, shops, and shade on the sidewalk. In a less similar study, proposed by Bivina and Parida (2019), the EFA results show four factors: the first one relates to attributes such as good sidewalk surface, wider and continuous sidewalks, presence of bus shelters, absence of encroachment, pedestrian amenities and facilities for people with disability; the second one consists of the absence of obstructions and cleaner sidewalks; the third one relates to

security from crime and theft, but differently from our work, it includes aspects like police patrolling, CCTV cameras, street lighting; and the last one includes items such as traffic speed and traffic volume. Finally, in another study proposed by Jahan et al. (2020) three factors were defined: one factor focuses on the physical aspects of the path, such as width and height of the sidewalk, surface condition, obstruction-free movement over sidewalk, cleanliness, drainage facilities; another factor regards security from robbery and harassment, lighting facilities; the last factor is very different from the factors proposed in the present work because it includes the undesirable movement of bike and motorcycle, vending activities, parking of light vehicles and crowd of passengers for buses over the sidewalk.

After EFA, a Structural Equation Modelling (SEM) approach was adopted. SEM was widely used for analysing service quality in the field of transportation because the involved variables are multidimensional and difficult to observe directly (de Oña et al., 2016; Allen et al., 2019; Allen et al., 2020). SEM allows the analysis considering latent variables that can be measured indirectly through a set of measurable indicators derived from the data collected from the survey.

As well-known, literature deals with two different approaches of SEM. The conventional approach, namely Covariance-Based SEM (CB-SEM), is used to verify a set of systematic relationships among multiple variables that can be tested empirically. The hypotheses on these relationships can be confirmed or rejected by determining how well a proposed theoretical model can estimate the covariance matrix for a sample data set (Bollen, 1989). The second and less used approach, namely Partial Least Squares SEM (PLS-SEM), is largely used to test service quality interrelations from available data when there is very limited theoretical support and the research has an exploratory purpose (Mandhani et al., 2020). For these reasons, a PLS-SEM was performed in our work. More, PLS-SEM allows to establish service quality interrelations for male and female passengers separately, as highlighted in Mandhani et al. (2021), who employed an integrated Bayesian Networks and PLS-SEM approach to explore if gender disparity exists in perceptions of metro rail transit service quality. Finally, this approach was chosen also because it works well even with small samples and data not distributed according to the normal distribution (Hair et al. 2011).

The first step of the adopted methodology consisted in defining the research hypotheses and drawing the path model for displaying the variable relationships. Path models are made up of the structural model (or inner model), which describes the relationships between the latent variables, and the measurement models (or outer models), which describe the relationships between the latent variables and their measures (or indicators) (Hair et al., 2017). The computation of the coefficients related to the link between the constructs is based on a series of regression analyses (Sarstedt et al., 2021).

The factors defined through EFA were used as independent (or exogenous) latent variables in the PLS-SEM, together with the following latent dependent (or endogenous) variables: Service Quality (SQ), Satisfaction (SAT) and Behavioural Intention (BI). Specifically, SQ is explained by the level of agreement expressed by pedestrians concerning comfort and pleasantness of the path, and the level of overall service quality. SAT is linked to the degree of satisfaction expressed by pedestrian in using the various paths. Finally, BI is linked to the preference to walk on the paths. Behavioural intentions were investigated for a long time (Ajzen and Fishbein, 1980). According to the theory of planned behaviour, behavioural intentions show whether a customer continues to utilise a service or switch to a different provider (Zeithaml, Berry, and Parasuraman 1996). More recently, the concept of behavioural intention has been considered together with the concepts of service quality and customer satisfaction (de Ona et al., 2016). In this study, we linked behavioural intention to the question “I would prefer not to walk on this pedestrian path”, as shown in table 3, which could represent an intention to continue to use the path or switch to a different one.

PLS-SEM was elaborated for investigating the relationships between service quality, satisfaction and behavioural intentions. The indicators of the latent variables included in the models are the questions described in table 3.

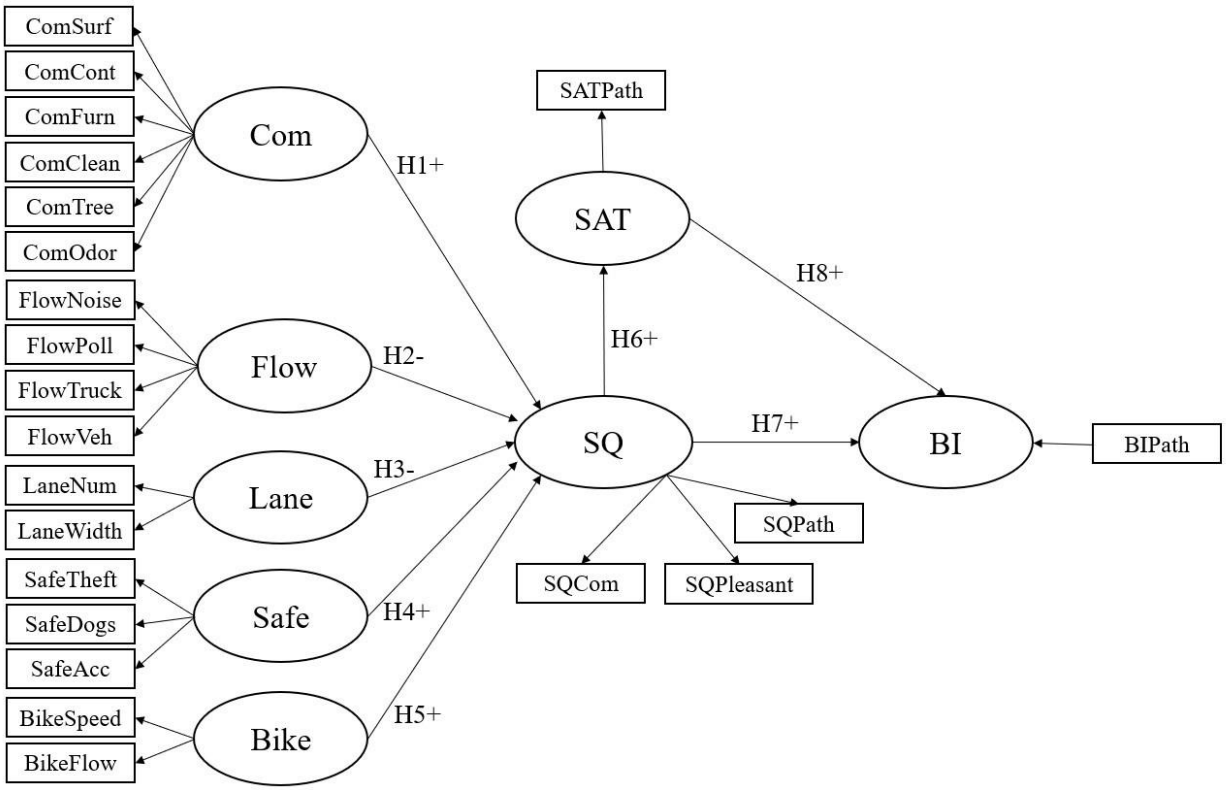


Fig. 3. PLS-SEM model.

We make the following hypotheses (Figure 3): Com has a positive impact on SQ(H1); Flow should have a negative impact on SQ, being the questions expressed in terms of degree of nuisance (H2), as well as Lane (H3); for Safe a positive impact is hypothesized on SQ, being the questions expressed in terms of degree of protection (H4); for Bike a positive impact is hypothesized on SQ because the presence of bikes could be perceived as positive by pedestrians although the questions are expressed in terms of degree of nuisance (H5); SQ has a positive impact on SAT (H6); SQ has surely a positive impact on BI (H7); also for SAT a positive impact on BI is hypothesized (H8). These hypotheses were tested running the same PLS-SEM model for male and female separately. PLS-SEM were developed using SmartPLS3.0 software (Ringle et al., 2015).

4.2 Model results

As reported in Sarstedt et al. (2021), evaluating PLS-SEM results involves completing two stages: the first one addressing the investigation of measurement models, and the second one focusing on the structural model evaluation, if the previous evaluation provides support for the measurement quality. For interpreting the adequacy of the results, researchers have developed numerous guidelines and rules of thumb. A rule of thumb should not be strictly interpreted for every situation in the decision-making process, and the threshold for a rule of thumb may vary depending on the research context.

Firstly, we have to examining the indicator loadings. Loadings above 0.7 indicate the construct explains more than 50% of the indicator's variance, demonstrating a satisfactory degree of item reliability (Sarstedt et al., 2021). Indicator loadings reported in table 6 showed satisfactory degree of reliability for almost all the items.

Table 6. Construct validity and reliability (M, male and F, female).

Latent variables	Indicators	Indicator loadings		AVE		Composite Reliability		Cronbach's Alpha		rho_A	
		M	F	M	F	M	F	M	F	M	F

Com	ComSurf	0.835	0.888	0.662	0.701	0.921	0.933	0.896	0.939	0.901	0.943
	ComCont	0.878	0.853								
	ComFurn	0.870	0.938								
	ComClean	0.809	0.877								
	ComTree	0.768	0.771								
	ComOdor	0.708	0.670								
Flow	FlowNoise	0.849	0.884	0.721	0.668	0.911	0.888	0.878	0.833	0.970	0.865
	FlowPoll	0.719	0.862								
	FlowTruck	0.914	0.836								
	FlowVeh	0.899	0.668								
Lane	LaneNum	0.948	0.895	0.919	0.876	0.958	0.934	0.913	0.874	0.953	1.217
	LaneWidth	0.969	0.976								
Safe	SafeTheft	0.690	0.887	0.583	0.708	0.805	0.879	0.690	0.798	0.779	0.850
	SafeDogs	0.692	0.756								
	SafeAcc	0.982	0.875								
Bike	BikeSpeed	0.981	0.973	0.949	0.943	0.974	0.971	0.947	0.939	0.989	0.943
	BikeFlow	0.968	0.969								
SQ	SQCom	0.924	0.917	0.832	0.829	0.937	0.935	0.899	0.896	0.902	0.897
	SQPleasant	0.942	0.929								
	SQPath	0.870	0.889								
SAT	SATPath	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
BI	BIPath	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

The assessment of the constructs' internal consistency reliability is tested performing the Average Variance Extracted (AVE), the Composite Reliability coefficient, the Cronbach's Alpha coefficient and rho_A coefficient (Table 6). The values of AVE of all indicators are higher than 0.5, as reported in Fornell and Larcker (1981). For all indicators the values of Composite Reliability exceeded 0.7, (Bagozzi and Yi, 1988). Cronbach's Alpha scores are greater than 0.7 (Nunnally and Bernstein, 1994), a sign of high level of reliability. The rho_A coefficients are all higher than 0.7 and demonstrate the reliability of PLS models for these data (Wong, 2019). Based on these results, the convergent validity of the PLS-SEM for male and female sample is confirmed.

For assessing discriminant validity, Fornell-Larcker criterion, Cross-loading and Heterotrait-Monotrait Ratio of Correlation (HTMT) were tested (Hair et al., 2017). Fornell-Larcker criterion check that the square root of AVE for each constructs is greater than the interconstruct correlation. As reported in table 7, this condition is verified for all the latent variables. Cross-loading consists in verifying that the loadings of each indicator on its construct are higher compared to the cross loadings on other constructs. This condition was also verified.

Table 7. Discriminant validity test (M, male and F, female).

Latent variables	BI		Bike		Com		Safe		SAT		SQ		Flow		Lane	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
BI	**1.00**	**1.00**														
Bike	0.06	0.26	**0.97**	**0.97**												
Com	0.31	0.36	0.25	0.72	**0.81**	**0.84**										
Safe	0.21	0.22	0.06	0.27	0.47	0.51	**0.76**	**0.84**								
SAT	0.26	0.36	0.18	0.43	0.64	0.65	0.29	0.29	**1.00**	**1.00**						
SQ	0.35	0.50	0.29	0.68	0.65	0.66	0.48	0.46	0.69	0.63	**0.91**	**0.91**				
Flow	-0.43	-0.35	-0.14	-0.24	-0.31	-0.42	-0.38	-0.44	-0.11	-0.25	-0.36	-0.49	**0.85**	**0.82**		
Lane	-0.36	-0.08	0.01	0.02	-0.08	0.01	-0.19	0.01	-0.07	0.06	-0.21	-0.06	0.51	0.39	**0.96**	**0.94**

Heterotrait-Monotrait Ratio of Correlation is a method to evaluate discriminant validity in PLS-SEM. Many studies (Henseler et al., 2015, Valaei and Nikhashemi, 2017) suggest that the discriminant validity is confirmed between two reflective constructs if the values are lower than 0.9. For our models, this requirement is true for all constructs (Table 8).

Table 8. Heterotrait-Monotrait Ratio of Correlation (M, male and F, female).

Latent	BI		Bike		Com		Safe		SAT		SQ		Flow		Lane	
variables	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
BI																
Bike	0.053	0.269														
Com	0.316	0.381	0.264	0.771												
Safe	0.246	0.249	0.150	0.304	0.500	0.587										
SAT	0.257	0.363	0.178	0.438	0.675	0.688	0.261	0.301								
SQ	0.364	0.529	0.315	0.741	0.843	0.849	0.477	0.512	0.726	0.662						
Flow	0.465	0.400	0.141	0.256	0.343	0.454	0.502	0.526	0.114	0.269	0.364	0.550				
Lane	0.378	0.092	0.024	0.036	0.098	0.101	0.276	0.051	0.068	0.058	0.223	0.073	0.519	0.476		

For the assessment of the structural model, firstly, we have to check for potential collinearity issues among the constructs; then, we have to consider the significance and relevance of the structural model relationships (i.e., the path coefficients) as well as the model's explanatory and predictive power. Collinearity has to be tested by calculating Variance Inflation Factor (VIF). According to Hair et al. (2011) in our models there are no collinearity problems among the latent variables because VIF values are lower than 5 (Table 9).

Table 9. Variance Inflation Factor (M, male and F, female).

	SQ		SAT		BI	
	M	F	M	F	M	F
SQ			1.000	1.000	1.910	1.647
SAT					1.910	1.647
BI						
Com	1.405	2.788				
Flow	1.906	1.652				
Lane	1.384	1.249				
Safe	1.408	1.540				
Bike	1.088	2.120				

The results reported in table 10 show that the hypotheses made before performing the PLS-SEM are all supported for male (the signs of the coefficients are correct), while for female H3 and H4 hypotheses have to be rejected because the signs of the coefficients are not congruent with the assumed ones. This means that women do not perceive as a nuisance the presence of traffic lanes near the pedestrian path. On the contrary, the degree of protection from some risk aspects does not increase service quality for women. All the relationships are statistical significant at 1%.

Table 10. Structural path results (M, male and F, female).

Hypotheses	Relationship			Coefficients		p-values			
				M	F	M	F	M	F
H1	Com	-->	SQ	0.775	0.694	***	***	Supported	Supported
H2	Flow	-->	SQ	-0.012	-0.173	***	***	Supported	Supported
H3	Lane	-->	SQ	-0.128	0.006	***	***	Supported	*Rejected*
H4	Safe	-->	SQ	0.075	-0.014	***	***	Supported	*Rejected*
H5	Bike	-->	SQ	0.099	0.146	***	***	Supported	Supported
H6	SQ	-->	SAT	0.690	0.627	***	***	Supported	Supported
H7	SQ	-->	BI	0.322	0.450	***	***	Supported	Supported
H8	SAT	-->	BI	0.035	0.081	***	***	Supported	Supported

*** significant at 1%

Finally, the coefficient of determination (R^2) measures the variance explained in each of the endogenous constructs and it is therefore a measure of the model's explanatory power. The R^2 ranges from 0 to 1, with higher levels indicating a higher degree of explanatory power. As a rough rule of thumb, the R^2 values of 0.75, 0.50, and 0.25 can be considered substantial, moderate, and weak, respectively (Hair et al. 2011; Sarstedt et al. 2021).

Table 11. Coefficients of determination (M, male and F, female).

Latent variables	R^2	
	M	F
SQ	0.752	0.777
SAT	0.476	0.393
BI	0.121	0.255

The values of R^2 for each latent endogenous variable are reported in table 11. PLS-SEM models showed that the latent constructs Com, Flow, Lane, Safe and Bike substantially explain the variance in SQ (R^2 is 0.752 for male and 0.777 for female) and moderately explain the variance in SAT (R^2 is 0.476 for male and 0.393 for female). On the other end, SQ and SAT explain only 12.1% and 25.5% of the variance of BI.

5. Discussion

Interesting findings emerge from the models in terms of comparison between male and female, both in terms of similarities than differences. Like Vallejo-Borda et al. (2020), who inspired us in the proposal of the questionnaire, we can confirm that variables concerning sidewalk characteristics, externalities, nuisance, protection, have an influence on the quality perceived by pedestrians. Among the latent variables that affect service quality, comfort variable has the greatest coefficients for both the groups of pedestrians. This means that service quality is largely influenced by comfort. This result is in accordance with Lee et al. (2021), who discovered that factors linked to pedestrian facilities and green space have a positive impact on service quality and satisfaction. On the other hand, safety has the lowest coefficient values, suggesting that overall safety is not considered by pedestrians as a relevant element. Service quality has an important influence on satisfaction, suggesting that if service quality is high, also satisfaction will be great. Finally, the aspects linked to behavioural intentions in reusing pedestrian paths are more influenced by service quality rather than satisfaction, both for male and female, indicating that the level of service quality in deciding to walk again on the path affect more than the degree of satisfaction. In fact, by observing the values expressed by pedestrians, we can observe that the average rate of service quality does not reach the sufficiency, while pedestrians are sufficiently satisfied with the path. In other words, they are satisfied even if the service quality levels are not well judged. This means that a user can be satisfied with a service characterized by low levels of service quality (Bellizzi et al. 2020).
From the analysis of the rates expressed by male and female, it emerges that female are in general less satisfied than male, and especially in terms of comfort and safety. This result agrees with the findings of Tan et al. (2007) and Parida and Parida (2011). On the other hand, we discovered that the presence of bicycles causes more nuisance to male than female, while Kang and Fricker (2016) found the contrary. Aside from the specific factors, women are on the whole less satisfied than men. This result agrees with several studies, such as Lee et al. (2021), Jensen (2017), Arshad et al. (2016).
For discovering substantial differences between male and female, a deep analysis of the coefficients obtained for the indicators of the measurement model has been effected. Differently from Arshad et al. (2016), but similarly to Parida and Parida (2011) we can state that there are some differences in perceptions between male and female. As an example, concerning the aspects linked to comfort, the greatest differences emerge for cleanliness and furniture. More specifically, for women the aspect

regarding comfort is mostly expressed by the presence of furnishing along the path and by the cleanliness of the environment as regards for male, who consider as more relevant the continuity of the pedestrian path and the condition of the walking surface. In terms of similarities, male and female equally appreciated the comfort due to the presence of trees providing shade along the path. From the observation of the loadings of the latent aspect linked to the presence of flows of motorized vehicles, a marked difference emerges in terms of nuisance due to vehicle flow and nuisance due to pollution. More in detail, while vehicle flow is the most relevant flow nuisance aspect for male, female consider this aspect as secondary. An opposite result emerges for the aspect relating to pollution, which is a very important aspect of flow nuisance for female but less for male. Interesting findings emerge from the observation of the values of the loadings obtained for the latent aspect relating safety. As we could imagine, safety for women is mostly expressed by the degree of protection from theft and other risk elements such as dogs along the path, while for male safety means essentially protection from accidents with vehicles. On the other hand, a great similarity in considering the aspects linked to the presence of bicycles has been discovered between male and female.

By summarizing and trying to interpret the above mentioned findings, we can conclude that the greatest differences between male and female were discovered in their way to consider the presence of flow of vehicles, which represents a relevant problem for male, also in terms of safety risk, while female are annoyed with motorized vehicles especially as determinants of pollution. Relevant differences emerged also for safety expressed as a degree of protection from theft and rubbery or animals along the path, which are expression of a safe path for women.

The different peculiarities of women and men, which are in the nature of the two genders and characterize their general behaviour in the daily life, emerge also in the perceptions of the paths and environment where they walk every day for their activities. Some findings were more expected, but others could be considered as quite surprising. While the risk of theft and rubbery or the presence of animals is obviously mostly considered by women, given their nature, the results regarding nuisance due to the presence of vehicles, which is mostly considered by men, could not be easily expected. An interpretation of this finding could be that women are more careful in walking distant from the roadway, and for this reason they suffer less the presence of vehicles. On the other hand, also in terms of similarities, interesting surprising findings emerged. As an example, one could think that women are more sensitive to the presence of tree and plants along the path, but we found that men consider these aspects in the same way. This result could be a little demonstration of the fact that men are ever more similar to women in the appreciation of beauty and appearance.

A final little discussion can be made about the differences between male and female perceptions linked to trip purpose of and frequency. We registered that male use the footpaths above all to play sports (sport training), while female to go to the place of study. Concerning frequency, we registered that female use the pedestrian paths more frequently (many times a day, once a day) than male (once every 10 days, rarely). These differentiations are in line with the diversities discovered in perceptions. In fact, while women are more sensitive to the presence of furnishing along the path and the cleanliness of the environment, as they walk more frequently and for reaching their places for making their activities, men consider as more relevant the continuity of the pedestrian path and the condition of the walking surface, as they use the path prevalently for sport activities.

Finally, males and females' behaviour differ also in the utilization of the paths, and this difference could be linked to the quality levels offered by the paths. As an example, path 1 is more frequented by males. Being the population living in the urban area almost equally distributed in terms of gender, we can conclude that the reason why path 1, sited in the city of Cosenza, is frequented by few women (35%), could be due to the quality levels of the path, which do not satisfy women; in this case, planners should point on the aspects retained as most important for women in order to guarantee an equal utilization of the path in terms of gender.

6. Conclusions and practical implications

The objective of this work was to analyse gender differences in pedestrians' perceptions. It is important to analyse perceptions by differentiating among groups of users, because the knowledge of the differences can help in determining the right strategies to improve pedestrian environment and increase the use of more sustainable transport modes, especially in urban areas characterized by a very large percentage of trips made by car and where there is not a real vision of integration between public transport and other transport modes. The need of this kind of work is due also to the scarcity of similar literature studies explicitly based on the use of PLS-SEM which allows to introduce latent aspects and to determine the relationship among latent and observed variables. From the findings of the present study some lessons for transport policy can be identified, and specific recommendations for local governments and planners can be derived to better implement gender-sensitive urban transport planning. More specifically, our work provides a practical contribution useful for researchers and practitioners in identifying specific strategies that can be suitable for different groups of users as long as valuable suggestions to invest on the aspects considered as particularly important both by males and females.

We discovered that women are more sensitive to aspects linked to personal security, landscape and environmental protection, while men are more oriented to aspects linked to traffic flow. Surely making the pedestrians paths green and secure would be a successful strategy for attracting both the two categories of users, even if security is an aspect considered more by females. Women are more sensitive to the aspects linked to security given their higher vulnerability compared to men. As stated by Motamed and Bitaraf (2016), increasing the feeling of fear may conduct to a reduction of the number of pedestrians, especially females. As an example, the closure of shops and the lack of nightlife businesses or lighting can intensify the possibility of criminal behaviours. Therefore, planners could pay more attention to guarantee a sense of security to women, in such a way as to assure a gender equity in the use of pedestrian facilities. As an example, security devise along the sidewalk should be warranted at 500 metres intervals, like CCTV cameras and panic buttons; in such a way, police patrol security could be ensured along the whole path.

On the other hand, Tan et al. (2007) remember that females have lower physical force and walking speed than males, and they feel more likely uncomfortable because of tiredness. These characteristics should be taken into account in the design of the walkways; as an example, sidewalks should be constructed with proper height, width, barriers and buffers; paths should have an adequate slope and appropriate paving. Landscape also have a crucial role in choosing a pedestrian path, because the features of the built environment are associated with travel behaviours and the ways they restrict or encourage particular mobility patterns. These aspects have to be taken into account especially for females which have a close eye to details, and therefore are very exigent in terms of walkway design. After all, men consider as particularly relevant the continuity of the pedestrian path and the condition of the walking surface. We can conclude that both the analysed categories of users pay attention to the design of the paths, although focusing on different details.

Giving a boost to use pedestrian paths can contribute to carbon emissions reduction because of the women's high sensitivity to environmental protection. This goal can be reached by introducing specific measures to encourage active mobility use as an efficient and environmentally sustainable mode of transport for short-distance trips, but also by promoting the use of public transport focusing on the improvement of public transport services or non-motorised modes and public transport and bike-sharing fare subsidies.

Finally, it should be emphasized that policies aimed at encouraging active mobility and the use of pedestrian and cycle paths must necessarily be supported by an adequate advertising campaign to attract new pedestrians because providing only infrastructure will not enhance pedestrian path usage and having proper education could change the attitude of people regarding such kinds of soft mobility.

Despite of the interesting findings, this work has also some limitations, due to the smallness of the various subsamples referred to each of the four analysed paths. It would be more correct and

interesting to make an analysis differentiated by the four walkways, which are characterized by peculiarities that are different among them.

Furthermore, our study context cannot surely be compared to the most developed cities of the northern and central Italy, and least of all to the European cities, where planners and administrators have extensively pointed to active mobility since many years. Unfortunately, Calabria region, as some other southern Italian regions, has to be considered as a developing region regarding some fields, including transportation sector. More specifically, it is still not very developed in terms of infrastructures dedicated to pedestrians and cyclists; also for this reason, the few pedestrian's paths are not very used as it should be done. So, our findings and results could be generalized and compared with such similar contexts only. In such a way, our work could represent a useful contribution for academics and practitioners.

Future developments could concern the investigation of differences in pedestrians' perceptions referring to some other categories of users differentiated in terms of socio-economic characteristics such as age, income, professional condition, or in terms of travel habits, as trip frequency, trip purpose, and so on. At this stage of the work, the numerousness of the sample did not allow analysing by groups of males and females differentiated also in terms the other pedestrians' characteristics. The analysis could be surely improved also by considering the heterogeneity among the analysed paths.

A further future development of the work could consist in involving the whole resident population of the two cities representing our study context, and consider both users and non-users, with the final aim to incentivize pedestrian mobility.

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