Gender Sensitivity in Urban Design: Strategies for More Inclusive Pedestrian Spaces in Tseung Kwan O, Hong Kong

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Abstract

As gender equality and women's rights have gained significant attention globally, there is a significant gap in gender-sensitive urban design in Hong Kong. To address the need for a more inclusive approach in urban planning, more research is needed, particularly regarding women's perceptions of and satisfaction with street design. This research investigates gender-based differences in pedestrian satisfaction through a case study of Tseung Kwan O, a high-density new town in Hong Kong. Using survey data from users of four different pedestrian path types, the study identifies seven key factors influencing the public space perception of different genders. Findings indicate that women prioritize service facilities such as signage and shops, lighting, and landscape comfort, while men focus on road safety. Female pedestrians reported lower overall satisfaction, highlighting the need for gender-responsive interventions. The detailed findings of this study inform guiding principles for creating inclusive pedestrian spaces, by identifying various factors which impact satisfaction and relating these to neighbourhood characteristics. This work highlights the need to take gender into account in urban planning, and proposes an urban design approach for the future development of pedestrian spaces in Hong Kong, aiming for a more inclusive urban environment.

Keywords

Gender Sensitivity, Pedestrian Satisfaction, High-density Cities, Hong Kong

1. Introduction

Gender equality and women's rights have gained significant attention globally. The United Nations' Sustainable Development Goal 11 calls for universal access to safe, inclusive public spaces, especially for women and other vulnerable groups (United Nations, 2017). Despite efforts in Hong Kong 2030+ to promote inclusive design in public spaces, a female perspective remains largely absent in urban design (Planning Department, 2021; Gender Case: Hong Kong, n.d.).

Hong Kong already promotes sustainable travel modes, with walking as a key connector to public transport (Transport Department, 2017). Walking offers numerous benefits, including improved accessibility, reduced costs, enhanced community appeal, and support for health and social equity (Litman, 2003). Urban designers emphasize the importance of well-designed pedestrian streets, which can accommodate diverse activities (Jacobs, 1961), promote social interaction (Gehl, 1971), and enhance urban legibility (Lynch, 1964).

Previous studies have indicated gender differences in the perception of public spaces, particularly of pedestrian streets and facilities (Grabosky, 1995; Mazzulla et al., 2024). Despite higher rates of walking and public transport use among women globally (Harrouk, 2019), their satisfaction with walking spaces is often lower than that of men (Mazzulla et al., 2024). Jensen et al. (2017) found that women are more likely to use high walkability streets with shops and residential complexes, while low walkability streets with undeveloped units and industrial sites are less frequented by women. Parida and Parida (2011) also highlighted that women give a higher priority to safety aspects of pedestrian facilities. Lee et al. (2021) confirmed that male pedestrians generally report higher satisfaction than females in relation of safety, convenience, and comfort of street environments. Zapata and Honey-Rosés (2022) have shown that women's access to urban spaces is more limited compared to men's, even in well-designed areas with high walkability and safety.

Seen together, these studies suggest that enhancing street environments and planning more walkable streets could improve gender equality in walkability. They highlight the need for gender-sensitive design in pedestrian spaces to address these disparities.

Research Gap

In Hong Kong, gender-sensitive studies have highlighted the lack of female perspectives in public space planning. For instance, Onebite (2021) identified barriers to women's participation in sports and transformed the Ming Tak Basketball Court into a "Girls First" space to encourage female engagement. However, current gender-inclusive designs in Hong Kong mainly focus on increasing women's public service facilities (The Government of the Hong Kong Special Administrative Region, 2018) and have not fully considered women's psychological needs. Gender considerations are not incorporated into the overall spatial planning framework, particularly in street space, recreation, and open space (Gender Case: Hong Kong, n.d.). Therefore, the

issue of women's perceptions and satisfaction with street design remains unaddressed, and this study aims to fill this gap by differentiating the needs of male and female pedestrians and assisting planning practitioners in developing gender-sensitive pedestrian space design strategies.

2. Literature Review

Several studies have analysed pedestrian satisfaction in various cities using systematic analysis methods (Bellizzi et al., 2019; Lee et al., 2021; Parida & Parida, 2011; Vallejo-Borda et al., 2020). Factors influencing pedestrian satisfaction include traffic, safety, comfort, maintenance, and aesthetics (Sahani & Bhuyan, 2020), as well as street environment characteristics (e.g., sidewalk conditions, shading, parking) and psychological stress (Vallejo-Borda et al., 2020). The importance of these factors can vary by trip purpose (Mazzulla et al., 2024) and physical environment variables (Jensen et al., 2017; Lee et al., 2021). This study will use assessment criteria for assessing local walking environment considerations synthesized from relevant literature (Table 1), to examine the gender-specific effects of different street characteristics and designs on pedestrian satisfaction in Hong Kong.

Previous studies have categorised pedestrian streets in various ways: segregated vs. non-segregated streets (Lee et al., 2021), commercial vs. residential streets (Mazzulla et al., 2024), and low walkability vs. high walkability streets (Jensen et al., 2017). These classifications help understand how different street attributes affect user satisfaction.

3. Research Questions and Conceptual Framework

This study examines gender differences in pedestrian satisfaction in Hong Kong, investigating the relationship between pedestrian space features and quality, and the impact on men's and women's satisfaction, as well as the influence of pedestrian space components on gender-based satisfaction differences.

For the study, a representative site in Tseung Kwan O was selected as a case study area, and different pedestrian space types were identified. Using the satisfaction indicators gathered through the literature review, qualitative data on pedestrian space satisfaction was collected. Surveys were used to collect demographic data and pedestrian satisfaction assessments, and data analyses was performed using SPSS analytical software.

The study explores the relationship between pedestrian space characteristics and satisfaction, comparing the findings with prior research to identify consistencies and discrepancies. Ultimately, gender-informed recommendations for urban planning and design are proposed

4. Methodology

4.1 Study Area

One of the new towns in Hong Kong, Tseung Kwan O, was chosen as the study site. As a third-generation new town (Fig. 1), Tseung Kwan O has a total development area of about 1,720 hectares. Tseung Kwan O South Town Centre is situated at the heart of this new town. Accord-

Category	Indicator	Observation	Reference
Respondents' Social Characteristics and Behaviours	Gender	Questionnaire	Bellizzi et al. (2019)
	Employment status		Mazzulla et al. (2024)
	Trip purpose		Parida and Parida (2011)
	Frequency		Vallejo-Borda et al. (2020)
Street Characteristics	Street feature	Mapping	Jensen et al. (2017)
			Lee et al. (2021)
	Sidewalk type		
Pedestrian satisfaction with safety	Lighting	Questionnaire	Bellizzi et al. (2019)
	Road safety		Vallejo-Borda et al. (2020)
	Sidewalk safety		Mazzulla et al. (2024)
	Lanes		Sahani and Bhuyan (2020)
	Road width		
	Vehicular speed		
	Vehicular flow		
	Bike flow		Bellizzi et al. (2019)
	Bike speed		Vallejo-Borda et al. (2020)
	Opposite direction flow		Mazzulla et al. (2024)
	Same direction flow		
Pedestrian satisfaction with convenience	Furniture		
	Public transit access		
	Signage		Bellizzi et al. (2019)
			Vallejo-Borda et al. (2020)
			Mazzulla et al. (2024)
			Sahani and Bhuyan (2020)
	Restrooms		Bellizzi et al. (2019)
	Shops		Vallejo-Borda et al. (2020)
Pedestrian satisfaction with comfort	Width		Mazzulla et al. (2024)
	Condition		
	Trees		
	Odour		
	Noise		
	Environment		
	Cleanliness		
	Landscape		
	Shade		
	Stress		Bellizzi et al. (2019)
	Distance between pedestrians		Vallejo-Borda et al. (2020)
			Mazzulla et al. (2024)
	Crowdedness		Sahani and Bhuyan (2020)
	Walking preference		Bellizzi et al. (2019)
			Vallejo-Borda et al. (2020)
			Mazzulla et al. (2024)

Table 1. Indicators and references, Source: Author, based on various literature.

ing to government policy, Tseung Kwan O New Town is currently developed as a self-contained community with a full range of transportation, shopping, community, recreational and other local facilities. The density of residential development in Tseung Kwan O is generally higher than other new towns in Hong Kong. According to the Hong Kong 2021 Census, its population is approximately 418,000 (Planning Department, 2022).

As one of the more recent new town developments in Hong Kong, Tseung Kwan O is the only new town which has adopted the concept of a healthy city into its urban planning (Centre for health protection, 2007). Its planning encourages people to travel healthily by incorporating continuous and spacious pedestrian streets and cycle tracks (Lee & Kung, n.d.).

4.2 Case Study in Tseung Kwan O

As commercial land use only accounts for 0.5% of the land use in Hong Kong (Planning Department, 2023), it is not possible to differentiate street attributes by the nature of the land use. Based on previous studies, this study classifies streets into service streets, non-service streets, segregated streets and non-segregated streets according to their characteristics. Non-separated street means that this street has a pedestrian space dedicated to pedestrians on either side or one side of the driveway, while segregated street means that the street is exclusively for pedestrians and has no vehicular traffic (Lee et al., 2021). Service streets are mixed residential streets with shops along the street, while non-serviced streets are streets other than serviced

Figure 1. The location of Tseung Kwan O as part of Hong Kong's New Towns (source: Author, adapted from Planning Department, 2022).

streets (Urban Planning Society of China, 2021). Figure 2 illustrates the types of pedestrian streets in Tseung Kwan O town centre. Four typical pedestrian streets with different characteristics and street types have been selected for this study (Table 2).

Path A (Fig. 3b) is the main road in Tseung Kwan O, with footpaths running parallel to six lanes of traffic. One side of the path is the parking lot, and on the other side of the path is the Tseung Kwan O MTR station.

	Path a	Path b	Path c	Path d
Name	Po Yap Rd	Tong Chun St	Tong Tak St	Tong Ming Street Park
Length [m]	250	200	150	200
Road width [m]	24.5	22.1	0	0
Sidewalk width [m]	5.25	5.6	5.9	10
Bikeway length [m]	0	200	150	200
Bikeway width [m]	0	3.5	3.5	0
Type of area	Non-separate non-service sidewalk	Non-separate service sidewalk	Separate service sidewalk	Separate non-service sidewalk

Source: Author

Table 2. Features of the four pedestrian paths

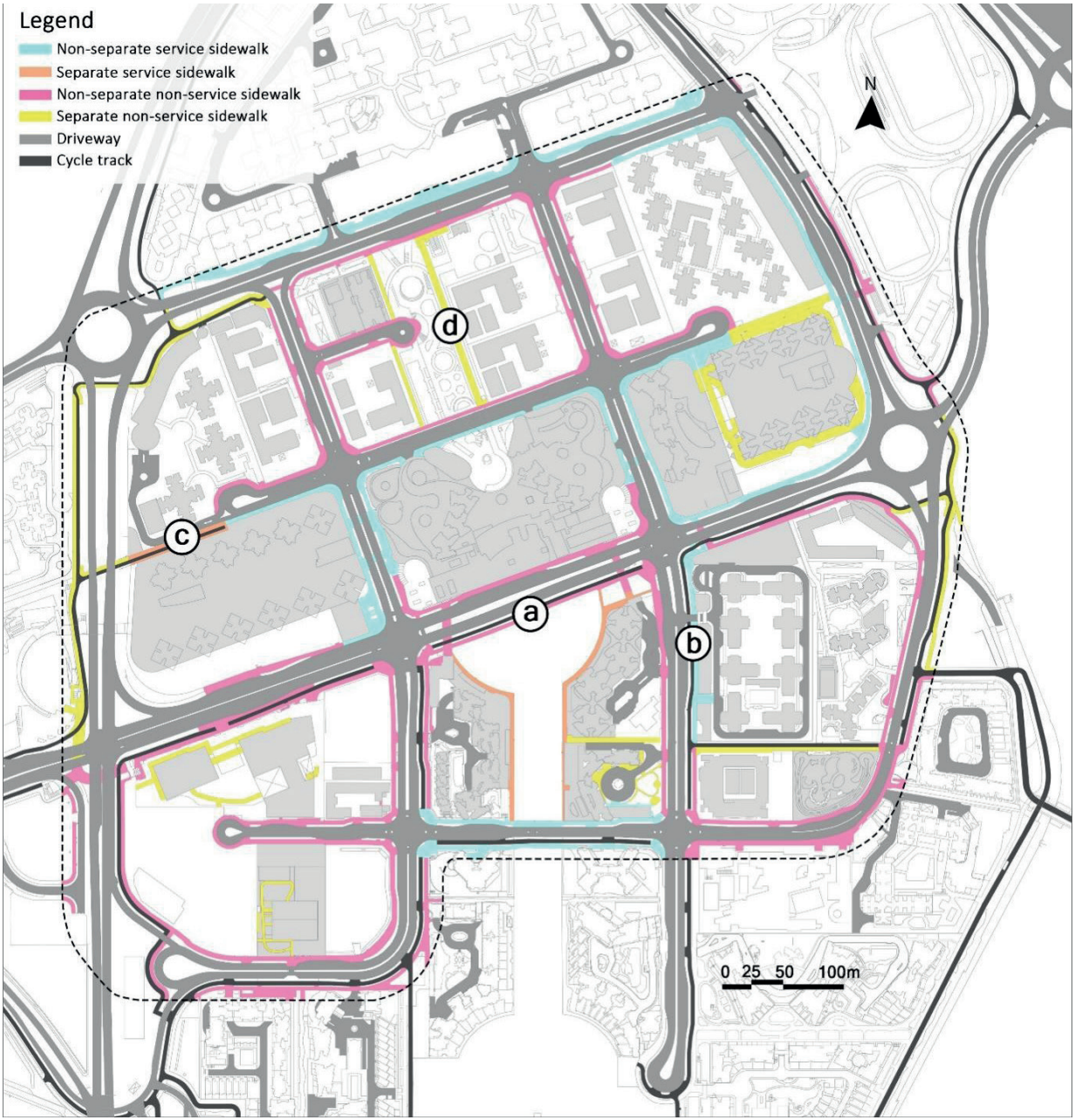
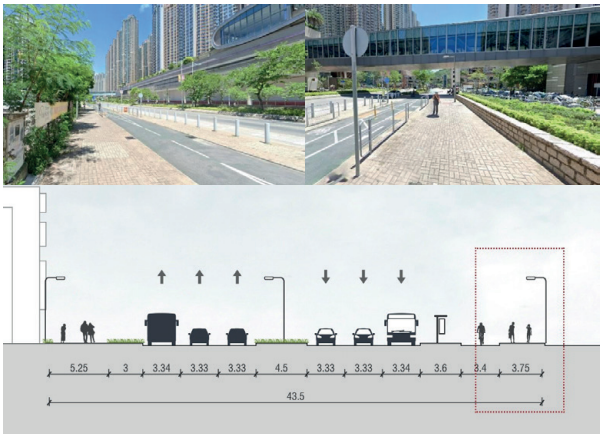


Figure 2. Selected study area in the Tseung Kwan O town centre (source: Author).

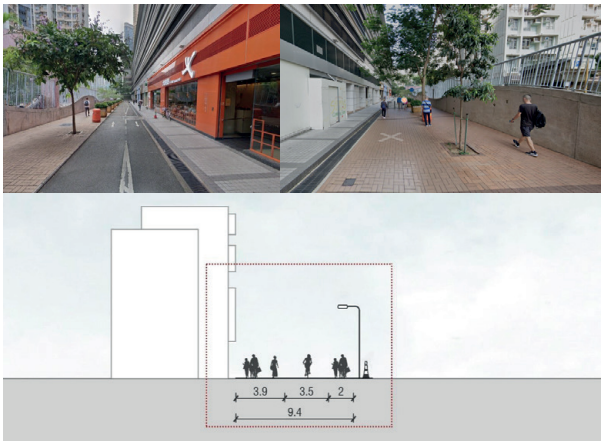
Path B (Fig. 3c) runs parallel to four motorway lanes. There are ground floor shops and a cycle track on one side of the street, which is heavily trafficked.

Path C (Fig. 3d) is a path with no motor vehicle lanes and a small number of shops or residences around the footpath, which runs parallel to the cycle track.

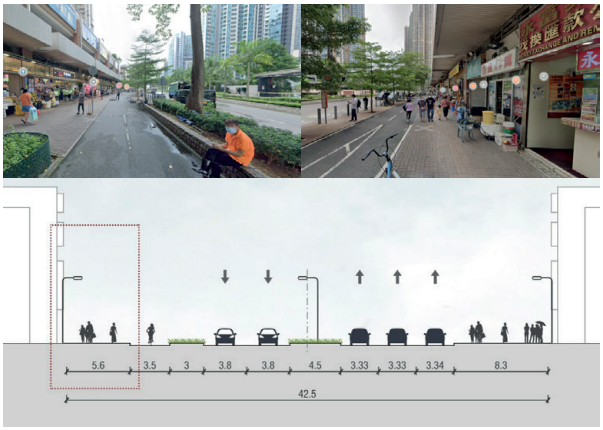
Path D (Fig. 3e) is a path with no motorways or cycle lanes. There are several facilities along the path where rest and relaxation can take place (benches, single track, etc.).



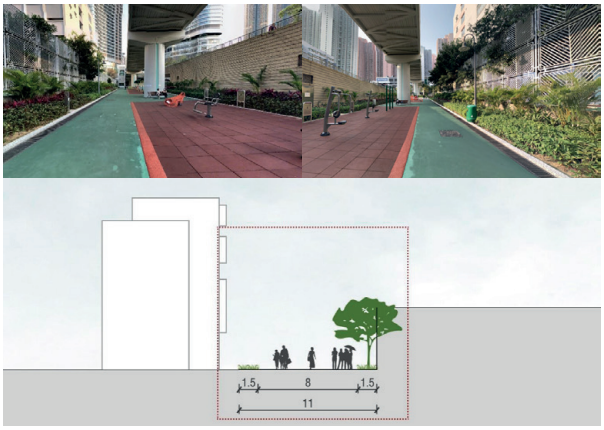
(a) Path A: Po Yap Rd



(b) Path B: Tong Chun St



(c) Path C: Tong Tak St



(d) Path D: Tong Ming Street Park

Figure 3. (a) non-separate non-service sidewalk; (b) non-separate service sidewalk; (c) separate service sidewalk; (d) separate non-service sidewalk (source: Author).

4.3 Research on Gender-based Subjective Preferences

The survey was conducted in Hong Kong between October and November 2024, a period characterised by stable climatic conditions, which contributed to consistency in participants' perceptions of the climatic environment. A questionnaire was conducted to collect pedestrian perceptions of sidewalks, consisting of 29 questions divided into two sections: (a) social information about respondents and (b) their general and specific perceptions of the path. A 6-point scale was used to assess overall sidewalk satisfaction (0 = not at all satisfied to 5 = completely satisfied) and comfort/nuisance levels (0 = completely uncomfortable/no nuisance to 5 = completely comfortable/high level of nuisance). Respondents also rated statements on a 6-point scale (0 = completely disagree to 5 = completely agree) regarding their walking experience. The survey targeted sidewalk users on four selected roads.

In this study, a stratified random sampling strategy was adopted to recruit 40 participants, comprising 20 males and 20 females, for face-to-face questionnaire interviews. This approach was employed to ensure adequate representation of both genders in the sample, thereby enhancing the representativeness of the data and minimizing potential bias arising from disproportionate gender distribution. Stratified sampling has been widely recognised in the literature as a valid and effective method for achieving balanced subgroup representation (Arieska & Herdiani, 2018; Sorenson et al., 2013). To assess the reliability of the sample, we employed Cronbach's alpha to examine whether there is significant consistency in the response patterns.

4.4 Modelling Approach

After collecting the questionnaire data, this study conducted a two-step analysis to identify key factors influencing the design of walking spaces for men and women. First, this study performed an analysis of Student's t-test to highlight statistically significant differences in pedestrian satisfaction between genders (Mishra et al., 2019). This method infers whether a difference may exist between two samples by examining the ratio of the difference in sample means to the variation within the samples, which could help determine whether key satisfaction indicators varied based on gender.

Subsequently, the study applied Principal Component Analysis (PCA) to reduce data complexity and extract the primary factors driving pedestrian satisfaction (Nasreldin & Ibrahim, 2024). Prior to PCA, the dataset was standardised to ensure all variables had a consistent scale (zero mean and unit variance), which is crucial for accurate analysis.

5. Results

5.1 Interview Results

Table 1 (Appendix) highlights the differences between the samples of pavements. The differences in the populations of the analysed pavements are mainly attributable to their location within the city. It is worth noting that the average age of respondents on path d was the oldest

of the four paths, which is not surprising given that the path connects to Tong Ming Street Park and has several recreational facilities where older people often recreate and exercise. This result is confirmed by the fact that 50 percent of those interviewed stated that 'exercise' was the purpose of their trip and that they were regular visitors to the path d.

Furthermore, Cronbach's alpha was calculated based on the questionnaire responses, yielding a value of 0.975. This indicates that the questionnaire in this study measures the same underlying construct, and the respondents' response patterns across these variables are highly consistent.

By counting the perceptions of the four footpaths (Table 2 in the Appendix), the study found that paths C and D were quite popular, with higher positive feedback than paths A and path B. For pedestrians walking on paths C and D, comfort and safety were satisfactory.

Compared to the other paths, paths A and B do not have a clear separation between the pavement and the motorway, and the distance between vehicles and the pavement is relatively close. As a result, satisfaction with the level of vehicular interference is lower on these two streets. Users perceive path C as less comfortable in terms of flow, odour and cleanliness. Users of path A were less satisfied with the environment, tree, shade, and facilities.

Finally, even if pedestrians find some of the factors of walking on the various trails unsatisfactory, they prefer to walk on these trails compared to walking alongside the main carriageway and alongside the footpath alongside the cycleway.

To highlight statistical gender differences in pedestrian perceptions, the data collected is analysed in Table 3 below. The sample of users interviewed was divided into two sub-samples, male and female. Each variable was analysed by Student's t-test to assess the difference in satisfaction between males and females. Statistically significant differences ($p<0.05$ or $p<0.01$) were found for 7 of the 29 questions asked in the survey, meaning that there was a significant difference between female and male perceptions of these 7 aspects. Regarding safety, no significant differences were found between traffic flow and the level of disturbance due to bicycles passing pedestrians or in the opposite direction. For comfort, no significant differences were found between the rates given by females and males in the assessment of odour, width, and pressure.

Indicator	Male (n=20)	Female (n=20)	t-stat	P-value
Lighting	4.65	3.7	3.58	**0.001****
Road safety	4.3	3.85	1.7	0.099
Sidewalk safety	4.3	4.1	0.8	0.432
Lanes	1.65	1.85	-0.41	0.682
Road width	2	1.6	0.71	0.483
Vehicular speed	1.75	1.4	0.64	0.528
Vehicular flow	1.4	1.3	0.22	0.826
Bike flow	1.35	1.15	0.46	0.649
Bike speed	1.3	1.35	-0.11	0.910
Opposite direction flow	1.1	1.4	-0.69	0.497
Same direction flow	0.95	1.15	-0.46	0.650
Furniture	4.65	4	2.29	**0.029***
Public transit access	4.5	4.25	1.07	0.292
Signage	4.5	3.7	3.24	**0.003****
Restrooms	4.65	3.6	4.91	**0****
Shops	4.5	3.5	2.52	**0.019***
Width	4.3	4.25	0.18	0.855
Condition	4.3	3.95	1.48	0.147
Trees	4.1	3.55	1.68	0.102
Odour	4.25	3.75	1.44	0.159
Noise	3.6	3.6	0	1
Environment	4	3.65	0.92	0.362
Cleanliness	4.3	3.8	1.74	0.093
Landscape	4.5	3.8	2.1	**0.043***
Shade	4.3	4.05	0.87	0.389
Stress	1.65	1.55	0.22	0.828
Distance between pedestrians	2.1	2.15	-0.08	0.933
Too many pedestrians	0.8	1.8	-2.51	**0.018***
I prefer not to walk here	0.75	1.15	-0.86	0.393

* p<0.05 ** p<0.01

Table 3. Student's t-test for the pedestrians' perceptions in different gender

Regarding convenience, significant differences were found in all areas except for public transport services.

The difference in values from the mean shows that females are less satisfied than males in most of the aspects. Significant differences were particularly evident in areas such as odour, landscape, light, and pavement services such as shops, restrooms, and street signage. Thus, females cared more about service facilities on the pavement than safety and comfort.

5.2 PCA Evaluation

The results of the PCA analyses of the pedestrian space were analysed using SPSS statistical software. The Varimax rotation method with Kaiser normalisation was retained to test its validity according to the Kaiser criterion (Kaiser, 1958).

The variables selected for retention from the PCAs were based on subjective judgement and the interpretability of the components (Abson et al., 2012). The retention criteria for the principal components were based on Kaiser's rule of thumb that components should have eigenvalues >1.0, as shown in Figure 4 below. Seven principal components were retained in the PCA of the male satisfaction questionnaire. The relative contribution of the seven principal components to the total explained variance (EV) was 83.87%.

As shown in Figure 5 below, seven principal components were retained in the PCA of the female satisfaction questionnaire. The relative contribution of the seven principal components to the total explained variance (EV) was 83.12%.

The impact of various factors on walking space was quantitatively assessed in a male satisfaction study of four paths. Table 6 below details the loadings for each variable for which principal components were retained, with the largest loadings in bold. All the 26 indicators in the eigenvectors are shown in the seven principal components. The loadings analysis is characterised by the highest values of the indicators, depending on the factor loadings above 0.5. These components can be used to assess the types of factors affecting pedestrian satisfaction.

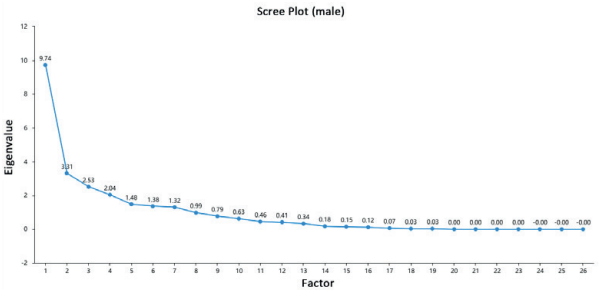


Figure 4. Scree Plot (Male): Principal component results for 26 interpretable satisfaction indicators extracted from male data (source: Author).

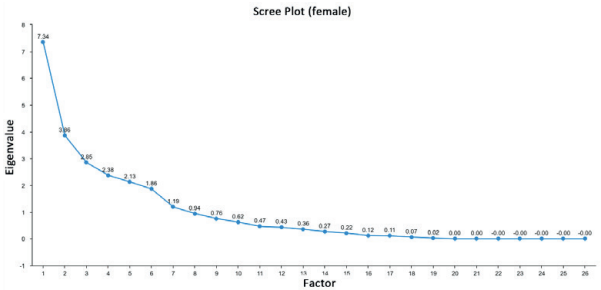


Figure 5. Scree Plot (Female): Principal component results for 26 interpretable satisfaction indicators extracted from female data (source: Author).

The seven principal component categories can be categorised as road safety, service facilities, cycle path safety, environmental comfort, cleanliness, psychological stress, and infrastructure.

As shown in the Table 3 (Appendix), the seven key components cumulatively account for 83.87% of male satisfaction with walking space. The factors with the greatest influence on satisfaction with walking space are external road safety (18.79%), followed closely by service facilities (14.54%), cycle path safety (12.27%), environmental comfort (12.24%), cleanliness (10.49%), psychological stress (8.10%) and infrastructure (7.43%).

The impact of various factors on walking space was quantitatively assessed in a study of female satisfaction on four paths. Table 4 (Appendix) lists the loadings for each variable for which

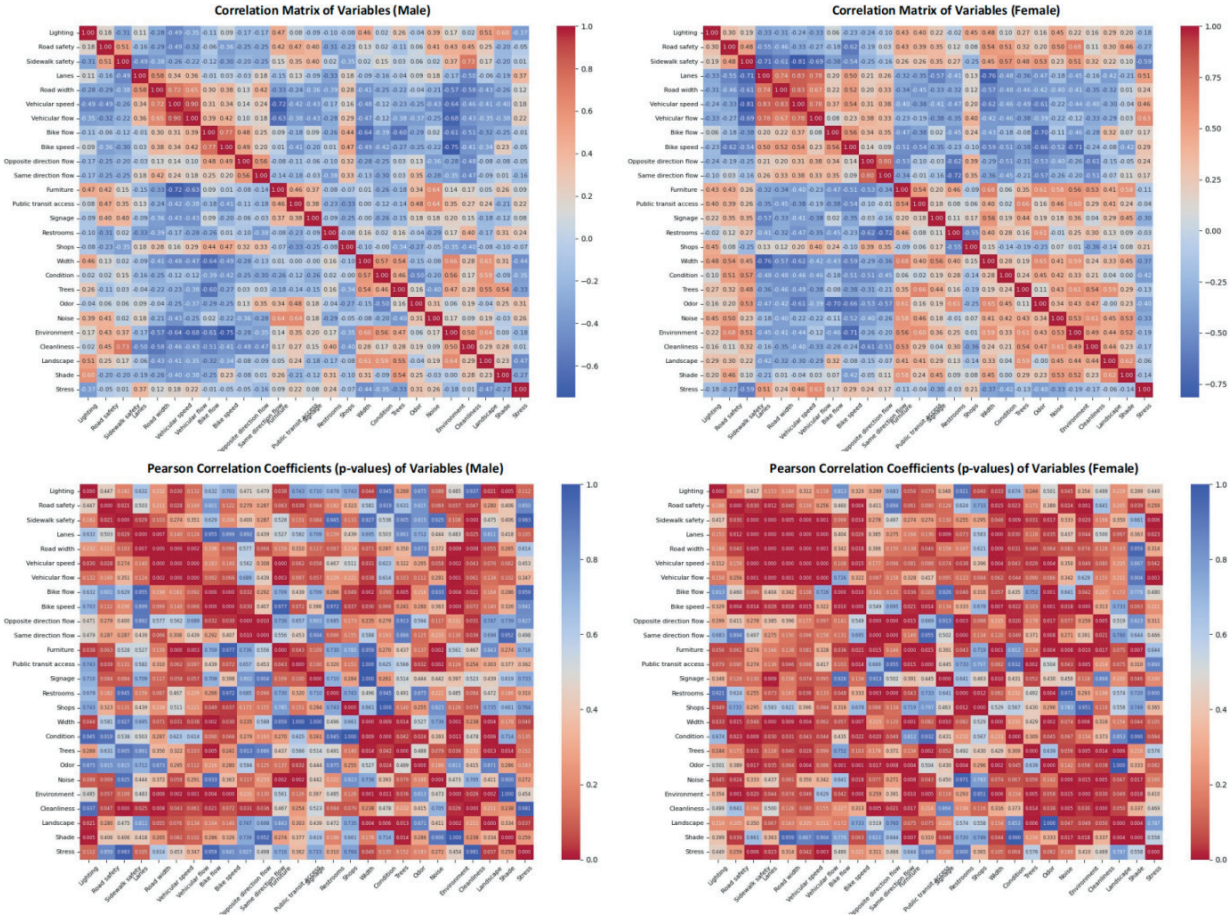


Figure 6. Pearson correlation patterns among original variables (source: Author).

principal components were retained, with maximum loadings in bold. All 26 indicators in the eigenvectors are shown in the seven principal components. The loadings analysis is characterised by the highest indicator values depending on factor loadings above 0.5.

The seven principal component categories can be categorised into service facilities, road conditions, street safety, environmental comfort, infrastructure, pedestrian orientation and public transport.

As shown in the table, the seven principal components cumulatively accounted for 83.12% of female walking space satisfaction. The most influential factors on walking space satisfaction were service facilities (18.49%), road condition (16.63%), street safety (10.89%), environmental comfort (10.04%), infrastructure (9.62%), pedestrian orientation (9.62%) and public transport (7.83%).

We examined the correlations of the variables before and after PCA. The results indicate that, although there were significant strong correlations among the original variables, the extracted factors exhibited almost no collinearity (Table 3 and Table 4). This suggests that PCA successfully achieved dimensionality reduction, concentrating the covariation of the original variables into a few uncorrelated components. This demonstrates that our method effectively reduces information redundancy while retaining the main information, making subsequent models based on these factors more robust and interpretable.

As an illustrative example, prior to PCA, road width and vehicular speed exhibited a strong and significant correlation ($r = 0.83$, $p < 0.01$ in Figure 6). Following PCA, both variables loaded highly on the same principal component, thereby consolidating their shared variance. This process effectively eliminates the multicollinearity between the original variables in subsequent analyses and ensures that their combined effect is captured in a more parsimonious and interpretable form.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Factor 1	**0.000****	**0.044***	**0.024***	**0.021***	**0.027***	**0.011***	0.420
Factor 2	**0.044***	**0.000****	**0.048***	0.083	0.321	0.122	0.797
Factor 3	**0.024***	**0.048***	**0.000****	0.117	0.104	0.087	0.470
Factor 4	**0.021***	0.083	0.117	**0.000****	0.080	0.132	0.548
Factor 5	**0.027***	0.321	0.104	0.080	**0.000****	0.172	0.303
Factor 6	**0.011***	0.122	0.087	0.132	0.172	**0.000****	0.564
Factor 7	0.420	0.797	0.470	0.548	0.303	0.564	**0.000****

* p<0.05 ** p<0.01

Table 4. Pearson correlation matrix of factors (Male respondents).

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Factor 1	**0.000****	0.340	0.089	0.213	0.266	0.141	0.649
Factor 2	0.340	**0.000****	0.125	0.633	0.140	0.162	0.755
Factor 3	0.089	0.125	**0.000****	0.959	0.411	0.248	0.372
Factor 4	0.213	0.633	0.959	**0.000****	0.789	0.752	0.339
Factor 5	0.266	0.140	0.411	0.789	**0.000****	0.313	0.587
Factor 6	0.141	0.162	0.248	0.752	0.313	**0.000****	0.859
Factor 7	0.649	0.755	0.372	0.339	0.587	0.859	**0.000****

* p<0.05 ** p<0.01

Table 5. Pearson correlation matrix of factors (Female respondents).

6. Discussion

This study investigated the perceived differences between male and female users and assessed gender-specific preferences for pedestrian spaces. The models yielded significant findings, both similarities and differences between genders,

based on satisfaction feedback from both men and women.

6.1 Different Types of Pedestrian Spaces and Features

Similar to the findings by Lee et al. (2021), this study found a relationship between pedestrian space types and user satisfaction. Overall satisfaction increased for pedestrian spaces characterised as service street. In addition to this, Lee et al. (2021) found that there may be a relationship between segregated and non-segregated streets and satisfaction. This study confirms this and further finds that satisfaction is higher on segregated streets without motorised lanes, and this effect can also be found when the street has cycle tracks.

Gender Differences in Satisfaction

As with the results of the Vallejo-Borda et al. (2020) study, our study confirms that variables related to the quality of the street as well as to amenities, such as pavement characteristics, comfort, convenience and safety, have an impact on pedestrian perceptions. Overall, women are usually more unsatisfied than men, a result consistent with the findings of Mazzulla et al. (2024) and Lee et al. (2021).

Safety

To discover substantial differences between males and females, this study used SPSS to analyse in depth the data obtained from the measurement model indicators. In relation to safety, no significant gender differences were found around the level of interference with traffic flow. In addition, male is highly concerned about the speed of motor vehicles and the safety of pavements. On the other hand, we found that bicycles were more intrusive for females than for males, which is the opposite of what Mazzulla et al. (2024) found.

Convenience

In similarity, men and women are equally concerned about the availability of public transport services in the street. Additionally, women are more interested in the availability of services such as rest benches, toilets, shops, and signage in the street. Overall, women find the convenience of the street to be very important, whereas for men it is less important.

Comfort

There are no significant differences in the ratings of females and males when assessing shade, odour and stress. Females are more concerned with street noise, cleanliness, and landscaping. Overall, comfort was less important to men.

To interpret the above findings, some of the findings are as predicted, while others may be considered unexpected. From the findings of our study, we can interpret that the biggest difference between males and females is in the way they regard the function of the street. While men seem to value the street as a means for commuting and getting to their destination, women seems to appreciate streets for the services they offer. Although Parida and Parida (2011) proposed that safety is a word that is often mentioned for women's streets, it was

found in the survey that this is something that is mainly considered by men. Females are more disturbed by motorised vehicles because of the noise associated with them. In addition, women are more sensitive to the cleanliness of streets, which may also be related to women's higher appreciation of street furniture because they use it more frequently. In relation to these insights, planners should consider the most important aspects for men and women separately to ensure that pedestrian spaces are utilised equally in terms of gender.

6.2 Gender-based Urban Design Recommendations

Based on the findings, the following urban design guidelines are proposed to increase the gender sensitivity of pedestrian spaces. The recommendations are not only specific to Tseung Kwan O but may also be useful in other areas of Hong Kong with similar spatial characteristics.

To create male friendly pedestrian spaces:

1) Appropriately reduce the number of lanes in areas with wide motorways and little traffic.

2) Increase safety measures for pedestrians.

To create female friendly pedestrian spaces:

1) Increase the number of effective street lights and improve the quality of lighting.

2) Design mixed-use streets to increase the proportion of street-facing retail in the neighbourhood.

3) Provide urban greening to separate sidewalks from car lanes to reduce motor vehicle noise.

4) Maintain tidy streets.

In general, to create pedestrian friendly spaces:

1) Design appropriate width pedestrian streets to improve walking comfort in crowded areas.

2) Increase the greening ratio by planting tall and dense trees along the streets to provide shade.

3) Increase public transport access points where appropriate.

4) Reduce spatial and visual complexity to improve visibility and wayfinding.

6.3 Environment Improvement Testing

Based on this study's findings, the potential improvements to the walking environment of Path A are illustrated (Figure 7). The lower walking experience ratings for Path A were primarily attributed to the proximity to vehicle lanes and insufficient greenery, leading to noise pollution and a lack of shelter.

Based on the findings and discussion, a guiding diagram for designing - male and female-friendly - walking spaces is presented (Figure 8). The diagram highlights the main urban design elements which can foster the creation of more equitable and inclusive walking environments.

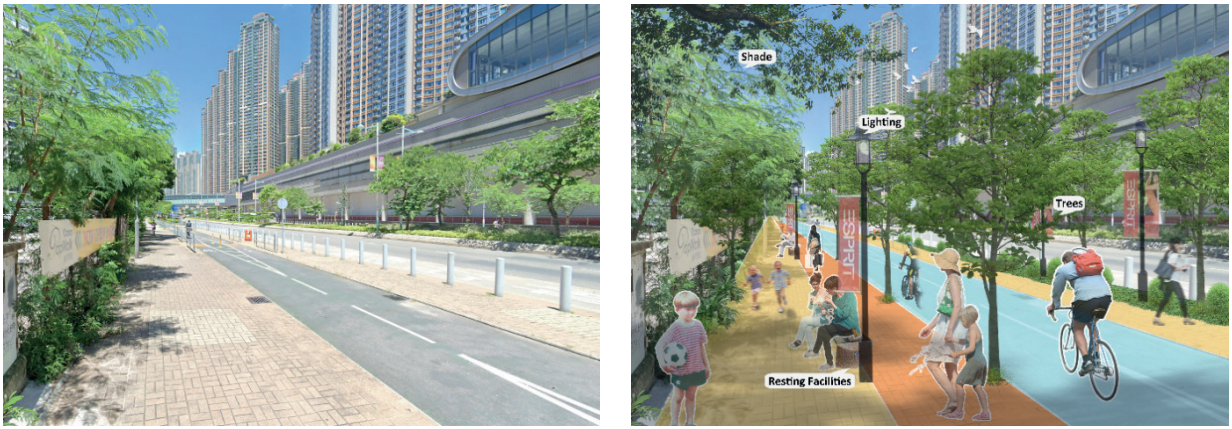


Figure 7. Original condition of Po Yap Rd (before) and improved situation (after) (source: Google Maps / Author).

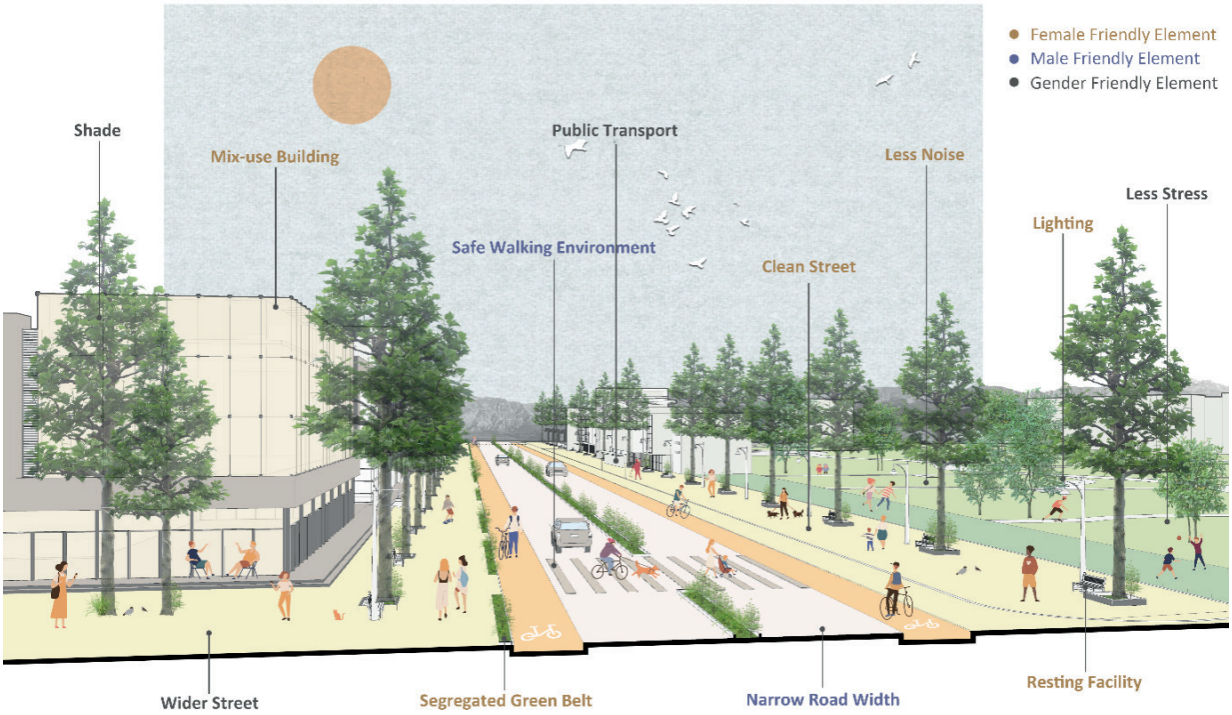


Figure 8. Design guidelines for gender-sensitive pedestrian spaces (source: Author).

6.4 Limitations

This study method also has certain limitations. Firstly, the sample sizes for each of the four analysed paths were quite small, which may limit the generalisability of the findings. In addition, the study artificially selected pedestrians to achieve a 1:1 gender ratio, which limits the study of the actual gender composition of street users. Extending the conclusions from these streets and sampled participants to the broader Hong Kong context requires caution, as spatial, social, and demographic variations across districts may produce different patterns of pedestrian perceptions and behaviours. Secondly, the Tseung Kwan O new town cannot be directly compared with areas in Hong Kong with higher population mobility (e.g. Hong Kong Island and Tsim Sha Tsui), which have a more complex demographic composition and more diverse street conditions. Our study findings are therefore more relevant for comparison with similar new towns.

In addition, the study was only conducted during daytime in October and November. Future studies can employ a larger sampling strategy to determine the potential impact of weather variables. Follow-up pedestrian satisfaction surveys could incorporate studies of pedestrian socio-economic characteristics such as age, income, occupational status, or travel habits, as these groups may also exhibit perceptual differences based on attributes other than gender.

The design strategies proposed in this study are speculative, and their real-world implementation would be subject to further development considering feasibility and integration with existing urban infrastructure on site. Complex interventions, including tree canopy expansion or improvements to public transport access, would require multi-departmental coordination across Hong Kong's complex regulatory and managerial frameworks. International examples of public realm improvements may serve as evidence to guide how such improvements can be both practically implementable and socially sustainable, when effective top-down coordination is focused on improving pedestrian experiences.

7. Conclusion

This study delved into gender sensitivity of urban pedestrian spaces in Hong Kong, underscoring the importance of integrating a gendered perspective into urban planning through qualitative and quantitative research methodologies. Tseung Kwan O in Hong Kong was selected as case study to conduct questionnaire surveys and data analyses, which revealed disparate perceptions of walking spaces among different genders and their subsequent impact on satisfaction with the walking environment.

The analysis of satisfaction surveys across four distinct types of streets revealed that respondents preferred pedestrian areas that were free of motor vehicle traffic and lined with shops. Student's t-test has demonstrated that females generally reported lower satisfaction with walking spaces compared to males, indicating a need for urban planners to pay greater heed to gender disparities and female preferences. Principal component analysis (PCA) revealed that females exhibited heightened sensitivity to ser-

vice facilities, lighting, and landscaping within walking spaces, while males prioritized motor vehicle speed and road safety.

This study advocates gender sensitivity as a fundamental aspect of urban planning and design in Hong Kong. Future research should focus on enhancing women's participation and sense of security in urban public life by improving walking spaces. Concurrently, there is a need for further exploration into how a gender perspective can be embedded into the planning of walking spaces in Hong Kong and beyond, to achieve a more comprehensive and nuanced urban design. This, in turn, will foster gender equality and social inclusion.

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Appendix

		Path A	Path B	Path C	Path D	All
Interviewed pedestrians [No.]		10	10	10	10	40
Average age [years]		37	43	32	47	39.75
Gender	Female [%]	50	50	50	50	50
	Male [%]	50	50	50	50	50
	Non-binary [%]	0	0	0	0	0
Employment status	Employed [%]	20	10	50	20	25
	Unemployed [%]	0	20	0	0	5
	self-employed [%]	10	0	0	0	2.5
	Students [%]	50	30	20	30	32.5
	Retired [%]	20	40	20	50	32.5
	Others [%]	0	0	10	0	2.5
Trip purpose	Work [%]	10	10	40	20	20
	Study [%]	10	10	30	30	20
	Shopping [%]	30	50	10	0	22.5
	Sport [%]	30	10	10	50	25
	Others [%]	20	20	10	0	12.5
Frequency	Many times, a day [%]	10	40	10	0	15
	Once a day [%]	30	40	70	80	55
	Once a week [%]	20	10	10	10	12.5
	Rarely [%]	40	10	10	10	17.5

Table 1. Characteristics of the sample

Appendix

Category	Indicator	Questions	Path A	Path B	Path C	Path D	All
Safety	Lighting	Evaluation of protection for lighting	3.7	4	4.6	4.4	4.175
	Road safety	Evaluation of road safety	3.3	4.3	4.3	4.4	4.075
	Sidewalk safety	Evaluation of sidewalk safety	3.7	4.2	4.3	4.6	4.2
	Lanes	Evaluation of nuisance due to the number of vehicular lanes	3	2.1	1.1	0.8	1.75
	Road width	Evaluation of nuisance due to the width of the vehicular lane	2.9	2.4	1.6	0.3	1.8
	Vehicular speed	Evaluation of nuisance due to vehicle speed	3.1	2.1	0.7	0.4	1.575
	Vehicular flow	Evaluation of nuisance due to vehicular flow	2.2	2	0.9	0.3	1.35
	Bike flow	Evaluation of nuisance due to bike flow	1.6	1.7	1.2	0.7	1.3
	Bike speed	Evaluation of nuisance due to bike speed	1.9	1.7	1	0.7	1.325
	Opposite direction flow	Evaluation of nuisance due to opposite direction flow	1.2	1.9	1	0.9	1.25
	Same direction flow	Evaluation of nuisance due to same direction flow	1	2	1	0.4	1.1
Convenience	Furniture	Evaluation of convenience due to the presence of furniture	3.6	4	4.7	5	4.325
	Public transit access	Evaluation of convenience due to the public transit access	3.9	4.3	4.4	4.9	4.375
	Signage	Evaluation of convenience due to the presence of signage	3.5	4.2	4.2	4.5	4.1
	Restrooms	Evaluation of convenience due to the presence of restrooms	4	3.9	4.1	4.5	4.125
	Shops	Evaluation of convenience due to the presence of shops	3.6	4.5	4.5	3.4	4
Comfort	Width	Evaluate of the comfort due to width of pedestrian streets	3.6	4.1	4.8	4.6	4.275
	Condition	Evaluation of the street condition	4	3.9	4.4	4.2	4.125
	Trees	Evaluation of comfort due to tree presence	3.4	3.7	3.9	4.3	3.825
	Odour	Evaluation of comfort due to odour	3.7	3.2	4.3	4.8	4
	Noise	Evaluation of comfort due to noise	3	2.8	3.9	4.7	3.6
	Environment	Evaluation of comfort for the environment near the walkway	3	3.8	4.1	4.4	3.825
	Cleanliness	Evaluation of comfort for street cleaning	3.8	3.5	4.2	4.7	4.05
	Landscape	Evaluation of comfort for landscape	3.6	4	4.3	4.7	4.15
	Shade	Evaluation of comfort due to the presence of the shade	3.4	4.2	4.3	4.8	4.175
	Stress	Walking on this sidewalk is stressful.	1.9	1.9	1.2	1.4	1.6
	Distance between pedestrians	I prefer for there to be a distance between other pedestrians and myself.	3.9	2.1	1.1	1.4	2.125
	Too many pedestrians	There were too many pedestrians for me to walk freely.	1.7	2	1	0.5	1.3
	I prefer not to walk here	I would rather not walk on this sidewalk.	2.5	0.8	0.5	0.2	1

Source: Author

Table 2. Statistics about pedestrians' satisfaction (average values of evaluation rates)

Appendix

Factor loading (Rotated)							
Variable	**Component**						
	Factor1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Lighting	-0.237	-0.139	-0.046	0.226	0.107	0.059	**0.839**
Road safety	-0.269	0.131	0.359	0.241	0.436	0.446	0.151
Sidewalk safety	**-0.71**	-0.041	0.298	0.218	0.034	0.405	-0.153
Lanes	**0.893**	0.101	-0.164	-0.072	-0.278	-0.125	-0.074
Road width	**0.73**	0.136	-0.225	-0.363	0.074	-0.12	-0.171
Vehicular speed	**0.844**	0.241	-0.281	-0.235	0.003	-0.091	-0.002
Vehicular flow	**0.838**	0.286	0.142	-0.146	0.035	-0.253	0.002
Bike flow	0.089	0.331	**-0.873**	-0.006	0.145	0.008	0.112
Bike speed	0.277	-0.026	**-0.755**	-0.22	-0.261	-0.334	-0.13
Opposite direction flow	0.052	**0.866**	-0.051	-0.185	0.002	-0.292	-0.042
Same direction flow	0.189	**0.877**	-0.063	-0.017	0.075	-0.089	-0.016
Restrooms	-0.07	**-0.507**	0.434	0.344	0.457	-0.087	0.268
Condition	-0.208	0.068	0.431	**0.713**	0.069	-0.163	0.265
Cleanliness	**-0.538**	0.062	0.002	-0.007	**0.558**	0.026	0.134
Public transit access	-0.317	**-0.737**	0.261	-0.045	0.128	-0.194	-0.266
Signage	0.162	0.453	0.068	-0.166	0.084	-0.035	**0.767**
Shops	**-0.522**	-0.284	0.43	-0.021	0.495	0.011	0.388
Width	-0.348	-0.243	0.165	0.027	-0.054	**0.761**	-0.007
Furniture	-0.332	-0.07	0.027	**0.824**	0.144	0.062	-0.048
Environment	-0.31	**-0.593**	**0.593**	-0.085	0.147	0.203	0.006
Landscape	0.071	-0.254	0.134	**0.531**	0.315	**0.528**	0.37
Trees	-0.168	-0.058	**0.56**	**0.517**	0.431	0.204	0.021
Shade	-0.022	**-0.586**	0.068	**0.621**	0.065	0.189	-0.06
Noise	-0.238	-0.107	-0.311	**0.626**	**0.568**	-0.068	0.015
Odor	0.084	-0.01	0.098	0.219	**0.938**	0.1	0.049
Stress	0.472	0.108	-0.003	0.099	-0.129	**-0.604**	0.03
Eigenvalue (Rotated)	4.885	3.781	3.190	3.182	2.729	2.106	1.933
% of total variance	18.79%	14.54%	12.27%	12.24%	10.49%	8.10%	7.43%
Cumulative percentage	18.79%	33.33%	45.60%	57.84%	68.33%	76.43%	83.87%

Source: Author (Rotation Method: Varimax)

Table 3. The PCA analysis loading of male psychological elements and street factors

Appendix

Factor loading(Rotated)							
Variable	**Component**						
	Factor1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Lighting	0.231	0.36	0.222	**0.779**	-0.129	-0.195	0.174
Road safety	0.131	**0.502**	-0.376	-0.137	0.044	-0.261	0.479
Sidewalk safety	0.075	0.152	**-0.803**	-0.296	0.198	-0.166	0.181
Lanes	-0.053	-0.09	**0.83**	-0.129	0.162	-0.055	0.241
Road width	-0.399	**-0.513**	0.47	-0.11	0.035	0.146	0.329
Vehicular speed	-0.392	**-0.81**	0.235	-0.258	-0.044	0.026	0.147
Vehicular flow	-0.441	**-0.705**	0.242	-0.206	-0.198	-0.1	0.269
Bike flow	**-0.645**	0.048	-0.037	-0.05	**-0.594**	0.294	0.221
Bike speed	**-0.652**	-0.192	0.04	0.384	-0.463	0.259	-0.039
Opposite direction flow	-0.179	-0.013	0.035	-0.036	-0.172	**0.833**	-0.046
Same direction flow	-0.125	-0.146	0.206	0.027	0.14	**0.823**	0.234
Restrooms	-0.159	**0.855**	-0.048	0.267	0.013	-0.075	0.056
Condition	0.067	**0.636**	0.014	-0.254	0.387	-0.148	0.323
Cleanliness	-0.078	**0.581**	-0.304	-0.295	0.119	0.132	0.013
Public transit access	0.04	-0.037	-0.181	0.071	0.036	-0.183	**-0.913**
Signage	-0.126	-0.036	0.332	-0.034	**-0.623**	0.294	-0.05
Shops	**0.843**	0.091	0	0.251	-0.016	-0.075	-0.101
Width	**0.803**	-0.248	-0.107	-0.097	-0.279	-0.203	0.024
Furniture	**0.645**	-0.239	-0.111	0.417	0.393	0.191	-0.125
Environment	-0.161	0.371	0.099	0.072	**0.806**	0.287	-0.012
Landscape	-0.12	**0.711**	0.27	0.029	0.063	-0.432	0.312
Trees	**0.817**	0.351	-0.195	-0.136	0.169	-0.165	-0.055
Shade	0.221	0.161	**-0.663**	0.097	0.37	-0.432	-0.142
Noise	**0.747**	0.134	-0.074	0.309	-0.037	-0.037	0.331
Odour	0.06	0.069	-0.065	**0.895**	0.206	0.04	-0.283
Stress	-0.434	0.129	0.308	-0.448	0.335	-0.274	-0.311
Eigenvalue (Rotated)	4.807	4.323	2.832	2.609	2.502	2.501	2.036
% of total variance	18.49%	16.63%	10.89%	10.04%	9.62%	9.62%	7.83%
Cumulative percentage	18.49%	35.12%	45.01%	56.05%	65.67%	75.29%	83.12%

Source: Author (Rotation Method: Varimax)

Table 4. The PCA analysis loading of female psychological elements and street factors