Supplementary Material

(1) Questionnaire survey

Survey on the Pedestrian-Perceived Comfort of Streets in Nanjing

Dear Respondent,

We are conducting a survey to gauge your experiences regarding the pedestrian-perceived comfort in your daily life. The insights you provide will be instrumental in evaluating the current state of urban streets and in guiding our efforts to enhance the conditions for future improvements. The questions in this survey are designed to be broad in order to be applicable to a wide range of respondents. We appreciate your valuable feedback, which will help us improve urban street conditions in the future. To facilitate your understanding, we have simplified academic terms and abstract concepts into a more straightforward form.

Thank you for your participation.

1. Date: _____ Site: _____*

2. Your gender [Single-choice question] *

○ Male

○ Female

3. Your age

○ Under 18

○ 19–30

○ 31–40

○ 41–50

○ 51–60

○ Over–61

4. Your occupation

○ Student

○ Corporate employee

○ Self-employed

○ Other

5. The level of familiarity with this street

○ Very familiar

○ Fairly familiar

○ Familiar

○ Slightly familiar

○ Not familiar

6. What urban street space conditions are you concerned about? [Multiple-choice question]*

☐ Level of urban greening

☐ Extent of sky visibility

☐ Balance of urban greenery

☐ Width of non-motorized and pedestrian lanes

☐ Extent of motor vehicle street surface

☐ Proportion of the visual field occupied by surrounding buildings

☐ Density of surrounding road networks

☐ Number of chemical-pollution-related enterprises in the vicinity

☐ Number of nearby bus stops

☐ Number of industrial-noise-related enterprises in the vicinity

☐ Completeness of surrounding parking facilities

☐ Population density in the vicinity

☐ Height of surrounding buildings

☐ Degree of traffic congestion

☐ Proportion of street ancillary facilities

☐ Number of street intersections

☐ Cleanliness or aesthetic appeal of the street

☐ Sense of safety in the neighborhood

☐ Level of street maintenance

☐ Other

7. How would you rate the safety of this street? [Single-choice question]*

(1–3: Poor, 4–6: Fair, 7–8: Good, 9–10: Excellent)

☐ 10

☐ 9

☐ 8

☐ 7

☐ 6

☐ 5

☐ 4

☐ 3

☐ 2

☐ 1

8. How would you rate the comfort of this street? [Single-choice question] *

(1–3: Poor, 4–6: Fair, 7–8: Good, 9–10: Excellent)

☐ 10

☐ 9

☐ 8

☐ 7

☐ 6

☐ 5

☐ 4

☐ 3

☐ 2

☐ 1

Notes：

In this study, street ratings were collected through a questionnaire survey conducted with respondents who were familiar with the study area. Respondents were asked to provide subjective ratings of various streets within the study area, based on their perceptions of factors such as comfort, safety, traffic conditions, and overall environmental quality. Each street was rated individually by respondents on a Likert scale (e.g., 1 to 5, where 1 represents very uncomfortable or unsafe and 5 represents very comfortable or safe).

To ensure the representativeness and reliability of the collected data, the ratings from all respondents were aggregated. For each street, the average score across all respondents was calculated. This average score was used to assess the overall perceived comfort of the street. In cases where multiple respondents evaluated the same street, their individual ratings were combined to produce a single composite score that reflected the general public's perception of that street.

(2) Selection of questionnaire indicators

The results of questionnaire indicator selection are presented in Table S1. Table S2 presents the scoring results for partial streets in the questionnaire survey. The indicator selection results, ranked by the number of selections from highest to lowest, are presented in Table S3.

Table S1. Selection Results of Questionnaire Indicators

ID	Indicator	Related factors	Samples
1	Green view index (GVI)	Surrounding landscape	73/172
2	Street environment safety (SES)	Feeling of street environment safety	130/172
3	Pedestrian safety (PS)	Safety facilities on streets	108/172
4	Building enclosure (BE)	Surrounding landscape	67/172
5	Degree of street motorization (DM)	Street width ratio	87/172
6	Proportion of sky view (SV)	Surrounding landscape	52/172
7	Degree of street traffic congestion (DC)	Traffic flow smoothness	95/172
8	Proportion of street facilities	Safety facilities on streets	31/172
9	Number of enterprises related to industrial noise (EIN)	Noise level	59/172
10	Number of nearby bus stops (BS)	Convenience level	61/172
11	Number of street intersections (SI)	Convenience level	76/172
12	Height of surrounding buildings	Surrounding landscape	27/172
13	Density of the surrounding road network	Convenience level	19/172
14	Number of enterprises related to chemical pollution (ECP)	Air quality	63/172
15	Level of street cleanliness/aesthetics	Surrounding landscape	34/172
16	Degree of parking facility completeness	Convenience level	34/172
17	Population density	Sensation of safety	27/172
18	Street maintenance level	Street conditions	30/172
19	Others	Others	8/172

Table S2. Scoring Results of the Street Survey (Partial)

ID	Name	District	Grade	Safety score	Comfort score
1	Caochangmen Avenue	Gulou District	Arterial Road	8	9
2	Caochangmen Avenue	Gulou District	Arterial Road	7	7
3	Shuiximen Avenue	Jianye District	Sub-Arterial Road	5	7
5	Qingliangmen Avenue	Gulou District	Arterial Road	8	8
6	Dingxin Road	Qinhuai District	Arterial Road	5	7
7	Dingxin Road	Qinhuai District	Arterial Road	8	8
8	Zhonghua Road	Qinhuai District	Sub-Arterial Road	8	8
9	North Taiping Road	Xuanwu District	Sub-Arterial Road	8	8
10	North Taiping Road	Xuanwu District	Sub-Arterial Road	8	8
11	Yongji Avenue	Qixia District	Arterial Road	6	7
12	Xinyao Road	Qixia District	Sub-Arterial Road	7	6
13	Xinyao Road	Qixia District	Sub-Arterial Road	7	8
...	...	....	...	...	...
166	Lingyuan Road	Xuanwu District	Access Road	6	7
167	Ningdan Road	Yuhuatai District	Arterial Road	5	6
168	Anhuai Road	Gulou District	Access Road	5	5
169	Taishan Road	Jianye District	Access Road	8	8
170	Huanshan West Road	Yuhuatai District	Access Road	6	6
171	Huanshan West Road	Yuhuatai District	Access Road	4	4
172	Andemen Avenue	Yuhuatai District	Arterial Road	8	7

(3) AHP weight determination process

The AHP weight determination process is detailed in Tables S3 – S10. The scale of pairwise comparisons for the AHP is presented in Table S3 [2][79].

Table S3. Scale of Pairwise Comparison for the AHP

Weight	Definition	Description
1	Equal importance	Two elements have the same level of importance.
3	Moderate importance	The former element is slightly more important than the latter.
5	Strong importance	The former element is significantly more important than the latter.
7	Very strong importance	The former element is extremely more important than the latter.
9	Absolute importance	The former element is absolutely more important than the latter.
2, 4, 6, 8	Intermediate values	Intermediate values between the adjacent judgments above.

Based on field investigations, expert consultations, and a review of relevant literature, pairwise comparisons were conducted to determine the relative importance of indicators at various levels, forming the judgment matrix. For the first-level criteria used to evaluate pedestrian-perceived comfort on urban streets in Nanjing, the criteria layer weights are presented in Table S4. The judgment matrix, shown in Table S5, yielded a maximum eigenvalue (λ_{max}) of 5.039, a consistency index (CI) of 0.010, and a consistency ratio (CR) of 0.009. Referring to the random index (RI) table (RI = 1.120 for a 5th-order matrix), the CR value is less than the threshold of 0.1, indicating that the judgment matrix satisfies the consistency test. Consequently, the derived weights are deemed reliable and consistent.

A CR value less than 0.1 typically signifies that the judgment matrix meets consistency requirements, while a CR value exceeding 0.1 indicates inconsistency, necessitating adjustments before further analysis. The results of this study confirm that the constructed judgment matrix adheres to the required consistency standards, ensuring the validity of the weights calculated for the "Urban Street Pedestrian-Perceived Comfort Evaluation" objective.

Table S4. Criteria Layer Weights

Dimensions	Street safety	Street mobility	Street aesthetics	Street perceptibility	Street convenience	W_i
Street safety	1.000	2.000	3.000	3.000	4.000	0.4209
Street mobility	0.500	1.000	1.000	1.000	1.000	0.1569
Street aesthetics	0.333	1.000	1.000	1.000	1.000	0.1431

Street perceptibility	0.333	1.000	1.000	1.000	1.000	0.1431
Street convenience	0.250	1.000	1.000	1.000	1.000	0.1362

Table S5. Consistency test results summary

maximum eigenvalue (λ_{max})	CI	RI	CR	Consistency test
5.039	0.010	1.120	0.009	Pass

For assessing the relative importance of street safety indicators, the pairwise comparison outcomes are detailed in Table S6. The consistency ration (CR) is 0.0000, weight assigned to "Evaluation of Pedestrian-Perceived Comfort on Urban Streets" is 0.4209, and maximum eigenvalue (λ_{max}) is 2.000. These results satisfy the consistency test requirements.

Table S6. Weights for Street Safety Indicators

Street safety	PS	SES	W_i
PS	1.000	0.500	0.3333
SES	2.000	1.000	0.6667

For assessing the relative importance of street mobility indicators, the pairwise comparison outcomes are detailed in Table S7 The CR is 0.000, weight assigned to "Evaluation of Pedestrian-Perceived Comfort on Urban Streets" is 0.1569, and maximum eigenvalue (λ_{max}) is 3.018. These results satisfy the consistency test requirements.

Table S7. Weights for Street Mobility Indicators

Street mobility	RM	TC	W_i
RM	1.000	0.500	0.3333
TC	2.000	1.000	0.6667

For assessing the relative importance of street aesthetics indicators, the pairwise comparison outcomes are detailed in Table S8 The CR is 0.018, weight assigned to "Evaluation of Pedestrian-Perceived Comfort on Urban Streets" is 0.1431, and maximum eigenvalue (λ_{max}) is 3.018. These results satisfy the consistency test requirements.

Table S8. Weights for Street Aesthetics Indicators

Street aesthetics	GVI	SV	BE	W_i
GVI	1.000	3.000	2.000	0.5485
SV	0.333	1.000	1.000	0.2106
BE	0.500	1.000	1.000	0.2409

For assessing the relative importance of street perceptibility indicators, the pairwise comparison outcomes are detailed in Table S9 The CR is 0.0000, weight assigned to "Evaluation of Pedestrian-Perceived Comfort on Urban Streets" is 0.1431, and maximum eigenvalue (λ_{max}) is 2.0000. These results satisfy the consistency test requirements.

Table S9. Weights for Street Perceptibility Indicators

Street perceptibility	ECP	EIN	W_i
ECP	1.0000	1.0000	0.5000
EIN	1.0000	1.0000	0.5000

For assessing the relative importance of street convenience indicators, the pairwise comparison outcomes are detailed in Table S10 The CR is 0.000, weight assigned to "Evaluation of Pedestrian-Perceived Comfort on Urban Streets" is 0.1362, and maximum eigenvalue (λ_{max}) is 2.000. These results satisfy the consistency test requirements.

Table S10. Weights for Street Convenience Indicators

Street mobility	RM	TC	W_i
SI	1.000	0.500	0.3333
BS	2.000	1.000	0.6667

Based on the construction judgment rule, the authorization of each indicator in the standard and indicator layers was conducted, and the requirements for the indicator consistency test were verified. The authorization results of each indicator for urban roads in the main urban area of Nanjing are presented in Table S11.

Table S11. Weight of Each Indicator

ID	Indicator	Weight
1	SES	0.2806
2	PS	0.1403
3	TC	0.1046
4	BS	0.0908

5	ECP	0.0716
6	EIN	0.0716
7	GVI	0.0785
8	RM	0.0523
9	SI	0.0454
10	BE	0.0345
11	SV	0.0301

In this study, the AHP model comprised a top-level goal layer (Layer A), middle-level criterion layer (Layer B), and bottom-level indicator layer (Layer C). Based on the selected evaluation indicators, the AHP model was constructed with pedestrian-perceived comfort on urban streets as the goal layer. The first-level evaluation indicators included street safety (B1), street mobility (B2), street aesthetics (B3), street perceptibility (B4), and street convenience (B5) as the criterion layer. The second-level evaluation indicators comprised 11 factors—PS (C1), SES (C2), RM (C3), TC (C4), GVI (C5), SV (C6), BE (C7), ECP (C8), EIN (C9), SI (C10), and BS (C11)—forming the indicator layer. The final weights of each indicator factor are presented in Table S12.

Table S12.AHP Measurement of Street Comfort Index Weights

Goal	Criterion	Weight	Indicators	Weight
Pedestrian-perceived comfort on urban streets	Street safety	0.4209	PS	0.3333
			SES	0.6667
	Street mobility	0.1569	RM	0.3333
			TC	0.6667
	Street aesthetics	0.1431	GVI	0.5485
			SV	0.2106
			BE	0.2409
	Street perceptibility	0.1431	ECP	0.5000
			EIN	0.5000
	Street convenience	0.1362	SI	0.3333
			BS	0.6667

The results of the entropy method are shown in the Table S13.

Table S13. Weight of Each Indicator (entropy)

ID	Indicator	Weight
1	SES	0.0374
2	PS	0.1435

3	TC	0.0090
4	BS	0.3290
5	ECP	0.0027
6	EIN	0.0012
7	GVI	0.0641
8	RM	0.0195
9	SI	0.2235
10	BE	0.1334
11	SV	0.0369

The results of the EW-AHP method are shown in the Table S14.

Table S14. Weight of Each Indicator (EW-AHP)

ID	Indicator	Weight
1	SES	0.1078
2	PS	0.1426
3	TC	0.0367
4	BS	0.2601
5	ECP	0.0226
6	EIN	0.0216
7	GVI	0.0683
8	RM	0.0290
9	SI	0.1720
10	BE	0.1048
11	SV	0.0349

References

[2] Wei, Z.; Cao, K.; Kwan, M.-P.; Jiang, Y.; Feng, Q. Measuring the Age-Friendliness of Streets' Walking Environment Using Multi-Source Big Data: A Case Study in Shanghai, China. Cities 2024, 148, 104829. https://doi.org/10.1016/j.cities.2024.104829.

[79] Saaty, T.L. A Scaling Method for Priorities in Hierarchical Structures. Journal of Mathematical Psychology 1977, 15, 234–281, doi:10.1016/0022-2496(77)90033-5.