Research on Multidimensional Perceptions Evaluation of Historic Districts Based AHP-Fuzzy Comprehensive Evaluation Method

Yaohui Han(✉) and Le Li

Changchun University of Technology, Jilin, China
hanyaohui@ccut.edu.cn

Abstract. The level of public satisfaction is one of the criteria for measuring the quality of service-oriented government. The core purpose of multidimensional perception evaluation of historic districts is to actively improve the service quality of public spaces and enhance public satisfaction with urban cultural carriers. This paper takes the multidimensional perceptions evaluation of historic districts as an entry point, the aim is to explore how indexes determined based on diverse perceptual roles can be used to develop a comprehensive evaluation with a quantitative approach. Firstly, the Analytic Hierarchy Process (AHP) was used to determine the weights of the multidimensional perceptual styles by integrating the opinions of experts, and using the Fuzzy Comprehensive Evaluation Method to derive the evaluation results on the satisfaction of the multidimensional perceptual styles of three historic districts in Changchun City.

Keywords: Historic Districts · Multidimensional Perceptions · Analytic Hierarchy Process · Fuzzy Comprehensive Evaluation · Changchun City

1 Introduction

Studying the quality of public services from the perspective of public satisfaction has become an important research topic [7]. The Historic Districts is the evidence of a city's development lineage, it's also the core of the city's historical culture preservation and sustainable development. The evaluation of planning and renewal of historic districts is mostly from the perspective of static spatial image construction, however the vitality of the development of historic districts cannot ignore the organization, feeling and recognition of the site by people.

Most studies on the perceptual evaluation of historic districts focus on single sensory perceptions such as visual perception (Luo Xi et al., 2011; Chen Ranpeng et al., 2022) and auditory perception (Ren Xinxin et al., 2016; Liu Jiang et al., 2018). Assessing whether the material form, spirit of place, individual psychological spatial needs, and group social spatial needs of historic districts are better expressed and understood; it is necessary to make use of the multidimensional perceptual styles, which includes visual perception, soundscape perception, olfactory perception, tactile perception, and orientation perception; assessing the shortcomings of the historic districts' current situation

Z. Zhan et al. (Eds.): EIMSS 2022, AHCS 7, pp. 533–546, 2023.
https://doi.org/10.2991/978-94-6463-024-4_56

based on multiple perceptual roles, so as to enrich the effect of people's perception of the historic districts, thereby making people more willing to get comfortable and satisfied in it while soaking in the essence of urban culture.

2 Subjects and Data Sources

2.1 Subjects

Changchun is located in the middle of Jilin Province, which is the capital city of Jilin Province and an important old industrial base in Northeast China.

This paper selects the main urban area of Changchun City as the study area, and three historic districts within its scope as specific study subjects, including Renmin Street, Xinmin Street, and the First Automobile Works district. Renmin Street is one of Changchun's main representative roads running from south to north. It has been constructed for over a century and has carried the key historical development stages of Changchun city, with many public green spaces featured in the core of the city and magnificent heritage protection buildings adjacent to it, such as Culture Square, South Lake Park, Changchun World Sculpture Park and the Palace Museum. Xinmin Street was once designed as the imperial street of the Puppet Manchukuo, and it is the first historic district in Jilin Province, bringing together many precious relics and architectural relics of the pseudo-Manchukuo period. In 2015, the First Automobile Works district was named as a Chinese historical and cultural district by the housing ministry. Its street pattern and overall appearance are well preserved and have been in use, also its production, residential functions, and supporting facilities, scale and planning methods occupy a special position in the history of modern Chinese urban planning, as well as it has special values that cannot be replicated in terms of historicity, period style and memory of the times.

2.2 Data Sources and Collection

This paper uses expert interview survey method and questionnaire distribution at actual sites for primary data collection. A total of eight experts in related fields (all living in Changchun) were consulted, including two professors in urban planning, four associate professors in landscape planning and design, and two researchers in urban planning and design.

The experts assigned scores to the relative importance of multidimensional perceptions based on the current situation of construction and usage of Changchun's historic districts. In addition, 78 questionnaires were distributed separately to each of the three historic districts in July and August 2021. 71 questionnaires were valid for Renmin Street, 70 for Xinmin Street, and 74 for the First Automobile Works district. More than 60% of the respondents passed by the researched site more than twice a week, about 20% came to the researched site occasionally, and about less than 20% ever visited the researched site. In order to avoid the respondents' psychological focus, this questionnaire was conducted under the name of "evaluation of urban comprehensive environmental improvement".

3 Research Design and Methods

Firstly, the multidimensional perceptions evaluation set A = {A1-visual perception, A2-soundscape perception, A3-olfactory perception, A4-tactile perception, A5-orientation perception} of Changchun city's historic districts were assigned scores according to the results from experts' opinions, and the respective weight vector values of the multi-dimensional perception approaches of the historic districts, and the respective weight vector values of the multidimensional perceptual styles of the historic districts were calculated using AHP. The Analytic Hierarchy Process (AHP) is a research method that combines qualitative and quantitative approaches to solve multi-objective complex problems for calculating decision weights [2]. Based on the current situation and specificity of the historic district, the method mainly adopts the experience of experts to judge and measure the relative importance between different dimensional perceptual styles.

Secondly, the results of the survey were quantitatively analyzed by applying the fuzzy comprehensive evaluation method, which was based on the summary of the data from the research questionnaires of the three historic districts, i.e., the proportion of each perception evaluation index (25 indexes) selected. Fuzzy comprehensive evaluation provides evaluation of practical comprehensive problems by applying the principle of fuzzy relationship synthesis with the help of some concepts of fuzzy mathematics, which evaluates indexes that are not easy to quantify quantitatively and comprehensively in multidimensional perceptual evaluation of historic districts.

3.1 Construction of Multidimensional Perception Evaluation Indexes System

The act of landscape perception requires a combination of the multidimensional perceptual styles [6], any one of which alone is influenced by multiple intrinsic and extrinsic factors. This paper draws on the corresponding discussion of urban perceptual scales and perceptual roles by Xili Han of Peking University [1], according to the field research visited of Changchun's historic districts, and combined with the perceived roles corresponding to these five dimensions of perception as the basis for determining the evaluation index system (see Table 1).

3.2 Judging for the Weight Value

By means of a questionnaire, experts were asked to assign scores to the relative importance of the three historic districts in terms of their multidimensional perceptual styles (A1–A5), which used the 1–5 scale method, the geometric mean values were calculated assigned by 8 experts, the weight judgment matrix of the first-degree evaluation set (A = A1, A2, A3, A4, A5) was constructed (see Table 2). In addition, since the underlying evaluation indexes are the main assessment factors selected based on different perceptual roles, so the experts discussed together to set the weights of the secondary evaluation indexes (A-X) are consistent.

AHP was performed using SPSSAU18.0 software, and Table 2 the weight judgment matrix was entered into the software [4], which was calculated by Asymptotic Normalization Coefficient (ANC) (see Table 3). According to Table 3, we can conclude that the multidimensional perceptual styles' weights of Changchun's historic districts are

Table 1. Building an evaluation index system for historic districts based on multiple perception roles

First-degree evaluation set (A)	Perceptual roles	Secondary evaluation indexes (A-X)	Description of the meaning of the index
Visual perception (A1)	Viewing perspectives	A variety of viewing angles (A1–1)	A variety of viewing angles such as overlooking, looking down, looking up; suitable and diverse viewing points need to be provided, otherwise the lack of visual perceptual information seriously affects the efficiency and evaluation of the use of the landscape.
		Overall Sense (A1–2)	Amplify the distance of visual perception, provide a quality platform to observe the service places of leisure life and facilitate quick access to site information.
	Light and shadow effects	Light & Shadow Perception (A1–3)	A place enhanced by light will enrich the visual enjoyment, increase the infectiousness of the place, and multiply the feeling of warmth, while enhancing the sense of direction and liveliness of the space.
	Natural elements	Abundant and dense vegetation (A1–4)	Abundant and regionally distinctive native plants can enhance the city's sense of regional uniqueness and seasonality.
	Continuity	Continuous perceptual elements (A1–5)	Visual perceptual elements which is continuous occurrence creates a visual memory and enhances the friendly and intimate feeling of the environment.
Soundscape perception (A2)	Relatively quiet atmosphere	Quiet auditory perception (A2–1)	In a noisy urban environment, quiet auditory perception has become one of the main indexes for people to evaluate the environment of urban public space.
	Pleasant sound	Natural sound richness (A2–2)	Pleasant sounds such as water and bird calls will enhance the infectiousness of the landscape of the place.
	Living Voices	Appropriate volume of street sound (A2–3)	"Street sounds" (the sound of people talking, the noise of festivals) feel safe and balance the negative visual perception.

(*continued*)

Table 1. (*continued*)

First-degree evaluation set (A)	Perceptual roles	Secondary evaluation indexes (A-X)	Description of the meaning of the index
Olfactory perception (A3)	Nature's Taste	Strong botanical fragrance (A3–1)	The right plant scent will be pleasant to the senses and have a positive impact on relieving one's mood.
	The taste of a good life	Enhance the taste of environmental quality (A3–2)	Some flavors (e.g., the smell of food) can reinforce the sense of living atmosphere of a place, enhance the quality of the environment, and enrich the diversity and interest of the urban environment.
Tactile Perception (A4)	Proximity Sensation	Plants within reach (A4–1)	The trees' canopy offers a wealth of perceptual opportunities to visualize the wind, for birds to roost, and for people to touch the leaves.
	Protectiveness	Safe guarding facilities (A4–2)	Excellent protective tactile design can enhance the desire to stay in a space while defining it and increasing the opportunities for social interaction among users.
	Comfortability	Paving materials with comfort perception (A4–3)	Consider the comfort of tactile perception on the basis of regional climate characteristics.
		Suitable steps and ramps (A4–4)	The height ratio of steps and ramps, slip resistance, and whether they are sturdy and durable.
		Suitable location and sufficient number of seats (A4–5)	Sufficient outdoor seating can enhance opportunities for people to stay, socialize, and engage with nature.
		Comfortable materials for seats (A4–6)	The material affects the popularity of the seat.
		Appropriate temperature perception (A4–7)	In the winter of a cold city, sunbathing outdoors is the most enjoyable thing to do; in the hot summer, feeling the breeze is a pleasant thing to do.

(*continued*)

Table 1. (*continued*)

First-degree evaluation set (A)	Perceptual roles	Secondary evaluation indexes (A-X)	Description of the meaning of the index
	Pleasurability	Form-rich waterscape design (A4–8)	Waterscape is the most attractive element to touch.
		Sculpture design that provides opportunities for tactile perception (A4–9)	The sculpture will stimulate the occurrence of tactile perception, and its material, form, proportion and other characteristics lead to the generation of different interactive behaviors with it, while achieving the purpose of rendering the atmosphere of the place and accentuating the theme.
		Interesting paving materials (A4–10)	The unique paving materials in the place can inspire people to perceive, touch, explore and enhance tactile memory.
		Temporary outdoor installations (A4–11)	Increase the landscape's gradation and texture of the place, enrich the diversity and interest of the district, and promote the conversation between people and the environment.
Orientation Perception (A5)	Reachability	Degree of articulation between the boundaries of the site and the city (A5–1)	It is easier for people to access the site when the boundary of the site is seamlessly connected to the city's feeder roads and sidewalks.
		Clear path perception (A5–2)	Without relying on electronic devices such as GPS, the journey to your destination is filled with pleasurable experiences along the way.
	Spatial Imagery	Distinctive site characteristics (A5–3)	The urban imagery has local characteristics and respects the natural pattern characteristics of the site, which becomes a reference for people to establish a good orientation perception. For example, the topography, surface structures, and the superposition of topography and water.

(*continued*)

Table 1. (*continued*)

First-degree evaluation set (A)	Perceptual roles	Secondary evaluation indexes (A-X)	Description of the meaning of the index
	Distinctiveness	Landscape elements filled with unique memories (A5–4)	It contains intriguing events, elements that carry unique and rich activities and elements that become favourite references.

Table 2. The weight vectors judgment matrix of the first-degree evaluation set A.

A	A1	A2	A3	A4	A5
A1	1.000	2.500	5.000	1.667	1.250
A2	0.400	1.000	2.000	0.667	0.500
A3	0.200	0.500	1.000	0.333	0.250
A4	0.600	1.500	3.000	1.000	1.000
A5	0.800	2.000	4.000	1.000	1.000

Note. See Table 1 for detailed description of A1–A5 in the table.

Table 3. Results of the vector analysis for the First-Degree Evaluation set A

Item	Eigenvector	Weight Value	Max Eigenvalue	CI Value
A1	1.670	33.393%	5.010	0.002
A2	0.668	13.357%		
A3	0.334	6.679%		
A4	1.064	21.286%		
A5	1.264	25.286%		

Note. See Table 1 for detailed description of A1–A5 in the table. Max Eigenvalue are used to calculate CI values (consistency index), CI = (λmax-n)/(n-1), "n" denotes the order of the matrix.

ranked from the maximum to minimum is visual perception (0.334), Orientation perception (0.253), Tactile perception (0.213), Soundscape perception (0.133), olfactory perception (0.067).

Consistency test is needed for using AHP to study the weight calculation results, the consistency index CR values were calculated as CR = CI/RI, the smaller the CR value indicates that the consistency of the judgment matrix is better, usually CR < 0.1 to meet the matrix consistency test. The analysis test result of CR = 0.002 < 0.1 for the historic district was obtained through SPSSAU18.0 software (see Table 4), so the judgment matrix of the multidimensional perception analysis study satisfies the consistency test and the calculated weights are consistent [3].

Table 4. Weights and consistency test

Matrix	Max Eigenvalue	N	CI Value	RI Value	CR Value	Consistency Test Value
A	5.010	5	0.002	1.120	0.002	Pass

Note. CR = Consistency Ratio, RI = Random Index (Random consistency index obtained from 1000 simulations by the software).

Table 5. The weight judgment matrix of multidimensional perception for Renmin Street R1

Multidimensional Perceptual Style	Evaluation Index	Very satisfied	Moderately satisfied	General	Dissatisfied
A1	A1–1	0.254	0.352	0.296	0.098
	A1–2	0.492	0.394	0.114	0.000
	A1–3	0.366	0.395	0.255	0.014
	A1–4	0.380	0.422	0.198	0.000
	A1–5	0.535	0.352	0.113	0.000
A2	A2–1	0.338	0.324	0.324	0.014
	A2–2	0.352	0.395	0.211	0.042
	A2–3	0.268	0.437	0.282	0.013
A3	A3–1	0.091	0.176	0.324	0.409
	A3–2	0.028	0.211	0.093	0.253
A4	A4–1	0.352	0.437	0.211	0.000
	A4–2	0.381	0.464	0.155	0.000
	A4–3	0.394	0.394	0.212	0.000
	A4–4	0.352	0.436	0.212	0.000
	A4–5	0.437	0.338	0.211	0.014
	A4–6	0.351	0.426	0.196	0.027
	A4–7	0.394	0.366	0.239	0.000
	A4–8	0.000	0.000	0.000	1.000
	A4–9	0.000	0.254	0.493	0.253
	A4–10	0.000	0.156	0.366	0.478
	A4–11	0.000	0.156	0.366	0.478
A5	A5–1	0.282	0.408	0.282	0.028
	A5–2	0.253	0.409	0.239	0.099
	A5–3	0.479	0.366	0.127	0.028
	A5–4	0.394	0.352	0.169	0.085

Note. See Table 1 for detailed description of the letter codes in the table.

3.3 Fuzzy Comprehensive Evaluation

Firstly, the respondents selected the multidimensional perception evaluation index rubric about three historic districts, based on the current situation of the site and their real perceptions. The weight judgment matrix R1–R3 for each of the three historic districts were constructed according to the proportion of respondents' choices for each evaluation index (see Tables 5, 6, and 7).

As mentioned previously (Sect. 3.2), the weights of the secondary evaluation indexes (A-X) are consistent. This paper sets the set of comments = (very satisfied, moderately

Table 6. The weight judgment matrix of multidimensional perception for Xinmin Street R2

Multidimensional Perceptual Style	Evaluation Index	Very satisfied	Moderately satisfied	General	Dissatisfied
A1	A1–1	0.157	0.257	0.385	0.201
	A1–2	0.543	0.343	0.086	0.028
	A1–3	0.357	0.586	0.043	0.014
	A1–4	0.743	0.214	0.043	0.000
	A1–5	0.400	0.486	0.071	0.043
A2	A2–1	0.314	0.357	0.257	0.072
	A2–2	0.214	0.271	0.429	0.086
	A2–3	0.157	0.357	0.229	0.257
A3	A3–1	0.786	0.143	0.071	0.000
	A3–2	0.971	0.029	0.000	0.000
A4	A4–1	0.828	0.157	0.015	0.000
	A4–2	0.514	0.343	0.114	0.029
	A4–3	0.100	0.257	0.529	0.114
	A4–4	0.614	0.371	0.015	0.000
	A4–5	0.500	0.371	0.100	0.029
	A4–6	0.172	0.257	0.514	0.057
	A4–7	0.343	0.257	0.286	0.114
	A4–8	0.000	0.029	0.086	0.885
	A4–9	0.000	0.043	0.228	0.729
	A4–10	0.014	0.029	0.271	0.686
	A4–11	0.343	0.386	0.200	0.071
A5	A5–1	0.628	0.329	0.043	0.000
	A5–2	0.214	0.514	0.243	0.029
	A5–3	0.514	0.343	0.114	0.029
	A5–4	0.214	0.357	0.386	0.043

Note. See Table 1 for detailed description of the letter codes in the table.

Table 7. The weight judgment matrix of multidimensional perception for the First Automobile Works District R3

Multidimensional Perceptual Style	Evaluation Index	Very satisfied	Moderately satisfied	General	Dissatisfied
A1	A1–1	0.189	0.446	0.338	0.027
	A1–2	0.649	0.243	0.095	0.013
	A1–3	0.622	0.243	0.108	0.027
	A1–4	0.473	0.365	0.122	0.040
	A1–5	0.703	0.243	0.041	0.013
A2	A2–1	0.459	0.500	0.041	0.000
	A2–2	0.230	0.338	0.378	0.054
	A2–3	0.351	0.378	0.217	0.054
A3	A3–1	0.608	0.351	0.014	0.027
	A3–2	0.649	0.230	0.122	0.000
A4	A4–1	0.608	0.311	0.068	0.014
	A4–2	0.500	0.311	0.149	0.041
	A4–3	0.284	0.446	0.189	0.081
	A4–4	0.338	0.378	0.230	0.054
	A4–5	0.149	0.203	0.486	0.162
	A4–6	0.068	0.189	0.500	0.243
	A4–7	0.351	0.500	0.108	0.041
	A4–8	0.000	0.027	0.243	0.730
	A4–9	0.149	0.162	0.473	0.216
	A4–10	0.203	0.189	0.351	0.257
	A4–11	0.162	0.243	0.378	0.216
A5	A5–1	0.459	0.311	0.176	0.054
	A5–2	0.568	0.324	0.108	0.000
	A5–3	0.459	0.473	0.068	0.000
	A5–4	0.216	0.459	0.270	0.054

Note. See Table 1 for detailed description of the letter codes in the table.

satisfied, general, dissatisfied). Using SPSSAU18.0 software, the study was conducted using the Weighted Averaging operator M $(\Lambda, +)$, which uses more R matrix information as the basis for calculating. After that, based on the corresponding fuzzy comprehensive evaluation matrix R1–R3 of the three historic districts, the weights of their first-degree evaluation set A were calculated respectively, and their evaluation results are detailed in Tables 8, 9, and 10.

Table 8. The weight calculation results of the first-degree evaluation set about Renmin Street

A	Membership Degree Normalization			
	Very satisfied	Moderately satisfied	General	Dissatisfied
A1	0.341	0.341	0.280	0.039
A2	0.332	0.352	0.291	0.025
A3	0.069	0.268	0.241	0.421
A4	0.223	0.317	0.317	0.143
A5	0.331	0.331	0.260	0.079

Note. See Table 1 for detailed description of the letter codes in the table.

Table 9. The weight calculation results of the first-degree evaluation set about Xinmin Street

A	Membership Degree Normalization			
	Very satisfied	Moderately satisfied	General	Dissatisfied
A1	0.356	0.372	0.165	0.107
A2	0.240	0.328	0.287	0.145
A3	0.804	0.137	0.057	0.002
A4	0.243	0.271	0.276	0.210
A5	0.346	0.373	0.243	0.038

Note. See Table 1 for detailed description of the letter codes in the table.

Table 10. The weight calculation results of the first-degree evaluation set about the First Automobile Works District

A	Membership Degree Normalization			
	Very satisfied	Moderately satisfied	General	Dissatisfied
A1	0.370	0.374	0.212	0.045
A2	0.345	0.385	0.228	0.042
A3	0.574	0.333	0.078	0.015
A4	0.248	0.262	0.273	0.217
A5	0.361	0.374	0.225	0.040

Note. See Table 1 for detailed description of the letter codes in the table.

The 5×4 weight judgment matrix was constructed based on the vector weight values of the first-degree evaluation set A and the calculated results of the first-degree fuzzy comprehensive evaluation belonging to the three historic districts. Using SPSSAU18.0 software, the study was conducted using the Weighted Averaging operator M (+), which combines the information of A matrix and R matrix as the basis of calculation. The

Table 11. Fuzzy comprehensive evaluation results of three historic districts

Historic District	Membership degree normalization			
	Very satisfied	Moderately satisfied	General	Dissatisfied
RS	0.294	0.330	0.282	0.095
XS	0.344	0.329	0.217	0.110
FAW	0.352	0.349	0.221	0.078

Note. RS = Renmin Street, XS = Xinmin Street, FAW = First Automobile Works District.

results of the combined weight calculation regarding the four sets of comments about the three historic districts were analyzed (see Table 11 for details).

4 Results

4.1 Fuzzy Comprehensive Evaluation Analysis About Multidimensional Perception Styles

In summary, the results of multidimensional perceptions fuzzy comprehensive evaluation of three historic districts in Changchun city show that the overall evaluation of the respondents is on the level of "Moderately Satisfied" and "Very Satisfied", the highest weight value of Renmin Street is moderately satisfied as 0.330, Xinmin Street is very satisfied by 0.344, First Automobile Works District is very satisfied by 0.352, so the overall evaluation is positively.

The evaluation results from the first-degree evaluation set A can indicate: (1) More than 68% of respondents on Renmin Street rated the results of visual perception and soundscape perception on two levels: very satisfied and moderately satisfied; more than 66% were relatively satisfied with orientation perception and above, more than half were also satisfied with tactile perception, but more than 40% were dissatisfied with olfactory perception. (2) More than 80% of respondents on Xinmin Street were very satisfied with olfactory perception, more than 70% rated visual perception and orientation perception as moderately satisfied and very satisfied, and more than 51% felt more satisfied and above in soundscape perception and tactile perception, while 21% were also dissatisfied with tactile perception. (3) More than 72% of respondents in the First Automobile Works District rated visual perception, soundscape perception, olfactory perception and orientation perception on both moderately satisfied and very satisfied, with 90% rating olfactory perception above the moderately satisfied. In addition, 50% of respondents were moderately satisfied and very satisfied with tactile perception, but the percentage of rating general and dissatisfied was also close to 50%.

4.2 Satisfaction Analysis of Multidimensional Perception Evaluation

The satisfaction data of 25 multidimensional perception evaluation indexes from the three historic districts were obtained through on-site questionnaires, and the scores were assigned for four rubrics, including 4 points for very satisfied, 3 points for moderately

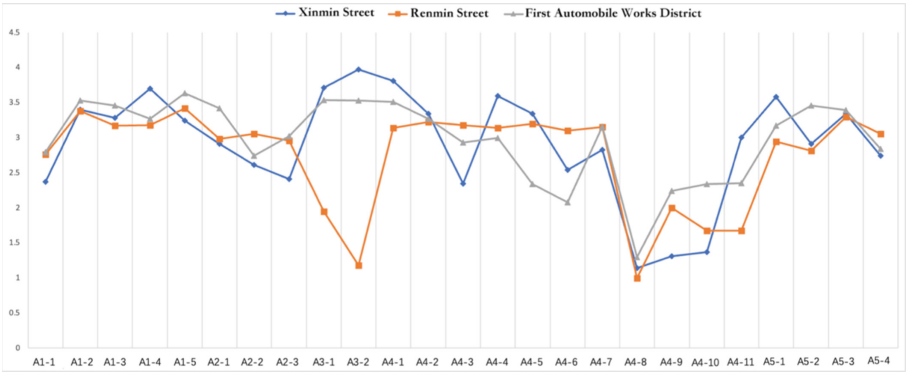

Fig. 1. Summary of satisfaction scores of multidimensional perception evaluation indexes in three historic districts.

satisfied, 2 points for general, and 1 point for dissatisfied. The total satisfaction score for a single historic district is the number of weights corresponding to each rubric multiplied by the corresponding score. The scores of the four rubrics were added together to calculate the total score, and the total satisfaction scores of the corresponding evaluation indexes of the three historic districts are shown in Fig. 1.

Among the 25 multidimensional perception evaluation indexes for the three historic districts, the common problems that need attention are specifically focused on the lack of diverse viewing perspectives, the extreme lack of rich waterscape design, sculptures that do not provide tactile perception opportunities, and paving that makes people feel dull, etc. Areas for improvement on Xinmin Street include enriching the natural sounds of the neighbourhood, increasing the impact of "street sounds", improving the comfort of paving materials and seating, and adding temporary outdoor installations. Renmin Street should pay attention to improving the quality of living environment and enriching the diversity of the neighbourhood, and it is also necessary to consider adding temporary outdoor installations to increase the landscape level and texture of the neighbourhood. There is an urgent need to increase the number of outdoor seats with comfortable materials in appropriate locations in the First Automobile Works District, which increase the opportunity for people to experience the charm of the neighbourhood and get in touch with nature.

5 Conclusions and Forecast

Human perception is not isolated, and the limitation of this study is to categorize different perceptual modalities and formulate evaluation indexes with parallel relationships, without much reference to the hierarchical relationships and interactions between perceptual roles. In addition, the physical and mental state of the respondents on site may also interfere with the research results.

Because different people come to the venue for different purposes and different levels of demand, the perceived preferences and behavioural characteristics of different people can be subsequently incorporated into the multidimensional perception evaluation for

detailed classification and collation [5]. Positive and negative perceptions often occur simultaneously and act together to create a multifaceted experience of the site. When faced with the interaction between a positive perception and a different negative perception, it is important to explore how to enhance the positive perception while weakening the negative perception, so as to optimize the multidimensional perception effect. These are the shortcomings of this paper and the suggestions for further research in the future.

References

1. Han X, Siostrom P (2015) City sence—hidden dimensions of urban places, 1st edn. China Architecture and Building Press, Beijing
2. Han G, Lu Y (2021) Research on visual accessibility assessment methods for urban parks. Landsc Architect 28(1):93–98
3. Luo X, Huang Y, Bi J (2011) Exploration of visual landscape evaluation methods in historical and cultural districts. J Landsc Res 3(1):21–24
4. Wang Y, Peng S (2022) Evaluation of regional characteristic landscape along the commercial pedestrian street based on AHP: a case study of Dongpo Bund in Huangzhou. J Landsc Res 14(1):4–9
5. Wang M, Li J (2021) A Study on the influence of landscape on visitors' emotion and behavioral intentions in urban historic and cultural cistricts: a case study of Xi'an historic and cultural district. J Southwestern Univ (Nat Sci Edn) 43(10):146–153
6. Wu G, Ma Y, Gao J (2012) Research on the evaluation of tourism resources in ancient capital cities based on tourists' perceptions. Arid Zone Resour Environ 26(2):186–191
7. Yang Q, Jia Y (2018) A study of public service satisfaction: a literature review. J Aba Teachers College 35(4):109–117