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Research on Public Space Micro-Renewal Strategy of Historical and Cultural Blocks in Sanhe Ancient Town under Perception Quantification

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Abstract: The public space environment of historical and cultural blocks is inseparable from human activities, which affects tourists' behavior and perception activities. Through the evaluation of tourists' environmental behavior perception, the relationship between spatial characteristics and tourists' perception is fully considered, which plays an important role in the protection and development of public space in historical and cultural blocks. This paper takes the historical and cultural block of Sanhe Ancient Town in Hefei as the research area, focusing on the public space of the block. Through the analysis of the semantic differential method and eye movement legal quantitative analysis, from the angle of psychological perception and visual perception, we carried out an analysis of the historical and cultural block's public space, and built the double sense of a comprehensive evaluation system of parsing the historical and cultural blocks with the whole situation of public space and the rule of the performance. The results show that: (1) the visual perception preference for spatial elements is in the order of architectural structure > green landscape > architectural decoration > commercial activities > participants > pavement > street furniture > others. (2) There is a significant correlation but not a complete convergence of psychological perception and visual perception. (3) Buildings, structures, and space formats play a key role in creating a sense of space scale, with the former playing a positive role and the latter a negative role. (4) The visual attraction of a green landscape is strong and can improve the visual quality of space. The research found that there are evaluation differences between the visual perception and psychological perception of spatial elements, which are significantly correlated but not fully convergent. Through quantitative analysis and the interpretation of tourists' perception from different perspectives, we can take relevant improvement and optimization measures for many deficiencies of public space in historical and cultural districts.

Keywords: public space; psychological perception; visual perception; semantic difference method; eye-movement apparatus; space elements

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1. Introduction

The public space of the historical and cultural block is regarded as a place where the history and culture of the city gather together, and it is the core area that reflects the cultural connotation of the city. Unique historical and cultural advantages are the essence and core of the public space of historical and cultural blocks [1]. Cultural elements have a strong attraction and sense of substitution for tourists, which affects the physiological and psychological reactions of tourists [2] and make it easier for people to obtain the environment image and place feeling with clear structure and vividness [3]. Therefore, in the study of the public space in historical and cultural blocks, more energy should be invested to protect and inherit.

At present, the research on the public space of historical and cultural blocks focuses on the protection and utilization of historical and cultural blocks, space optimization, and

organic renewal [4,5]. The research results are often reflected in the static effect of landscape changes after the transformation of historical blocks and the dynamic process of interaction between humans and the environment, that is, how people perceive the characteristics of the street landscape and tourists' preferences for different spatial characteristics [6].

In many cases of public space renewal design in historical and cultural blocks, due to the excessive pursuit of economic benefits and the use of a rough and fragmented transformation, the design of the public space in historical and cultural blocks towards a serious commercial trend is common. It is not uncommon to see designs that lead to the development of the public space in historical and cultural blocks towards serious commercialization. In the past decades, people have paid great attention to the relationship between the physical environment and human perception, cognition, preference, and behavior [7]. The study found that people's interaction with the public environment is mainly in the visual aspect. The landscape visual quality evaluation is one of the important methods of tourism resource evaluation [6]. The scholar Zhang Xiaomin uses visual perception evaluation to judge the degree of satisfaction of the landscape ecosystem and demand [8]. French scholars began to pay attention to the correlation between eye movements and mental activity in the 1890s. From the perspective of personal perception and environmental perception, the scholar Qin Yuhao determined that there is a correlation between human subjective perception and the green visual exposure index [9]; Sun Liang used the semantic difference method and eye movement experiments with exploration the interaction between pedestrians and a pedestrian mall, and made a comprehensive analysis of the perception data onto different interface forms [10]; Lohse used an eye tracker to conduct research on advertisement layout designs, and took yellow page advertisements as the object to understand how the characteristics of yellow page advertisements affect consumers' information processing behavior [11]; Guo Suling et al. recorded the eye movement data of college students when viewing landscape pictures through an eye movement experiment, and conducted a correlation and regression analysis between objective eye movement indicators and subjective visual quality evaluations [12]; Joel Mart showed that there was a relationship between the emotional potency of the environment and the quality of recovery by observing that the environment with a different recovery potential would lead to differences in eye movement and pupil size [13]. In order to explore the influence of some landscape elements on the restoration of attention, investigate the effect of landscape pictures with various attributes and characteristics on crowd cognition, and evaluate the construction effect of urban buildings, a data analysis of landscape elements and spatial elements was conducted by using eye movement tracking technology. The evaluation results showed that the study of visual preference is of great significance to urban design, the architectural environment, landscape environment improvement, and other aspects [14–16].

In this study, the semantic difference method (SD method) was used to construct the evaluation index system of spatial psychological perception. The common factors of space were summarized as the experience factor, scale factor, and atmosphere factor, and the weight of the common factor was calculated to comprehensively evaluate the spatial visual quality of each sample [15,16]. Eye movement tracking technology was used to analyze the participants' eye movement behavior and visual perception data of spatial elements, and to understand the visual perception preference of the participants for different spatial elements. The aim was to explore the correlation between psychological perception and visual perception, build a comprehensive evaluation system of public space of Sanhe Ancient Town's historical and cultural block under dual perception, and summarize the problems existing in public space, so as to propose targeted micro renewal strategies for the public space of historical and cultural blocks of Sanhe Ancient Town and carry out design practices.

2. Regional Overview and Methodology

2.1. Overview of the Study Area

Sanhe Ancient Town is located at the border between Hefei and Luan and on the shore of Chaohu Lake. It has a 2500-year cultural heritage and is one of the main sightseeing hubs around Chaohu Tourist Avenue (Figure 1). The overall layout of the historical and cultural blocks in Sanhe Ancient Town is in the shape of fish bones. The main streets are composed of West Street, Middle Street, and East Street, collectively known as Hebei Street, which is 2900 m long. The main street runs through numerous alleys and hutongs. Hebei street sections brings together different types, rich colors, and a degree of old and new landscapes; the public space is the most intuitive reflection of traditional style, with strong representativeness and maneuverability. Based on the comprehensive consideration of the case location and the experimental results, this study selected to choose this road as the experiment site, complying with the design of experiment of this study.

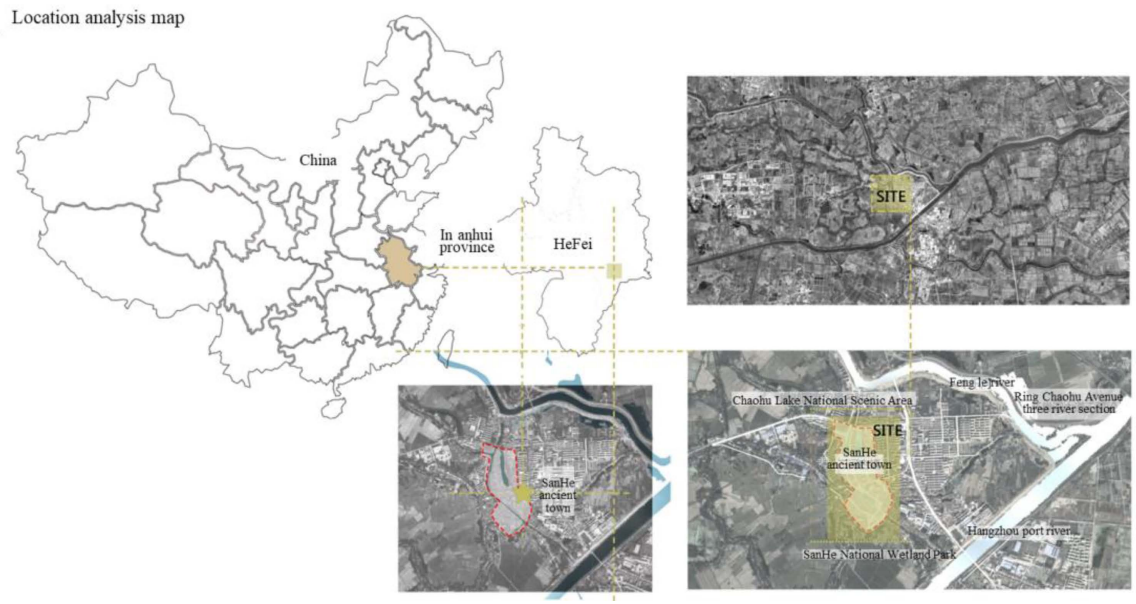

Figure 1. Location of Sanhe ancient town in Hefei.

2.2. Research Method and Process

2.2.1. Selection of Samples

(1) Site Sample Selection

Considering the constraints on human and material resources in site environmental evaluation, this paper selected photographic images as the media to conduct perceptual evaluation research [17]. In order to present the public space of historical and cultural blocks in the most complete and authentic way, using the expert scoring method and taking it as the criterion that the cultural features of Sanhe Ancient Town are representative, and that there are few interference factors, such as the shooting angle and light. Nine experts on landscape architecture and urban and rural planning were used to pre-screen the 500 survey pictures and obtain 50 pictures. Finally, 12 of the most representative sample pictures were selected as experimental research objects. Among them, there are two photos of the inner street space of East Street, Middle Street, and West Street, two photos of the outer waterfront space, two photos of the entrance space, and one photo of the intersection and the assembly square (Figure 2).

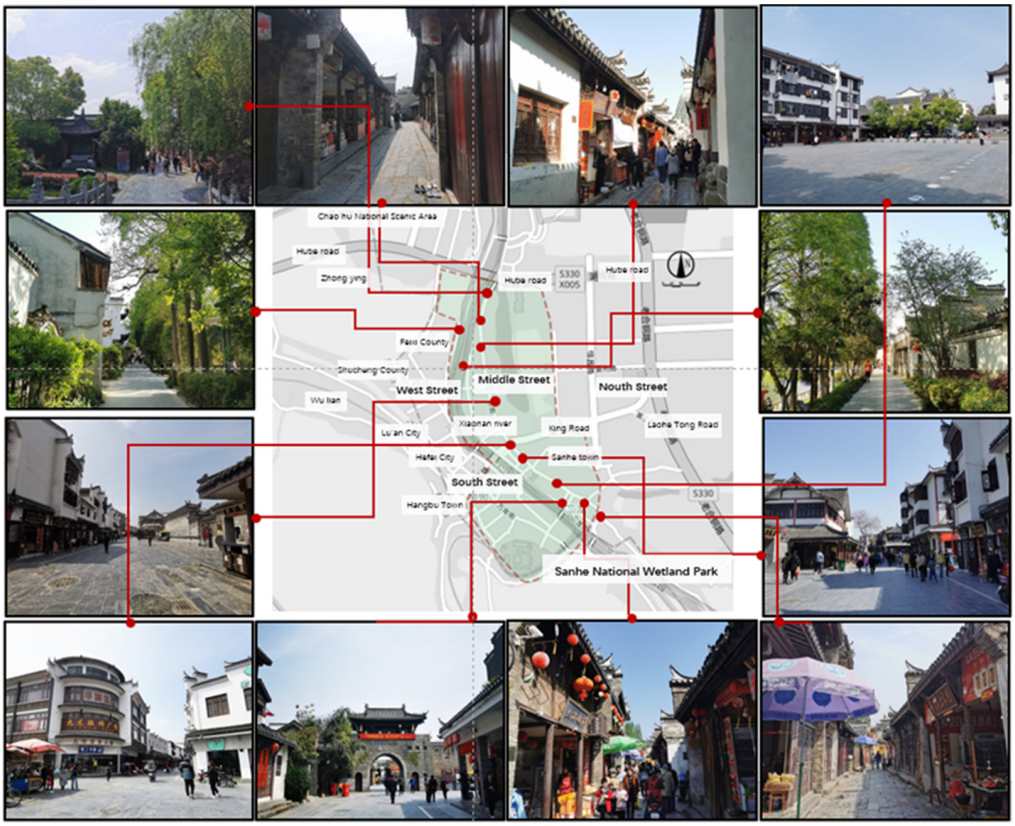

Figure 2. Distribution diagram of research samples.

(2) Selection of Subjects

The evaluation of semantic differences was carried out in the form of online questionnaires in this study (Appendix A). A total of 70 valid questionnaires were collected, including 35 for the professional group and 35 for the non-professional group. The respondents of the professional group were 11 men and 24 women, aged 18 to 30. The respondents of the non-professional group were 16 men and 15 women, with an age distribution of 30 from 18 to 30 years old, and five from 30 to 50 years old.

In the eye movement experiment study, 50 subjects were selected to participate, including college students of different majors and school staff, to ensure the common participation of people with various social attributes. There are 30 professional groups, including 10 males and 20 females, aged 18 to 30. There are 20 persons in the non-professional group, including seven males and 13 females. The age distribution is 18–30 years old, including 14 persons, and 30–50 years old, including six persons.

2.2.2. Psychological Visual Perception Evaluation

(1) Psychological Perception Evaluation

Based on the main components of the physical space environment and non-physical space environment of the public space in historical and cultural blocks of Sanhe Ancient Town, this paper searched, summarized, and screened the index factors based on the existing research results. The scope of the index factors was defined from the three dimensions of material factors, space atmosphere, and subjective feelings, and the psychological perception evaluation scale was constructed (Table 1).

Table 1. SD evaluates the selected adjective.

Spatial Perception Category	The Serial Number	The Evaluation Factors	An Adjective for
Material factors	1	Spatial openness	Open space–closed space
	2	Degree of spatial variation	Rich in spatial variation–monotonous in spatial variation
	3	Spatial characteristics	Distinctive–not distinctive
	4	Color perception	Brightly colored–dull in color
	5	The passage degrees	Unimpeded–congested
	6	Shade degrees	Shady–exposed to the sun
	7	Green degree	More green–less green
Space atmosphere	8	Aesthetic	Beautiful–not beautiful
	9	Uniformity	Neat–messy
	10	Cleanliness	Clean–dirty
	11	Busy degree	Lively–cold and quiet
	12	Traditional style integrity	Intact in traditional style–lacking in traditional style
Experience	13	Comfort	Comfortable–uncomfortable
	14	Degree of safety	Safe–dangerous
	15	Attractive	Attractive–unattractive
	16	Likeability	Like–dislike
	17	Overall impression of space	Bad overall impression of space–good overall impression of space

Material factors describe people's intuitive impression of spatial scale and spatial pattern. Space atmosphere is concerned with the overall atmosphere of a space place; subjective feeling describes the psychological and emotional feelings conveyed by space, which is the most direct evaluation of people's environmental feedback. In the specific semantic difference method survey, each spatial element is determined as seven evaluation levels [18], namely, very poor, poor, general, good, and very good. The corresponding score of the seven levels is −3, −2, −1, 0, 1, 2, and 3 respectively.

(2) Visual Perception Evaluation

(1) Experimental steps

The equipment used was a Tobii Pro screen eye tracker, and the software used in the experiment was Tobii Studio 3.0 and ErgoLAB. The experimental steps include: ① explaining the purpose, process, and requirements of the experiment to the subjects; ② calibrate the eye tracker, adjust the distance and observation height of the subject and the eye tracker; ③ at the beginning of the experiment, select three warm-up pictures unrelated to the experiment to eliminate the eye movement interference with the subjects when they first enter the experiment. The playback time of each picture is set to 10 s; ④ the experimenter shall keep a distance from the subject so as not to affect the experiment; ⑤ after the experiment, semi-structured interviews were conducted with the subjects and subjective questionnaires were filled in to understand their perception of Sanhe Ancient Town [19].

In this study, the subjects' visual perceptions of the public space in the historical and cultural blocks of Sanhe Ancient Town were evaluated by physiological measurements obtained from eye movement experiments. It mainly consists of the implementation phase and the data (Figure 3).

(2) Division of spatial elements and selection of eye movements

The spatial elements of all samples are divided uniformly according to type attributes, and the spatial elements are divided into AOI regions of interest using ErgoLAB software (Figure 4).

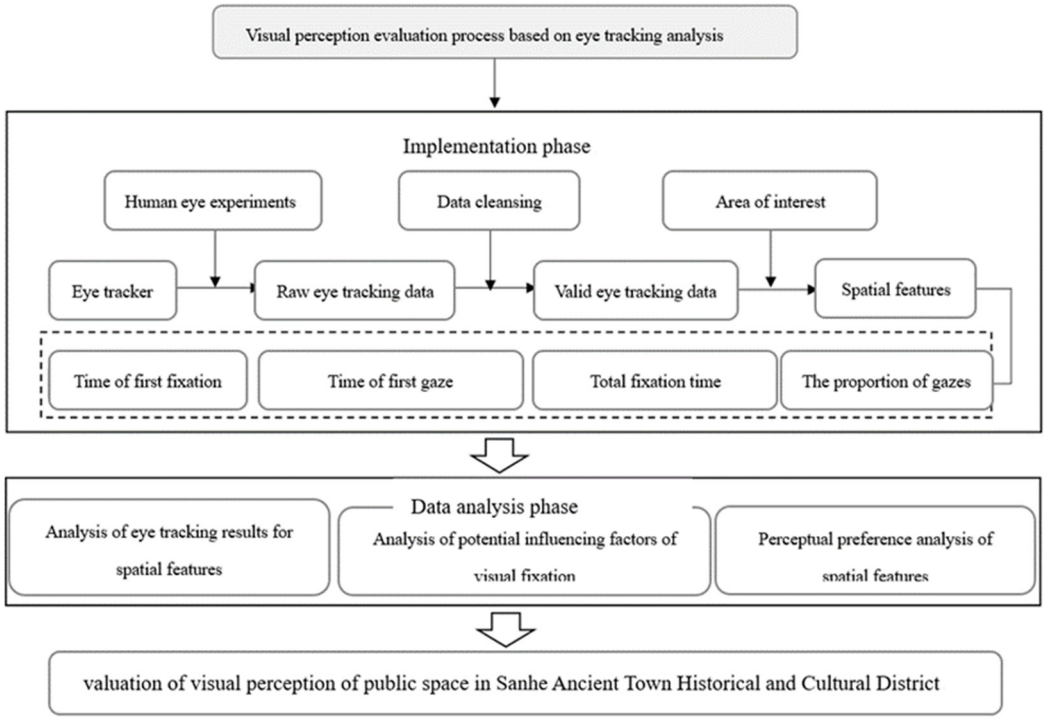

Figure 3. Overall flow chart of eye movement analysis.

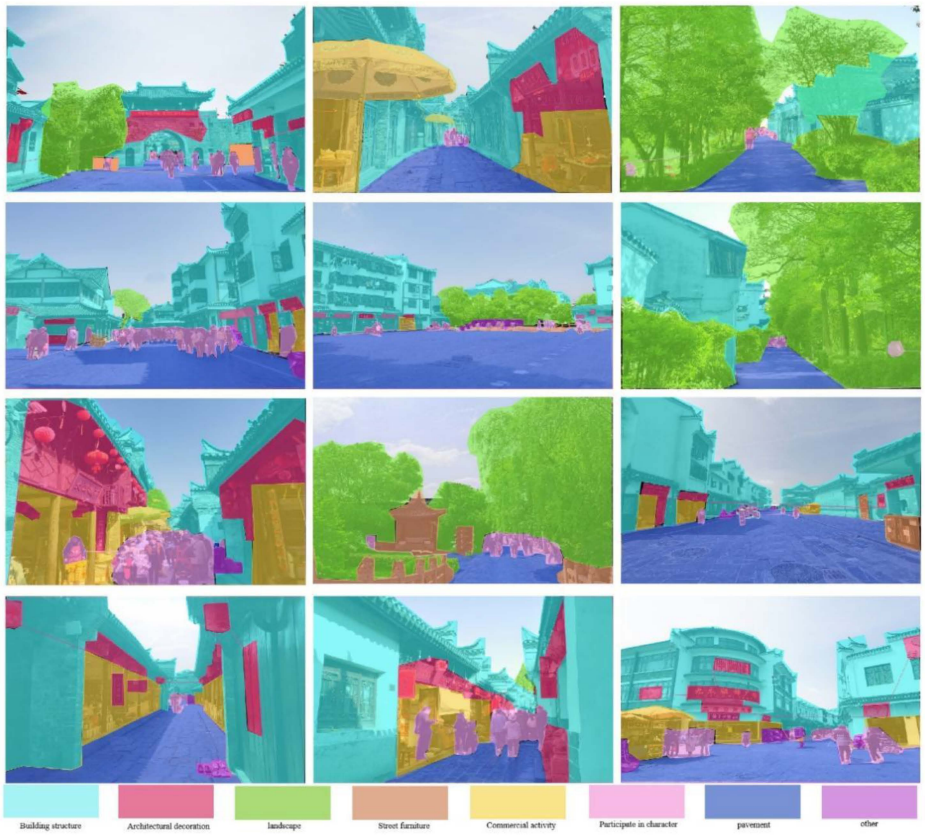

Figure 4. Division of spatial elements.

Space elements are divided into three dimensions, namely, buildings and structures, landscape facilities, and space formats, and eight subcategories (Table 2).

Table 2. Division of spatial elements.

Space Elements		Element Content
Buildings and structures	Building structure	Eaves, horsehead walls, doors and windows, walls, columns
	Architectural decoration	Lanterns, couplets, shop bidding card
Landscape facilities	Landscape	Halosols deserts
	Street furniture	Sketch, sign system
	Pavement	Material, style
Space forms	Business format	Commodity stalls, snack trucks
	Participate in character	Visitors, residents, workers
	Other	Household articles

(3) Data Processing Method

(1) Common factor variance

Common factor variance is the cumulative contribution rate of several common factor variances. The higher the cumulative contribution rate, the higher the representativeness or interpretation rate of the extracted common factors for the original variables, the better the overall effect.

$$Xp \times 1 = \mu p \times 1 + Lp \times mFm \times p + \varepsilon p \times 1$$

A p-dimensional observation random vector X is set. The factor analysis model represents X as m unobservable random variables (common factor) Fi and p error terms ε linear combination of i (called special factor), where μp × 1 is the mean vector of X.

(2) Factor weight calculation

The visual quality of a public space is interpreted as the experience factor, scale factor, and atmosphere factor, and it is difficult to comprehensively evaluate a single public factor. Therefore, the proportion of the variance contribution rate corresponding to each common factor is used as a weight to calculate the visual quality of each sample. The calculation formula is:

$$VQ = \frac{45.377}{90.299} * FAC\_1 + \frac{28.375}{90.299} * FAC\_2 + \frac{16.547}{90.299} * FAC\_3$$

where, VQ is the comprehensive evaluation value of the visual quality of public space; FAC_ 1 stands for experience factor, FAC_ 2 represents the scale factor, FAC_ 3 represents the atmosphere factor, in which the weight of each factor is the experience factor > scale factor > atmosphere factor.

(3) Pearson correlation formula

$$r = \frac{\sum (x - m_x)(y - m_y)}{\sqrt{(x - m_x)^2 \sum (y - m_y)^2}}$$

x and y are two vectors of length n; mx and my correspond to the mean values of x and y, respectively.

The *p* value (significance level) of the correlation can be determined in the following ways:

① Query the correlation coefficient table, where the degree of freedom is df = n − 2, and n is the number of observations (length) in x and y variables.

② Or calculate the t value as follows: the corresponding p value is confirmed by the t distribution table, where the degree of freedom is df = n − 2, and n is the number of observations (length) in x and y variables.

$$t = \frac{r}{\sqrt{1 - r^2}}\sqrt{n - 2}$$

If $p < 0.05$, the correlation between x and y is significant.

3. Analysis and Results

3.1. Psychological Perception Evaluation of Public Space

The statistical software Excel and SPSS21.0 were used to analyze the questionnaire data of the semantic difference method: the mean and standard deviation values of 17 pairs of adjectives from 12 samples were calculated by screening invalid data in Excel. The evaluation mean values of each sample were input into SPSS21.0 analysis software, and the data were analyzed for factor dimension reduction. The factors of similar effects were summarized and identified as three common principal component factors, namely the experience factor, scale factor, and atmosphere factor. Factor scores of the samples were counted, and the comprehensive evaluation value of the spatial visual quality of each sample was obtained by calculating the weight of each factor (Table 3).

Table 3. Factor score and comprehensive evaluation value.

	Factor Shaft			**Comprehensive Evaluation Value**
Sample Number	Experience Factor	Scale Factor	Environment Factor	Factor Axis 2
1	−0.45	0.71	1.12	0.20
2	−0.06	−1.08	0.03	−0.37
3	1.80	0.28	−0.87	0.83
4	−0.53	0.81	1.05	0.18
5	−0.62	0.64	−1.66	−0.40
6	1.92	−0.10	−0.08	0.91
7	−0.50	−2.15	0.49	−0.85
8	0.86	0.98	0.92	0.91
9	−1.15	1.32	0.04	−0.15
10	−0.12	−0.76	1.19	−0.09
11	−0.24	−0.48	−0.92	−0.44
12	−0.91	−0.17	−1.32	−0.75

3.2. Visual Perception Evaluation of Public Space

It can be seen from the analysis that AOI's first fixation time (TFF), first fixation duration (FFDS), total fixation duration (TFD), and fixation frequency ratio (FC%) are important eye movement indicators to measure the visual preference of spatial elements [20]. Eye movement data were collected and output by eye movement analyzer analysis software. Four eye movement indicators were selected from AOI to study the visual preferences of interviewees, namely, AOI first fixation duration (TFF), FIRST fixation duration (FFDS), total fixation duration (TFD), and the proportion of fixation times in each region (FC%). In order to evaluate fixation time more fairly and effectively, the average value of eye movement indicators was selected as a reference item [21], and the average value of eye movement data onto spatial elements was comprehensively counted (Table 4).

Table 4. Eye-movement data for the spatial elements.

	AOI	TFF	FFDS	TFD	FC (%)	Comprehensive Average
Buildings and structures	Building structure	1.33	0.26	2.43	31.01	7.7
	Architectural decoration	2.63	0.27	1.23	15.23	4.85
Landscape facilities	Landscape	2.20	0.27	1.92	25.30	6.85
	Street furniture	3.98	0.28	0.49	6.16	3.05
	Pavement	2.96	0.32	0.76	9.05	4.35
Space forms	Business format	3.03	0.28	1.27	15.76	3.40
	Participate in character	2.55	0.33	1.17	13.33	2.85
	Other	4.79	0.30	0.22	2.58	0.9

The dimensions of eye movement index values and psychological preference data of each spatial element were reduced by SPSS21.0, and the cumulative contribution rate of the factor was 82.423% > 60%, which confirmed that the data onto this factor was available. Factor analysis is used to aggregate the five indicators into a common factor analysis dimension according to the commonness of the five indicators after dimension reduction, which can more simply evaluate the preference for each spatial element.

The factor score of each space element is obtained by calculating the average value of the factor scores of each space element, which reflects that the three space elements of the architectural structure (1.7), green landscape (1.05), and architectural decoration (0.27) have the strongest preference; secondly, commercial activities (−0.04), participants (−0.36), and pavement (−0.47) have good preferences; on the contrary, the preference of street furniture (0.74) and others (−1.440) is relatively weak. That is, the order is architectural structure > green landscape > architectural decoration > commercial activities > participants > pavement > street furniture > others (Table 5).

Table 5. Landscape preference factor score.

	Category of Spatial Elements	Factor Score
Buildings and structures	Building structure	1.7
	Architectural decoration	0.27
Landscape facilities	Landscape	1.05
	Street furniture	−0.74
	Pavement	−0.47
Space forms	Business format	−0.04
	Participate in character	−0.36
	Other	−1.44

3.3. Dual Perception Comprehensive Evaluation Analysis

By entering the eye tracking index of each sample spatial element into SPSS21.0 for dimension reduction, it was extracted from three common factors to measure the visual preference of the participants for buildings and structures, landscape facilities, and spatial formats of a public space. The extracted three common factors were analyzed in pairs with the scores of the three common factors obtained by a psychological perception analysis: the experience factor, scale factor, and atmosphere factor, and the analysis results were shown in the following table (Table 6). From the correlation analysis results, it can be seen that the scale factor is significantly positively correlated with buildings and structures at the 0.05 level, and the spatial format is significantly negatively correlated to the 0.01 level, indicating a strong inverse linear relationship between the two, and there is no significant correlation between landscape facilities and psychological index factors. Through Equation (3), the comprehensive evaluation value of the spatial visual quality of psychological perception is further analyzed with the value of the eye movement index

after the dimension reduction of eight types of spatial elements. From the correlation analysis results, it can be seen that the visual perception preference of a green landscape and the spatial visual quality VQ is significantly positively correlated with the level of 0.05, that is, the spatial visual quality is affected by the green landscape, and there is a strong positive linear relationship between the two.

Table 6. Correlation analysis of visual perception preference with mental perception and spatial visual quality.

Correlation between Visual Perception Preference and Spatial Visual Quality									
		Building construction	Architectural decoration	Landscape	Street furniture	Pavement	Business format	Participate in character	Other
VQ	Pearson correlation significance (bilateral)	0.316 0.344	−0.577 0.063	0.766 * 0.027	0.370 0.415	0.105 0.758	−0.442 0.233	−0.291 0.359	0.576 0.135
Correlation between Visual Perception Preference and Psychological Perception Evaluation Factors									
		Buildings and structures			Landscape facilities			Space forms	
Experience factor	Pearson correlation significance (bilateral)	0.254 0.452			0.458 0.134			−0.189 0.556	
Scale factor	Pearson correlation significance (bilateral)	0.653 * 0.029			0.342 0.277			−0.711 ** 0.010	
Atmosphere factor	Pearson correlation significance (bilateral)	−0.226 0.504			−0.418 0.716			0.282 0.375	

Note: * significant correlation at level 0.05 (bilateral), ** significant correlation at level 01 (bilateral).

According to the results of statistical analysis, there is a certain correlation between visual preference for spatial elements and psychological perception, but it is not completely similar:

(1) Buildings, structures, and spatial formats play a key role in creating a sense of spatial scale, but there are contradictions between them. Buildings and structures play a positive role in shaping spatial uniformity, cleanliness, and safety, while excessive business prosperity will lead to a spatial order imbalance, which will negatively affect spatial uniformity, cleanliness, and safety. In addition, as visible carriers of the historical and cultural atmosphere, buildings and structures in the historic and cultural blocks of Sanhe Ancient Town show a trend of increasing and decreasing with spatial formats, which means that there is an imbalance between the cultural atmosphere and spatial formats in the historical and cultural blocks of Sanhe Ancient Town.

(2) A green landscape can improve the visual quality of space, and its quality has a profound impact on the spatial experience of the subjects. Combined with psychological perception analysis, it can be seen that the evaluation score of spatial psychological perception of a strong green plant enclosure is higher, giving people a better experience. Therefore, strengthening the management of landscape facilities is an important link to ensure the use experience of a public space in historical and cultural blocks of Sanhe Ancient Town.

(3) The order for visual perception preference for spatial elements is architectural structure > green landscape > architectural decoration > commercial activities > participants > pavement > street furniture > others. Therefore, in the subsequent optimization and update design of block public space, we can focus on these spatial elements and optimize and improve the existing problems in the space.

4. Discussion and Conclusions

4.1. Discussion

The psychological perception research of public space in the historical and cultural district of Sanhe Ancient Town has certain limitations in the evaluation of spatial details, and the use of eye movement behavior experiments to evaluate space also has shortcomings in macroscopic control. Therefore, the analysis results of the two perceptual evaluations are integrated and sorted out, and a comprehensive evaluation system of dual perceptions is established based on field research and analysis, and a targeted update strategy is proposed for the public space of the historical and cultural district of Sanhe Ancient Town (Figure 5).

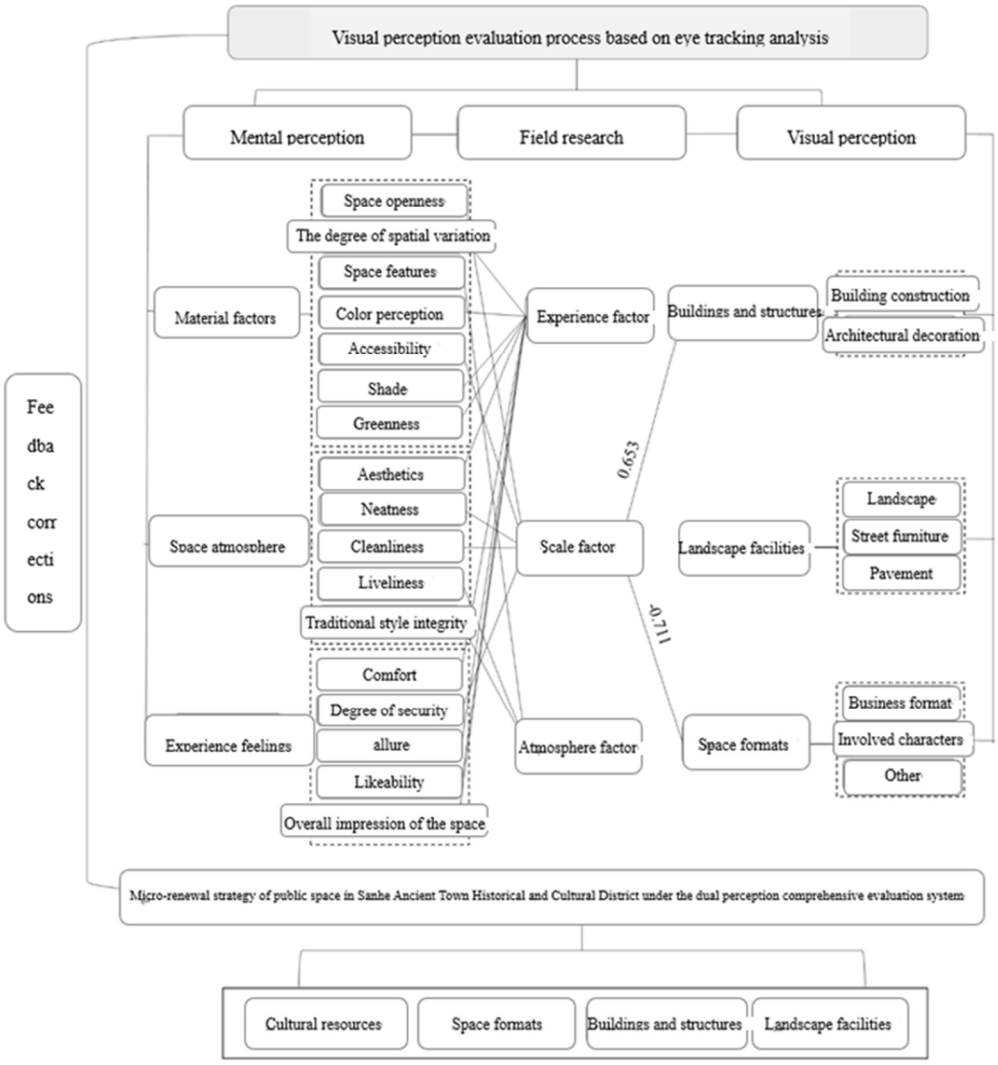

Figure 5. Double perception comprehensive evaluation system.

According to the dual-perception comprehensive evaluation system above, the evaluation differences between visual perception and psychological perception of spatial elements are compared and analyzed, and the problems existing on the four classification levels of cultural resources, spatial formats, buildings and structures, and landscape facilities in public space are summarized through comprehensive research and analysis. Due to the unique historical and cultural background, Sanhe Ancient Town's historical and cultural block has obvious resource advantages, but its development situation is not optimistic, exposing a series of problems, such as the gradual weakening of cultural deposits, the serious homogeneity of commercial forms, a poor landscape environment, and so on. In

view of the specific problems existing in public space, the paper puts forward micro-update strategies and discusses them in turn (Figure 6).

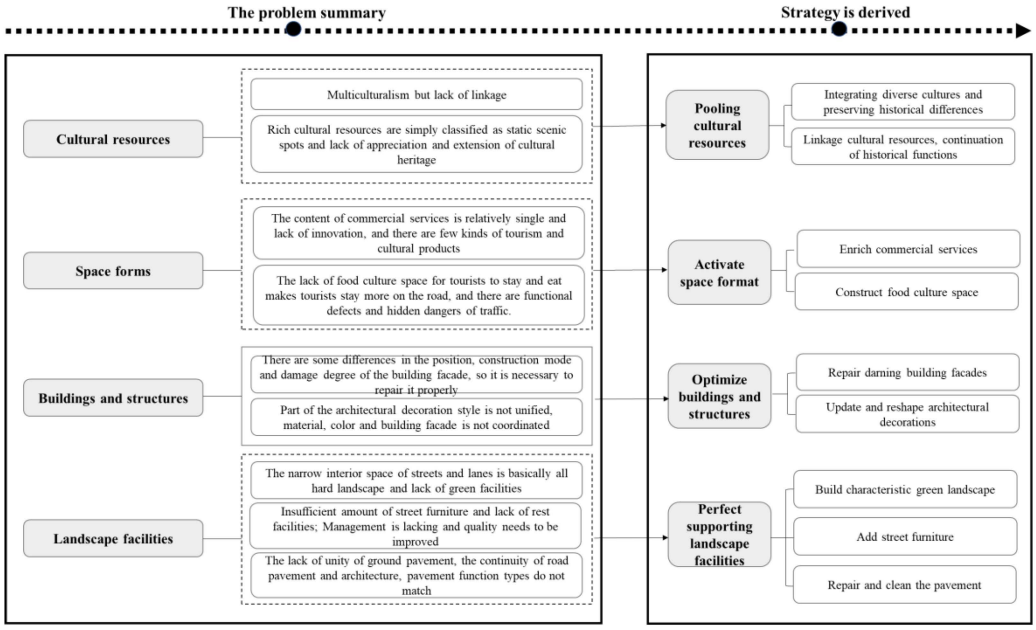

Figure 6. Derivation of micro renewal strategy of public space in historical and cultural blocks of Sanhe Ancient Town.

4.2. Micro-Update Strategy

4.2.1. Coordinating Cultural Resources

(1) Integrate diverse cultures and retain historical differences

Sanhe Ancient Town, has a profound cultural heritage, traditional skills, unique architectural culture, folk culture, history, and the humanities flourishing, unique school. The multi-cultural quality of Sanhe Ancient Town is sorted and coordinated, and cultural elements are introduced into the public space of Sanhe Ancient Town to form an interconnected and permeable historical and cultural space, play and enhance the context value of the space, retain historical differences, and reflect regional cultural characteristics.

(2) Linkage of cultural resources and continuation of historical functions

Combined with the main tourist routes inside the block, the stay space and exhibition space are added as the public activity places, and the cultural resources in the region are connected by the public space system to form a public space system with rich levels. When no more space can be created, the scene can be updated to give more functions to form a multi-purpose public space. For example, a square area can be used as an activity gathering area and commercial exhibition area during the day, as a lighting display area and outdoor film viewing area at night, and as a cultural display area and folk activity area during holidays, so that the space has multiple different scene functions interfering with each other and can be changed alternately, according to different activity needs.

4.2.2. Activating Space Formats

(1) Enrich commercial services

According to the above dual perception analysis, excessive commercialization will lead to the imbalance of spatial order, weaken the sense of historical atmosphere of the public space, and reduce people's identity in the regional culture of ancient towns. In the commercial implantation, once the food and beverage overflows, one will lose the cultural charm of the block, and it will be reduced to "one side of thousands of streets". Therefore, it is necessary to carry out the targeted guidance of key streets and lanes, enrich commercial

service content, integrate into cultural and creative industries, strengthen the display and utilization of ancient architectural relics and regional culture in combination with business forms, and improve cultural publicity and public experience. At the same time, commercial services should also take into account various consumer groups to increase the consumption willingness of local residents [22].

(2) Building food culture space

Based on the above dual perception analysis, it can be seen that the prosperity of the industry leads to the overcrowding of the inner space of the streets and lanes, especially the overflow of catering, which leads to the overcrowding of tourists in the streets and lanes, which leads to the overlap between the eating space and the traffic space, leading to a decrease in the spatial safety. Therefore, through the construction of an outdoor food culture space, one can guide din staff to evacuate the overcrowded flow of people, improving the tourists' playing experience. As most streets and lanes are a hutong linear spatial structure, the space available for development is relatively limited. Therefore, according to the characteristics of the above status quo, it is advisable to adopt the space creation method of "fitting in" to create a small and beautifully exquisite food space, and integrate food culture into the physical space to bring an authentic food experience to tourists.

4.2.3. Optimize Buildings and Structures

(1) Repair the darning building facade

Based on the above double perception analysis, the building facade has a great influence on the creation of spatial scale and a sense of a historical atmosphere. By updating the spatial elements of the building facade, it is consistent with the style of the whole building and the cultural context of the block. The repair of the objects used for more local damaged buildings and the repair to retain the identification features of historical information with historic buildings to distinguish "normal" material to repair (this "normal" building material refers to the building itself with no significant characteristics of building materials) helps to retain and texture characteristics of outstanding architectural history, highlighting the local traditional style. To update the design of building facades, "appropriate medicine" should be taken, according to the differences in the damage degree, location, and construction mode [23].

(2) Update and reshape architectural decorations

According to the above analysis of the visual perception, the visual perception preference score of architectural decorations is high. Attached to the facades of historical buildings, architectural decorations play an important role in creating a sense of historical and cultural atmosphere. In the renewal and transformation of architectural decorations, historical culture and folk culture should be taken as symbols of cultural elements and integrated into architectural decorations by means of cultural reproduction to fully show the cultural deposits of Sanhe Ancient Town. First of all, improve the design sense of the facade decoration of buildings along the street, and shops along the street can choose evergreen plants for decoration; secondly, for advertising signs, lanterns and other architectural decoration unified specifications and styles can be added to bring integrity to the street; finally, the architectural structure is decorated with Huizhou cultural elements. Applying the three Huizhou sculptures to the decoration of doors, windows, walls, and other structures, would not only be rich in decorative interest, but can also carry forward and continue the regional culture.

4.2.4. Improve Landscape Facilities

(1) Create distinctive green landscape

The Sanhe Ancient Town street space internal rigid rate is high, with a lack of green space. According to the above factor analysis results, there are a lack of green space samples of streets and lanes, and the comprehensive score of their visual quality is generally low. An

appropriate green landscape has a positive impact on people's psychology and physiology. However, the layout of green facilities is limited due to the spatial scale of street lanes, lanes, and hutongs. Therefore, according to the spatial characteristics of streets and lanes, the characteristic green landscape is shaped by a supplementary vertical green. For example, for the roof, eaves, walls, doors, and windows and other areas of the exterior of the building, the layout of hanging flower baskets, fixed flower pools, vertical greens, and other ways were included in a short time to achieve a green visual and the color enhancement of the interior space of streets and lanes. For areas with relatively spacious transverse spaces of streets and lanes, movable flower boxes, tree boxes, container flowers, movable flower beds, and landscape sketches are decorated [24].

(2) Add street furniture

The placement of street furniture in streets and lanes has a profound impact on road accessibility and directivity, which provides convenience for people and affects the overall style of street facades [25]. Based on the open interviews with tourists, some tourists are dissatisfied with the lack of signage systems in the street area, which causes inconvenience to travel. The core of adding street furniture is to supplement the space function of streets and lanes and update the street furniture with different functions according to the activity content and space demand of tourists [26]. It is mainly carried out from two aspects. One is to add a sign system, guide, drainage, assist the block to guide customers to watch and play, complete all kinds of information of the block play plan, and increase the tourists' play experience; the second is to add supporting landscape facilities, such as interesting sculpture pieces, leisure seats, and other stopover facilities, improve the interest and interaction of public space, and improve the functional requirements of the block.

(3) Repair and clean pavement

Pavement is a major component of the road interface, which can clarify the sense of direction of street space and intuitively reflect the sense of atmosphere of the road [27]. For the overall micro-update of the pavement in the public space of Sanhe Ancient Town historical and cultural block, on the one hand, the damaged area should be repaired or refurbished in case of serious pavement damages; on the other hand, the road surface needs to be regularly cleaned and managed, and the influence of environmental factors of the building on road traffic should be considered, such as residential supplies, garbage cans, tourist signs, parking spaces, etc. In the selection of materials, the local materials of Feixi County are given priority, and the material and color of pavement are coordinated with the architectural style. The style is mainly dark gray granite and blue SLATE, and the cultural elements are extracted and integrated into the pavement design [28].

4.3. Conclusions

As one of the famous historical and cultural relics of Hefei, Sanhe Ancient Town's historical and cultural district has a very strong cultural atmosphere. The development of the neighborhood spatial environment is inseparable from human activities, which affects people's spatial perception and behavioral activities. This paper uses environmental behavior research methods to study the public space of historical and cultural districts through the SD method and the eye tracking experimental method, conducts dual perception evaluation and quantifiable analyzes, and interprets the correlation between spatial characteristics and human perception.

It is found that the Sanhe Ancient Town historical and cultural district mainly has different degrees of problems of four aspects: cultural resources, spatial formats, buildings and structures, and landscape facilities. There are evaluative differences between visual perception and psychological perception between spatial elements, which are significantly correlated but not completely convergent. Through the quantitative analysis and interpretation of tourists' perception of different angles, relevant improvement and optimization measures can be carried out to improve and optimize the many deficiencies of public space in historical and cultural districts. Through spatial perception research, this paper discusses

the protection and renewal of public space in Sanhe Ancient Town historical and cultural district, improves and optimizes many deficiencies in public space in the current situation of the historical and cultural district, and proposes micro-renewal strategies and provides a scientific theoretical basis. Therefore, when studying the public space of historical and cultural districts, the relationship between spatial characteristics and human perception should be fully considered, and scientific methods should be used to study the perception laws and behavioral laws in the public space of historical and cultural districts. Only by following the people-oriented design concept can the public space of the historical and cultural district be effectively protected and renewed.

5. Study Limitations

This paper verifies the feasibility of environmental behavior research methods in the field of landscape and architectural space and can overcome the limitations of current "space-perception-behavior" research and design through a more accurate analysis of the spatial environment. However, there are still some shortcomings in the article, and the experimental data and population types can be further expanded in future studies to enhance the rigor of the conclusions. In addition, the article is a study of the public space of the historical and cultural district of Sanhe Ancient Town, which is regional and special. In the future, a variety of research objects can be used for comparative research, so as to make the public space renewal strategy of historical and cultural districts more representative.

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Appendix A

SD evaluation questionnaire for public space in Sanhe Ancient Town Historical and Cultural District, Hefei

1. Statement of Consent: I have been informed of the purpose of this study and I have read the informed statement. My tick below indicates that I am willing to participate in this study and will answer the following questions carefully. [Multiple choice question] *

A. agree B. disagree

2. Your Gender: [Multiple Choice Question] *

A. male B. female

3. Your age is: [Multiple choice question] *

A. Under 18 years of age B. 18–30 C. 30–50 D. Over 50 years old

4. Your occupation is: [Multiple choice question] *

A. Landscape architecture, urban and rural planning, interior design, architecture, and other related disciplines

B. Other unrelated majors

5. Please carefully watch the sample images and make corresponding judgments based on your first image of the pictures. Taking the adjective "closed" and "open" as an example; there are seven grades from "closed" to "open": if the score is −3, that is, "-very", it means very closed; a score of 3 is "very", which means very open; a score of 0, which is "medium", is somewhere between closed and open.

Please evaluate the spatial components of the space shown above. [Matrix Scale Question].*

	−3	−2	−1	0	1	2	3	
The space is closed	○	○	○	○	○	○	○	The space is open
Spatial changes are monotonous	○	○	○	○	○	○	○	Space is rich in variety
The characteristics are not distinct	○	○	○	○	○	○	○	Distinctive features
The colors are dull	○	○	○	○	○	○	○	Colorful
Space congestion	○	○	○	○	○	○	○	The space is clear
Exposed to the sun	○	○	○	○	○	○	○	Shady
Less greenery	○	○	○	○	○	○	○	A lot of greenery
Unsightly	○	○	○	○	○	○	○	Aesthetically pleasing
Messy	○	○	○	○	○	○	○	Orderly
Dirty	○	○	○	○	○	○	○	Clean
Deserted	○	○	○	○	○	○	○	Hilarious
The traditional style is defective	○	○	○	○	○	○	○	The traditional style is complete
Uncomfortable	○	○	○	○	○	○	○	Comfortable
Dangerous	○	○	○	○	○	○	○	Safe
Unattractive	○	○	○	○	○	○	○	Attractive
Don't like it	○	○	○	○	○	○	○	Like
The overall impression of the space is not good	○	○	○	○	○	○	○	The overall impression of the space is good

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