Research on Restorative Environmental Evaluation of Community Parks Based on Environmental Characteristics

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Abstract. This study takes eight community parks in Chengdu as the research object, collects and organizes images of their environment, and selects the most representative environmental sample data for quantitative analysis to explore the impact of different physical characteristics of community parks on the evaluation of psychological characteristics of restorative environments, and establish a subjective evaluation model. The result shows: (1) Each physical feature element could explain the psychological feature score, and the richness of landscape plants, landscape naturalness, green vision rate, and activity space abundance all have a positive impact on the evaluation of psychological characteristics of the restorative environment; (2) Each physical feature has different interpretations of the psychological feature score. The naturalness of the landscape explains the psychological feature score the most, followed by the green vision rate and the richness of landscape plants. On the contrary, the richness of the activity space has a negative impact. The research results could provide design method suggestions for restorative environmental construction of community parks, and also provide basic support for future restorative landscape research.

Keywords: Environmental characteristics · Community park · Restorative environment · Evaluation research

1 Introduction

The rapid progress of urbanization and industrialization has gradually separated the close relationship between people and nature in the city, and the physical and mental health of the population has continued to decline. Parks are an important resource to promote the mental health of the population [1]. As the material space carrier most frequently used by people and the most accessible for outdoor activities, community parks have a positive impact on the people's physical and mental health [2, 3]. It is particularly important to deepen the research on its restorative benefits. Studies have shown that watching photos and videos of the park's natural environment could reduce skin conductance, heart rate, and other physiological indicators of stress [4]. Walking in woods and other natural landscapes could reduce cortisol levels [5, 6], and walking 50 in the natural environment of a community park for 50 min could increase the impact of

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positive emotions [7]. Approaching to parks and green spaces could promote low levels of "mental stress" and greater mental health [8]. However, the existing research focuses more on the impact of the overall environment of the park on the recovery effect of the population, and seldom explores the difference in the recovery benefits of different environmental factors within the park, especially the lack of quantitative analysis of the recovery effect of the environmental factors on the population. Therefore, this study takes eight community parks in Chengdu as the research object to explore the relationship between the different physical elements of community parks and the evaluation of the psychological characteristics of the restorative environment, constructs a community park restorative environment evaluation model based on environmental characteristics, and put forward the planning and design principles and strategies of community park restorative environment.

2 Research Area and Sample Acquisition

The main urban community park in Chengdu is selected as the case area of this study. The selection principles include covering all districts in the downtown area of Chengdu, high utilization rate, relatively complete landscape types, and area control within 1–5 hectares. Based on the above principles, 8 samples of Chengdu community parks were finally selected based on actual research (Living Water Park, Supo Park, Jiulidi Park, Jinniu Park, Chadianzi Park, Nanzhan Park, Hemei park, Sanliguqiao Park).

Randomly divide 60 photos into 3 groups, numbered A, B, and C, with 20 photos in each group. After that, 60 college students were invited to participate in the restoration benefit experiment, and the restoration overall score was made on 60 sample photos of community park environment. Each group selects 10 sample photos with high scores, of which 3 sample photos are too repetitive. In order to ensure the scientificity of subsequent experiments, only one is kept, and 28 sample photos are finally obtained. After renumbering, as shown in Fig. 1.

Fig. 1. Community park restorative environment sample photo

3 Research Method

3.1 Psychological Characteristics Data Acquisition

The psychological characteristic data of the restorative environment of the community park is obtained from the psychological characteristic evaluation scale, which is composed of four parts, namely, distance, malleability, fascinating, and compatibility. Each item of the scale is performed in the range of 0 to 10 points, where 0 = does not meet the description of the sentence at all, 5 = some agree with the description of the sentence, 10 = completely agree with the description of the sentence.

3.2 Physical Characteristics Data Acquisition

Use the photo grid measurement method to identify and quantify the physical elements of the 28 photos obtained, The steps are shown in Fig. 2. The processed physical elements are presented in grids of different colors (Fig. 3), and the ratio of the number of grids occupied by different elements to the total number of grids can be used to obtain the proportion of the element (Fig. 4).

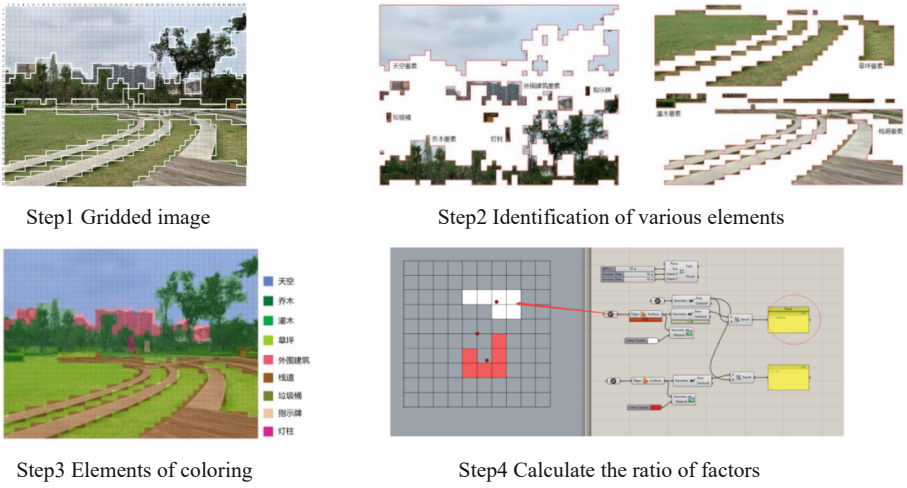

Fig. 2. Steps of photo grid measurement

3.3 Summary of Physical Characteristics

We summarized the physical characteristics of 28 sample photos through field investigations in community parks and combined with the physical elements of the sample photos (Table 1).

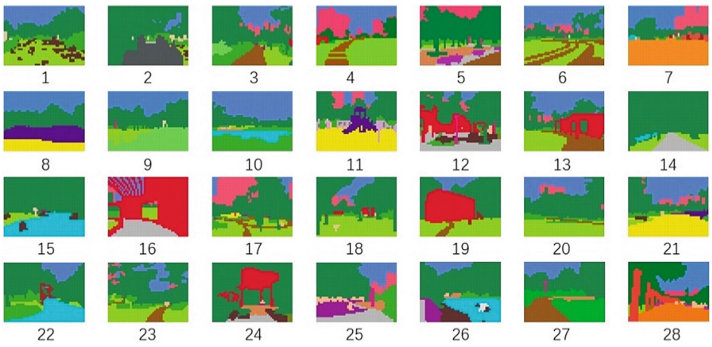

Fig. 3. Identify the processed sample image

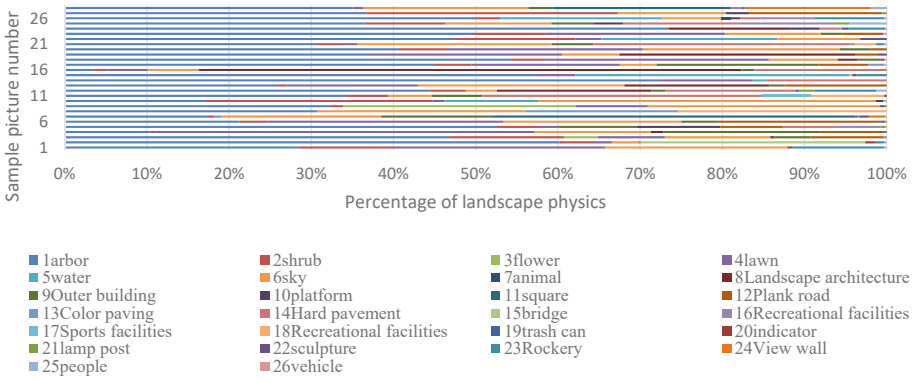

Fig. 4. Distribution of landscape elements in sample photographs

Table 1. Analysis on physical characteristics of restorative environment of Community Park

Number	Physical characteristics	Significance	Measurement methods
1	A Coverage of trees and shrubs	The area of trees and shrubs in the park	The proportion of trees and shrubs in the sample photos
2	B Coverage of flower lawn	The area of lawns and flowers in the park	The proportion of lawn and flower elements in the sample photos
3	C Waterscape coverage	The area of the water body in the park	The proportion of grass and water elements in the sample photos

(*continued*)

Table 1. (*continued*)

Number	Physical characteristics	Significance	Measurement methods
4	D Plant species richness	Number of plant species in the park	Statistics of the number of plant species in the sample photos
5	E The degree of undulation of the terrain	Undulating state of terrain	Divided into 5 levels based on sample photos from low-lying to mountainous areas
6	F Green vision rate	Percentage of green plants within sight	The proportion of trees, shrubs, flowers, and lawn elements in the sample photos
7	G Sky rate	The proportion of the sky in the line of sight	The proportion of sky elements in the sample photos
8	H Color richness	The obvious types of colors in the park	The statistical value of the number of main color types in the sample photos
9	I Landscape naturalness	The ratio of natural elements to artificial elements in the park	The ratio of natural elements to the total area of artificial elements and natural elements in the sample photos
10	J Richness of landscape sketches	The number and types of landscape sketches in the park	The proportions of bridges, sculptures, scenery walls, rockery, and gallery elements in the sample photos
11	K Richness of Recreational Space	The area of the open space in the park	The proportion of elements of recreational facilities and the type and quantity of rest space
12	L Activity space richness	The area of the activity space in the park	The proportion of sports, entertainment facilities, squares, platforms, hard paving, color paving, and human elements in the sample photos
13	M Internal environmental interference	The number and types of other physical elements in the park	The proportion of street lights, signs, trash cans, and vehicles in the sample photos
14	N External environmental interference	The area of the external environment of the park	Percentage of peripheral building elements in sample photos
15	O Total number of elements	Number of all physical elements in the park	Statistics of the number of physical elements in the sample photos

4 Result Analysis

4.1 Analysis of Psychological Characteristics

Calculate the psychological feature score of each sample picture according to the evaluation scale of the psychological characteristics of the restorative environment of the community park (Fig. 5), There are 13 pictures with a psychological feature score above 74.13.

4.2 Analysis of Physical Characteristics

From Fig. 6 we can see that there are 16 photos with physical feature scores above 37.14, among which there are 10 sample photos of community parks with a high score (above 40 points), of which the highest score is 43 points, which is 21 sample photos; there are 12 samples below the average score. The minimum score is 2753 points, which is 16 sample photos.

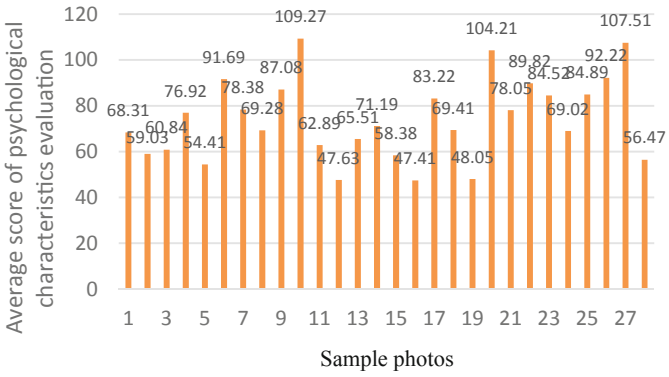

Fig. 5. The average score of psychological characteristics evaluation

5 Establishment of Restorative Environmental Assessment Model for Community Parks

5.1 Correlation Analysis

We use SPSS 22.0 software to analyze the correlation between the psychological feature evaluation score (dependent variable) and the physical feature evaluation score (independent variable): Psychological characteristics evaluation scores are positively correlated with A tree and shrub coverage rate and K resting space richness at the 0.05 level (bilateral), and D plant species richness and G sky rate are significantly positively correlated at 0.01 level (bilateral), and The abundance of J landscape sketches is significantly negatively correlated at the 0.01 level (bilateral), and is not significantly correlated with

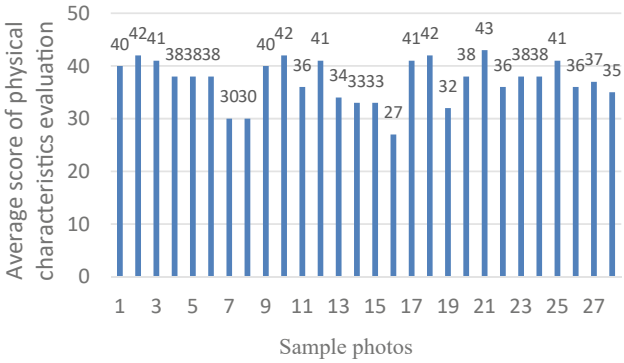

Fig. 6. The average score for physical characteristics evaluation

other landscape elements ($P > 0.05$). It shows that the evaluation scores of psychological characteristics are closely related to the physical characteristics. The naturalness of the landscape has the highest impact on restoration, but it cannot reflect the relationship between the evaluation scores of psychological characteristics and the combination of physical characteristics of the landscape. At the same time, natural physical characteristics are often more The psychological characteristics of physical characteristics are better evaluated.

5.2 Linear Regression Analysis

The multiple linear regression analysis (Table 2) shows that among the 15 independent variables, D plant species richness (Sig. $P = 0.004$), F green vision rate (Sig. $P = 0.001$), I landscape naturalness (Sig. $P = 0.000$), the significance of L activity space richness (Sig. $P = 0.004$) $< \alpha = 0.05$, so the null hypothesis that it is 0 is discarded, and the four physical characteristics have a linear relationship with the psychological characteristics. The established subjective evaluation model for the restorative environment of community parks is:

$$Y = 0.145X_D + 0.155X_F + 0.236X_I - 0.07X_L + 3.378$$

Where Y refers to the evaluation of psychological characteristics, X_D refers to the richness score of plant species, X_F refers to the green vision score, X_I refers to the naturalness score of the landscape, and X_L refers to the activity space richness score.

Table 2. Multiple linear regression analysis

	Standardization factor		Standardization factor	T Significance	
	B	Standard error	Beta		
Constant	3.378	.737		10.513	.001
A Coverage of trees and shrubs	−.032	.093	−.066	−.340	.740
B Coverage of flower lawn	−.001	.070	−.002	−.011	.991
C Waterscape coverage	−.043	.071	−.065	−.599	.561
D Plant species richness	.145	.042	.327	3.466	.004
E The degree of undulation of the terrain	−.022	.056	−.032	− .392	.702
F Green vision rate	.155	.076	.470	9.032	.001
G Sky rate	.001	.054	.002	.024	.981
H Color richness	.121	.043	.205	2.775	.017
I Landscape naturalness	.236	.136	.551	11.738	.000
J Richness of landscape sketches	−.009	.055	−.018	−.157	.878
K Richness of Recreational Space	.017	.077	.014	.224	.827
L Activity space richness	−.070	.045	−.324	−3.557	.004
M Internal environmental interference	.033	.081	.072	.411	.688
N External environmental interference	.016	.031	.031	.513	.617
O Total number of elements	.084	.058	.121	1.450	.173

Dependent variable: psychological characteristics.
Independent variable: physical characteristics.

6 Conclusion and Outlook

In this paper, taking community parks in the main urban area of Chengdu as an example, through the subjective evaluation method of restorative environment, the sample photos of restorative environment in selected community parks are collected and mathematically analyzed to establish a subjective evaluation model. The results show that each physical feature element can explain the psychological feature score, and the richness of landscape plants, landscape naturalness, green vision, and activity space abundance have a positive impact on the evaluation of psychological characteristics of the restorative environment. Each physical feature has different interpretations of the psychological feature score. The naturalness of the landscape explains the psychological feature score the most, followed by the green vision rate and the richness of landscape plants. On the contrary, the richness of the activity space has a negative impact. The research results can provide data support for improving the public space quality of community parks and promoting the construction of healthy cities.

This study has certain limitations in the process of restorative environmental evaluation: the physical elements of the evaluation are relatively independent, and there are deficiencies in the combination of physical elements; in addition, the subjective evaluation of the restorative environment cannot reflect the psychological changes of the subjects in the evaluation process. The experimental design should be optimized in the follow-up, and the quantitative research on the restorative environment of community parks should be further carried out.

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