Restoration of Road Landscape Space on Campus: A Case Study of Tianjin University

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Abstract In order to study the restoration of road landscape space, subjective evaluation method was adopted to visually evaluate different road spaces in Tianjin University with college students as the research objects. Using random block design, 9 plots were quantitatively studied by Perceived Restorativeness Scale (PRS) from four dimensions: alienation, compatibility, richness and attractiveness. The results show that gray space has the worst restorative effect in the dimension of alienation, and can not bring people the feeling of being away from daily trivialities; in terms of compatibility dimension, green and blue spaces have better restorative effects; richness dimension has no obvious influence on the restoration of plots; in terms of attraction dimension, blue space has strong restorative ability and can easily attract people's attention, while gray space has low attraction. There are differences in environmental restoration among different types of road space, and gray space, blue space and green space show weak, strong, and relatively stable restorative effects, respectively.

Keywords Campus road, Landscape space, Restoration, Tianjin University

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The main body of activities on university campus is college students, and campus mainly serves the student group. In recent years, a series of problems such as academic pressure and social communication have resulted in relatively high overall pressure level of college students[1]. The green space on campus, as one of the components of the campus, can bring psychological restoration for students, which is also a nonnegligible function[2]. Frederick Law Olmsted, a master of urban landscape design, holds that the natural landscape of cities plays an indispensable positive role in the mental health of residents. The theoretical concept of restoration has been paid more and more attention by researchers in the field of environmental psychology[3]. Chinese classical gardens emphasize the unity of nature and man, and focus on relieving the pressure with nature. Species richness in urban green space is not only a natural resource, but also a resource that has a positive impact on human health and happiness[4]. Zhang Liang[5] concluded that traditional gardens can provide reference and inspiration for the modern theory of restorative environment, and help to promote the green ecological construction of modern cities and improve the physical and mental health of human beings. In recent years, different types of environments have been assessed, including but not limited to the natural environment of blue space and green space[6]. The restorative potential of environment for psychological problems has attracted much attention. Based on descriptive information statistics such as Perceived Restorativeness Scale (PRS), Ye Liuhong et al.[7] translated, modified and completed the first Restoration Environment Scale (Chinese version). For the construction of public space system, some scholars suggest that the construction quality of human settlement environment can be improved by building public open spaces such as urban park green space and ventilation corridor[8].

The campus road, as the skeleton, is one of the spaces that students walk through every day. The research mainly focused on different types of road space, with college students as the research objects. Through field investigation, questionnaire survey, statistical analysis and other research methods, the related researches based on restorative environment were classified according to different types of road space. Questionnaires were distributed to investigate college students' evaluation of the restoration of different landscape spaces to explore the degree and elements of the restorative ability of different road landscape spaces[9-10]. Moreover, the results will provide a theoretical basis for the gaps of restorative environment in the related aspects of traffic road space.

1 Materials and methods

1.1 Research plots

Partial road landscape spaces of Tianjin University were selected as the research plots. According to the characteristics of campus public open space environment, the videos of 9 road landscape space plots were finally selected to study. Meantime, based on the concept of ecological unit mapping, the plots were divided into gray space A, gray space B, gray space C, blue space A, blue space B, blue space C, green space A, green space B, and green space C according to different land use and green coverage (Table 1 and Fig.1) [11].

1.2 Questionnaire

The questionnaire was composed of two parts, basic information and PRS. A total of 359 questionnaires were collected, 240 of which were valid.

(1) Personal information included gender, place of residence, and professional information.

(2) PRS was mainly used to evaluate different types of space, and measure the environmental restoration[12]. The respondents evaluated the given environmental space according to the 7-level scale. The higher the total score from 1 (completely inconsistent) to 7 (completely consistent), the stronger the restoration of the environmental space, the more the attention can be restored, and the better the psychological recovery ability. There were 22 questions in the scale (1−5: alienation dimension; 6−11: attraction dimension; 12−17: compatibility dimension; 18−22: richness dimension). The reliability of this scale was 0.695−0.936, and the split-half reliability was 0.903.

1.3 Research methods

The experiment adopted the subjective evaluation method, with college students as the research objects, and visually evaluated different road spaces. First of all, students to participate

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in the survey were randomly searched in the school, and informed the purpose of the survey. The students who were willing to participate were the subjects. A total of 359 college students were tested with PRS, and felt the plot information and received stimulation by displaying a 10 s video of the plot on a tablet PC or computer. The 9 plots appeared in a random order. Each student was asked to score the 9 plots, and their scores and personal information were collected.

1.4 Grouping

The experiment adopted a randomized block design with 9 treatments and a total of 30 replicates, and there were 8 participants in each replicate group. The personal information of all participants should be consistent as far as possible. Participants in groups 1−3 were male lived in urban areas, majoring in agriculture and forestry; participants in groups 4−10 were male lived in urban areas, majoring in non-agriculture and forestry; participants in group 11 were male lived in rural areas, majoring in agriculture and forestry; participants in groups 12−13 were male lived in rural areas, majoring in non-agriculture and forestry; participants in groups 14−21 were female lived in urban areas, majoring in non-agriculture and forestry; participants in groups 22−27 were female lived in rural areas, majoring in agriculture and forestry; participants in groups 28−30 were female lived in rural areas, majoring in non-agriculture and forestry.

1.5 Statistics and analysis

All data were statistically analyzed by SPSS 20.0 software and Micosoft Office Excel, and the significance of differences was analyzed at 0.05 level.

2 Results and analysis

This study mainly explored the restoration of different road space environments. In order to study the difference of the influence of four dimensions on road landscape space under the theory of restoration, one-way ANOVA and multiple comparison were carried out on the scale scores of 9 plots under each dimension, so as to judge the differences among plots and analyze the reasons.

2.1 Differences based on four dimensions of alienation, compatibility, richness and attractiveness

As shown in Table 2, in terms of alienation dimension, the scores of gray space A and C were significantly lower than those of gray space B, green space A and blue space A, while the scores of green space B and C were significantly higher than those of gray space B, green space A and blue space A; the scores of blue space B and C were significantly higher than those of green space B and C. Meantime, it can be concluded that the restorative ability of gray space in the alienation dimension is much weaker than that of green space and blue space.

The results of compatibility dimension scores showed that the scores of gray space A and B were significantly lower than those of gray space C, green space C and blue space C; the scores of green space A and B, and blue space A and B were significantly higher than those of gray space C, green space C, and blue space C. The results indicate that blue and green spaces basically have the same ability in the compatibility dimension.

The ANOVA results of richness dimension scores revealed that the scores of gray space A and C were significantly lower than those of gray space B, green space A, B and C, and blue space A and B; the scores of blue space C was significantly higher than those of other spaces. As shown in Table 2, except for gray space A and C and blue space C, there was little difference in the scores of all spaces in terms of richness dimension.

The ANOVA results of attractiveness dimension scores demonstrated that the scores of gray space A and C were significantly lower than those of gray space B, green space A and blue space A; the scores of gray space B, green space A and blue space A were significantly lower than those of green space B and C; the scores of blue space B and C were significantly higher than those of green space B and C. It can be concluded that the attractive ability of blue space is greater than those of green space and gray space.

2.2 Overall differences among the 9 plots

According to the statistical analysis of the final comprehensive scores of 9 plots (Table 3), green space had the best performance in most dimensions, especially in compatibility, richness and attractiveness. Blue space performed better in the alienation dimension and mean value. Gray space had general performance, but also got high scores in some dimensions. The overall restorative ability of gray space was much smaller than that of blue space and green space, and the restorative ability of blue space was the strongest, followed by green space.

3 Discussion

The restorative ability of road landscape space depends on a variety of factors. Each factor has different impacts on the final effect, and some may play a decisive role. Therefore, the discussion is based on the four dimensions proposed by restorativeness theory.

3.1 Influence of alienation dimension on the restoration of plots

From the above results, plots A and C in

Table 1 Grouping characteristics of landscape space type

Type	Characteristics
Gray space A	Traffic trunk road, with a large paved plaza and small amount of green space on one side (10%)
Gray space B	Paved road, with small amount of green space on both sides (30%)
Gray space C	Trunk road of student dormitory area, with the main scene of asphalt road and paved road, as well as very little green space (5%)
Green space A	Cement road, with large amount of green space on both sides (90%), while small amount of green space (10%) is bare land
Green space B	Paved road, with buildings on one side, and green space on both sides (about 50%)
Green space C	Paved road, with border trees on one side and green space on the other side (about 67%)
Blue space A	Paved road is an open space, with a river on one side, and rest space in the traffic space
Blue space B	A relatively enclosed space, with paved roads surrounding a body of water in the center, and very little green space on the outside of the road
Blue space C	Waterfront paved road, with large lake surface on one side and small amount of green space on the other side

Table 2 Multiple comparisons of 9 plots in four dimensions

Treatment	Dimension			
	Alienation	Compatibility	Richness	Attractiveness
Gray space A	3.10 a	3.97 a	3.45 a	2.79 a
Gray space B	3.71 b	4.16 a	4.24 c	3.49 c
Gray space C	3.16 a	4.32 b	3.87 b	3.19 b
Green space A	3.84 b	4.72 c	4.32 c	3.55 c
Green space B	3.94 bc	4.66 bc	4.45 cd	3.81 d
Green space C	4.16 cd	4.58 bc	4.36 c	4.28 de
Blue space A	3.75 b	4.42 b	4.47 c	3.65 c
Blue space B	4.47 d	4.85 c	4.37 c	4.62 e
Blue space C	4.83 e	4.77 c	4.90 d	4.74 e

Note: Different lowercase letters in the same column represent significant difference at 0.05 level; the same below.

gray space were the weakest. Compared with other plots, gray space A and gray space C were the traffic trunk road and trunk road of student dormitory area, with gray color mainly composed of paved and asphalt road which can not bring people a sense of being away from daily trivialities[13]. Similarly, blue space A was also a paved road, so the alienation was far less than that of blue space B and C, or even weaker than that of green space, and was similar to that of gray space. This is in agreement with Kapler's research that people are more likely to feel the alienation after they are far away from familiar environments and places[14]. In summary, it emphasizes non-daily activities, and space should be different from the environment in daily life, which is similar to Hu Chenhao's conclusion that landscape preference is influenced by alienation in his research on landscape restoration[15]. Compared with college students living on campus, they are mostly exposed to gray space full of pavement. For the restoration construction of campus, the change and combination of green and blue factors are essential[16]. Therefore, the difference in the alienation dimension among the 9 plots mainly depends on the proportion of gray factors. The less the proportion of gray factors, the more the alienation; on the contrary, the alienation of space is weaker. Therefore, in order to enhance the alienation of space, it is necessary to change the proportion of gray factors, making green and blue factors become the dominant factors.

3.2 Influence of compatibility dimension on the restoration of plots

From the above results, compatibility dimension occupied the highest proportion among the four dimensions. Comprehensive data showed that the top 3 plots were blue space B, blue space C and green space A. Blue space B was an enclosed space, blue space C was a lakeside path, and green space A was a forest path. Generally speaking, the passenger flow in these 3 plots was relatively low, which is also similar to the research on urban space by Wang Yumei et al.[17]. Compatibility refers to the result of integration between people and the environment, that is, the matching degree between the environment and individual needs[14]. Just as McMahan's research on the influence of contact with natural environment on emotional state draws the conclusion that the compatibility between individuals and the environment plays a role in generating positive emotions and restoration[18]. Therefore, from the perspective of compatibility, the difference between plots is whether they can be integrated into the characteristics of the environmental space. Therefore, the higher the degree of compatibility of the environmental space, the more matched the individual wants to do and the support that the environment can provide.

3.3 Influence of richness dimension on the restoration of plots

Richness refers to the complexity of the environment with enough content and complex structure to occupy the viewer's vision and thinking. There was no significant difference in the mean values of the remaining data when ignoring the three groups of data with polarization: blue space C, gray space A and gray space C. Therefore, it can be concluded that

Fig.1 Status of 9 plots

Table 3 PRS scores of 9 plots

Treatment	Mean value
Gray space A	3.33 a
Gray space B	3.90 b
Gray space C	3.63 a
Green space A	4.11 b
Green space B	4.21 b
Green space C	4.34 b
Blue space A	4.07 b
Blue space B	4.58 c
Blue space C	4.81 c

richness has little impact on plots. This is also the same problem encountered by Ye Hongliu that they could not divide the richness dimension when compiling the environment scale[12]. On the whole, there are still some difficulties in the study of richness. It is hoped that a more detailed study on this aspect can be carried out in the future research to solve this problem.

3.4 Influence of attractiveness dimension on the restoration of plots

Attractiveness refers to the degree to which factors in the environment can effortlessly attract a person's attention. It can be clearly analyzed that the score change of the attractiveness dimension was the same as that of the total score of the scale, and there was a positive correlation. According to the relationship between attractiveness and landscape preference, it can be judged that the degree of influence of attractiveness dimension on the restoration of plots was the same as that of attractiveness and landscape proposed by Zhang Yan[19], and spatial preference (the increase in the score of attractiveness dimension scale) can better enhance the restorative ability of environmental space. It is also consistent with Pasanen's research results on the relationship between perceived restorativeness of favorite places and self-reported well-being, that is, the higher the preference for a certain type of landscape, the higher the level of physiological stress recovery[20]. To sum up, it can be estimated that landscape space with stronger attractiveness dimension can cause individual preference and thus affect the restoration of landscape space, that is, the higher the attractiveness dimension, the stronger the restorative ability of landscape space.

3.5 Influence on the overall restoration of plots

According to the score data of PRS, the scores of gray space A and C were significantly lower than those of other spaces; the scores of blue spaces B and C were significantly higher than those of other spaces. In summary, the reason why gray space B and blue space A were significantly different from the same type of space was that gray space B had more green elements than gray space A and C, while blue space A had more pavement elements. Therefore, the PRS score of blue space A was relatively small and had no significant difference with that of green space. It is basically the same as the result of Sun Siyun[7] that blue space has the strongest restoration while gray space has the weakest. Green space, on the other hand, has a stable effect on environmental restoration.

4 Conclusions

Among the three different landscape types, gray space may have a negative impact on people's recovery and relaxation in the alienation dimension. In terms of compatibility dimension, green space and blue space have a better ability to provide restorative and relaxing effects. From the perspective of richness dimension, gray space has less environmental stimulation, while blue space has more advantages in providing environmental perception of richness. In the attractiveness dimension, blue space is more likely to attract people's attention and provide pleasure, while gray space may be less attractive to people. There are differences in the restoration of road space environment among different space types. Gray space is weak in the alienation dimension, while blue space is strong in the attractiveness dimension, and green space is relatively stable in the compatibility dimension. Blue space shows the most prominent performance in restoration.

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