Visual Impression of Japanese Rock Garden (Kare-sansui):
From the Point of View of Spatial Structure and Perspective Cues

Kayo Miura¹ & Haru Sukemiya²

¹. Faculty of Human-Environment Studies, Kyushu University, Fukuoka, Japan
². Graduate School of Human-Environment Studies, Kyushu University, Fukuoka, Japan

Abstract: The Japanese rock garden with the hidden order (fractal structure) is said to give the quiet and sophisticated impression. The perspective devices which are hard to notice are also said to be useful to show the narrow garden widely. This research was carried out to confirm the effect of such hidden devices in the rock garden using 2D-CG pictures. The whole impression of the gardens was examined by method of semantic differential (SD method), and the width and depth impression of them was examined by method of paired comparisons. The result of method of paired comparison showed that the decrease of stones brought the increase of the impression of width and depth, while the increase of stones and random perturbation of the spatial arrangement brought the decrease of them. The result of factor analysis and cluster analysis based on SD method showed that goodness and quietness were highly appreciated in the gardens with hidden order and with decreased stones. It is suggested that the hidden factor which observers do not notice affects the various impressions of gardens, and that unlike a general pattern layout, too much regular arrangement was not evaluated in gardens.

Keywords: Rock garden, Spatial arrangement, Perspective cue, Fractal structure, Impression

1. INTRODUCTION

Japanese gardens, especially dry landscape gardens (Kare-sansui), for example, the rock garden of Ryoan-ji in Kyoto (Figure 1), have been appreciated for their refined and profound impressions. This garden has calm and sophisticated atmosphere, which is said to be derived from the arrangement of the stones placed so that the empty space ("ground") has a simple fractal structure, namely, the dichotomously-branched tree structure [1]. This hidden order is considered to facilitate the perceptual organization of the stone arrangement of this garden, reduces the mental workload to look at it, and offers us easy and comfort impression.

This garden is also famous for having the perspective devices in order to show the narrow garden widely. The height of stones and walls become low gradually from the front to the back. These linear perspective depth cues can hardly be noticed, but are considered to contribute the depth impression of this garden.

However, there is no empirical research about whether the fractal arrangement contributes to the quiet and comport impression of this garden, and whether the perspective arrangement contributes to increase the depth impression of it.

This study was carried out to examine the goodness and the depth impression of the Japanese rock gardens using 2D-CG pictures with various arrangements of stones.

2. EXPERIMENT 1: The whole impression of the rock garden

Stimuli:

The 2D-CG pictures with walls and trees of background imitating the Ryoan-ji garden were used in this experiment. Based on eight kinds of the stone arrangement by Tonder et al. (Figure 2) [2], the pictures of the garden were produced assuming that a camera was on the main stem of the dichotomously-branched tree structure. (About the position and angle of camera, see Appendix.) The other Ryoan-ji arrangement based on the survey by Nishizawa (Figure 3) [3] was also used as a stimulus. These nine stimuli were projected on the screen (120cm×160cm) one by one. The stimulus size on the screen was 30cm×150cm. Observers viewed the stimuli from 300cm.

Figure1. Rock garden of Ryoan-ji in Kyoto

Corresponding author: K.Miura, miura@lit.Kyushu-u.ac.jp

1165
Procedure:

Thirty students (nine males and twenty one females, mean age of 23.3) without special knowledge about Japanese garden evaluated nine kinds of arrangement by the semantic differential method composed of twelve adjective pairs (good - bad, favorite - unfavorite, beautiful - unbeautiful, deep - undeep, interesting - uninteresting, quiet - noisy, desolate - bustling, modest - brave, wide - narrow, regular - irregular, organized - disorganized, simple - complex) by seven-point scale.

A factor analysis was conducted on the adjective pairs and cluster analysis was conducted on the stimuli.

Results:

(1) Factor analysis

The result of a factor analysis shows that gardens were evaluated from the three points of view, namely, evaluation (goodness, favorite, etc.), quietness (quiet, desolate, etc.) and regularity (regular, organized, etc.). Fifty four percent of the impression could explain from these three factors. This contribution ratio is not always high to explain all impression of the garden stimuli, but these three factors have been also shown in our other experiments using different arrangements and different observers. This factor structure seems to be stable when evaluating Japanese rock gardens.

(2) Cluster analysis

The result of a cluster analysis (Figure 3) showed that the gardens which gave the similar impression were classified into three groups: Original and stone-decrease arrangement (R, A, B, C), sector arrangement (G, H), and random and stone-increase arrangement (D, E, F). These impressions were related to three factors shown by the cluster analysis.

Figure 2. Top views of stimuli and their medial axis transformation.
A: Tonder’s arrangement of Ryoan-ji garden; B, C: Stone decrease arrangement; D: Stone increase arrangement; E, F: Random perturbations; G, H: Sector arrangements.
White ellipses indicate the rock clusters. Bottom white lines in each panel are the outlines of the verandah and main hall of the temple. Red lines are main axis of the tree structure.

Figure 3. Result of cluster analysis (Dendrogram using ward method).
factor analysis. Next, we show them based on the results of analysis of variance.

(3) Analysis of variance (ANOVA)

The results of one way analysis of variance (Figure 4) showed that whole impression appreciated in the original and stone-decrease group. The sector group got high score in regularity, but did not highly appreciated in whole impression. In general, goodness correlates with regularity as shown in Gestalt tendency. But, in the rock gardens, too regular arrangement seems to bore observers.

As was expected, quietness was high in the original and stone-decrease group, and low in the random and stone-increase group. That is, decrease in the number of stones or arrangement whose branch converged on one trunk brought the quiet impression and was evaluated high. These results suggested that the hidden structure (red line in Figure 2) affected the impression of gardens.

However, in this experiment, the impression of width and depth was not so large in each stimulus compared with whole impression of the gardens. In the next experiment, we focused on the impression of width and depth, and examined the spatial factors bringing them.

2. EXPERIMENT 2: The depth and width impression of the rock garden (1) : Stone arrangement

Stimuli:
The stimuli in experiment 2 were similar in stone arrangement to those of experiment 1 but differed in the shape of walls and the background. Most different thing was that all stimuli were presented on the 17inch monitor. Moreover, the basic stimulus (A: Tonder’s arrangement of Ryoan-ji) was always presented to the upper part of the display as a standard stimulus. Either of seven kinds of arrangement (Figure 2) was presented to the lower half of the display in random order. In this experiment, the Nishizawa’s arrangement of Ryoan-ji did not use because it showed the same results as those of Tonder’s in experiment 1..

Procedure:
Ten participants evaluated the impression of depth, the horizontal width and the whole width of garden area regarding each stimulus comparing with the basic stimulus by seven point scale.

Result:
As was shown in Figure 5, decrease in the number of stones brought increase of the width and depth impression to the gardens, and increase in the number of stones or random perturbation of spatial arrangement brought decrease of them. These results mean that the arrangement of stones affects the width and depth impression, even if observers did not notice.

Figure 4. Averaged rating score of evaluation (goodness), quietness, and regularity in each of cluster of stone arrangement.

Figure 5. Impressions of depth, width and whole width of garden area in 2D stimuli.
4. EXPERIMENT 3: The depth and width impression of the rock garden (2): Size gradient of stones

Are the impressions of the depth, the width, and the whole width of garden area related mutually? Or is there any special factor which gives a different impression respectively? Next, we examined the relation among the spatial impressions.

Stimuli:
Instead of stones, five spheres were used as stimuli. They were arranged on the line aslant extended from the front left or the front right (Figure 4). Five kinds of size gradient of the spheres were prepared from linear perspective to reverse perspective.

Result:
In the diagonal arrangements of the front left, “depth” impression increased with the degree of linear perspective. On the other hand, in the diagonal arrangements of the front right, “width” impression increased with the degree of reverse perspective. These results may be related to the position of blank space (Yohaku), which is on the right or left part in the display.

5. DISCUSSION:

The empirical research showed that the arrangement of stones in the rock garden affected the width and depth impression as well as the whole evaluation. It suggests that the hidden structure which observers do not notice affects the various impressions of gardens. The rock garden of Ryoan-ji is considered to have used the various hidden devices skillfully and to have made the excellent artistic space.

In this research, however, we used 2D-CG stimuli. There is a limit to investigate the impression of gardens using 2D-CG. It is desired to find out the method to investigate under control but in more realistic situation.

ACKNOWLEDGMENT

We appreciate the corporation of Ryoan-ji in this research. We also thank to Asuka Toki and Eriko Yamaguchi about stimulus production and data collection.

This research was supported by grants from Shimizu Corporation and Kyushu University the 21th COE Program.

REFERENCES


APPENDIX

We produced 2D-CG assuming the position and angle of a camera as Figure 7.