

Effects of Scenes Emerging from the Occluding Edges on Visual Attention and Evaluation of the Landscape

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ABSTRACT

The present study examines the influence of exit space design on the visual attention of a person who is leaving a building as well as on his/her impression of the outside scene. A visual simulation experiment was conducted to test the hypothesis that a visitor's impression of an unfamiliar scene is affected by the spatial layout of a building's exit space. Twelve movies, made by superimposing four kinds of CG animations of exits on three photographs of different outdoor scenes, were projected onto an orthographic projection screen that enabled subjects to observe a wide angle image. After viewing each 12-second long movie while wearing eye-mark recorders, 36 subjects were asked to rate their overall impression of the scene using seven bipolar adjective pairs. The results showed that some aspects of the subjects' impressions varied according to the way the scene opened up as they "moved" through the space. Analyses of subjects' eye movements revealed that subjects tended to attend to the part of the scene coming into sight from the occluding edges, where subjects could expect to find more information than other areas. These results altogether suggest that subjects' overall impressions are affected by the order in which parts of scenes (scene components) appear in the field of vision as well as by their eye movements, which tend to follow the occluding edges as they move rapidly toward the periphery.

INTRODUCTION

When we look at a scene through an opening such as a window, doorway or gate, the framed scene looks more beautiful than when seen without it. This is called the "frame effect" and is one common technique used in Japanese gardens to introduce a sense of unity into the design. However, little is known about this effect, particularly about how it operates when an observer moves through the opening. When we leave a building to go outside, for example, the view of the exterior comes progressively into our sight at the occluding edges created by the ends of the ceiling and walls. The way the vista ahead opens up is determined by the spatial layout of the surfaces around the exit space. For instance, if deep eaves stick out, then both sides of the vista open up first and the upper part comes into sight later.

Gibson (1979) suggests that perception of three-dimensional space during locomotion depends on the flow of the optic array particularly near the occluding edges, where people tend to focus on the part of the visual field that opens out rapidly. Yamashita et al. (2000) conducted a series of experiments to verify the above effects. The notion of the "mystery" of natural landscapes put forth by Kaplan may also be relevant to this topic. Kaplan (1987) noted that people preferred scenes that "appeared to promise that

more information could be gained by moving deeper into the depicted setting.” Hildebrand (1999) applied this idea to architectural space to explain enjoyable sequential experiences. When Cullen (1971) uses the word “anticipation” to describe one aspect of townscapes experienced while moving from one place to another, he seems to be dealing with visual effects similar to what we will be concerned with in this paper.

The present study examines the influence of exit space design on the visual attention of a person who is leaving a building as well as on his/her impression of the outside scene. An experiment making use of visual simulation was conducted to test the hypothesis that a visitor’s impression of an unfamiliar scene is affected by the spatial layout of a building’s exit space.

Hypotheses

The following hypotheses were examined through the visual simulation experiment:

- 1) Visual attention is affected by the movement of the occluding edges created by the ends of ceiling and walls.
- 2) Impressions of outside scenes differ according to exit space design.
- 3) The effects above are also influenced by the layout of the elements composing the outside scene.

METHOD

Visual stimuli

The experiment used 12 movies made by combining three photographs depicting different outdoor scenes with four kinds of exit spaces. The three outdoor scenes used in the experiment (Figure 1) were all virtual scenes created by putting together parts of photographs taken at different places so as to control the layout of visual elements and to avoid the influence of subjects’ familiarity with existing sites. A super-wide angle lens (fish-eye lens) was used to take the photographs for making the orthographic projection images.

Figure 2 shows four exit spaces with different surface layouts each leading to different movements of occluding edges in the visual field of a person moving through the space. CG animations of occluding edges for each exit space were created and overlaid on the images of the outdoor scenes.

The movies, each lasting 12 seconds, were projected onto a screen giving a wide-angle image view (visual angle of 132 degrees). Figure 3 shows the movements of the occluding edges for each exit type using scene III as a background.

Experimental instruments

Since viewers' peripheral vision was expected to play an important role, an orthographic projection screen made of curved translucent plastic was used to present the subjects with a wide view of the visual stimuli (see Figure 4). The orthographic projection image looked normal when it appeared on the screen. We also asked subjects to wear eye-mark recorders in order to get a trace of their eye movements.

Subjects

Thirty-six (22 male and 14 female) subjects were divided into six groups, each consisting of six persons. The order of the visual stimuli presented to each group was systematically varied to avoid observation order effects.

Procedure

Each subject observed six movies made by combining each of three outdoor scenes with two types of exit spaces (standard type and one of the three asymmetrical types). After viewing each movie, the subject was asked to rate his/her overall impression of the scene using seven bipolar adjective pairs.

RESULTS AND DISCUSSION

Overall impressions of scenes

Subjects' overall impression ratings were standardized (variance=1, mean=0) before calculating the average. Figure 5 shows the differences in overall impressions between the three types of exit space. No significant differences were obtained for the "bright-dark" and "quiet-lively" scales, suggesting that these aspects are affected only by the characteristics of the outdoor scenes and not by the spatial layout of the exit. On the other hand, impressions rated by the other adjective pair scales did differ according to exit type in some cases. In particular, on the "unified – not unified" scale the wall type was found to give more sense of unity than the ceiling/wall type for both scenes I and III. This suggests that the "frame effect", often considered to contribute to a sense of unity, is valid not only in the case of static vision but also for vision while in motion.

Eye movement traces

Subjects' eye movements (see Figure 6) were recorded and analyzed. Figure 7 shows typical eye movements for scene III. Analyses of subjects' eye movements revealed the following general tendencies: 1) when a major component comes into sight from the occluding edges, it tends to draw the observer's attention, and 2) when there is no notable component in sight, the observer's eyes tend to follow the occluding edges as they move rapidly toward the periphery, likely because that is where subjects can expect to get the most information. However, some differences in eye movement patterns were noted depending on the combination of exit space type and outside

scene. Such differences may have affected the subjects' overall impressions of the scenes.

Some causes of differences in impressions

The order in which the outside scene components appear differs according to the type of exit space. The first thing viewers see in the early parts of the movies shown in Figure 3, for example, is the sky above the temple for the ceiling type, the greenery stretching out to either side of the temple for the wall type, and the high-rise building to the right of the temple for the ceiling/wall type. Figure 7-1 shows a typical eye movement trace for the ceiling type space. It shows that the observer's visual attention follows the edge of the ceiling, which is the part that moves the most rapidly during the earlier stages of the movie. This vertical eye movement and attention to the sky may be part of the reason why the ceiling type was rated as giving a greater impression of breadth when compared to the other types.

Figure 7-3 shows a typical eye movement trace for the ceiling/wall type space. The observer's eyes first followed the edges along the top and right side before noting the high-rise building and beginning to pay frequent attention to it. The contrast between the traditional temple and the modern building seemed to have been intensified by the way they appeared. The movie of the ceiling/wall type was therefore rated as being more incoherent, unique and artificial than the other types.

Similar explanations based on the order that the outside scene components appear as well as on subjects' eye movements as they "move" through the space can also be made for ratings of scenes I and II.

CONCLUSION

The present study examined the influence of exit space design on viewers' visual attention and evaluation of outdoor scenes. The results revealed that overall impressions varied according to the way the view of the exterior opened up even when the scene was the same. Subjects' overall impressions were affected by the order in which scene components appeared in the visual field as well as by the way their eyes were led along by the movements of the edges. Thus at least in some cases the spatial layout of an exit space affects the impressions of a person who goes through it, although the cause of the effect is yet to be clearly explained.

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