VISUAL PERCEPTION IN KARESANSUI GARDENS

Gert J. VAN TONDER (1), Michael J. LYONS (2) & Yoshimichi EJIMA (1)

(1) Grad. School of Human & Environmental Studies 201,
Kyoto University, Yoshida-Nihonmatsu-cho, Sakyou-ku,
Kyoto City, 606-8501, Japan
Fax: +81-(0)75-753-6574
Email: gvtonder@yahoo.co.uk

(2) ATR Media Information Science Labs
2-2-2 Hikaridai, Seika-cho
Soraku-gun, Kyoto 619-0288, Japan
Email: mlyons@atr.co.jp

SCENE PERCEPTION AND VISUAL SEGMENTATION

Japanese gardens are widely appreciated all over the world for sophisticated, minimal compositions and for the calm yet profound atmosphere which they engender. How are the visual elements of a garden, its rocks, moss, and shrubs, interpreted by the brain, and how do gardens achieve particular expressive and artistic effects? In this paper we suggest how principles of visual psychology can be used to gain insight into these aesthetic phenomena.

The Gestalt psychologists [2] stressed the importance of the process of visual *segmentation*, the division, by the visual system, of a scene into figure and ground, as an early step in the analysis of a visual scene. The influential work of Koenderink *et al*. [1], analyzed the segmentation process further into the active description of a scene, at an intermediate stage of visual processing, in terms of the *surface regions* and *bounding contours* of objects. This process is roughly illustrated in figure 1.A.

The process of visual segmentation, central and fundamental to the understanding of human vision, is not yet completely understood. The Gestalt school, provided a set of intuitive guidelines, still widely in use by perception researchers, for predicting the outcome of the process of *grouping*, or the formation of meaningful arrangements of visual elements. The main guidelines, often called Gestalt laws, are (see figure 1.C for simple examples):

- Proximity law: elements spaced more closely together are seen as belonging together
- Similarity law: elements that look more similar are grouped together
- Smoothness law: elements group together if their spatial alignment follows a smooth path
- Enclosedness law: Objects group together if they are arranged on a closed path
- Simplicity law: Simplest configurations of parts result in the objects actually perceived.

These are key features for predicting which visual elements group into the boundary contours and surface regions constituting image segments of figure and ground. Superposition of features with different gestalt qualities is not linearly additive but complex: gestalt formation at one scale can enhance or suppress gestalt formation on another. The smooth curve in figure 1.D1 disappears among distractors (Fig. 1.D2) whereas a closed contour remains visible (Fig. 1.D3). Addition of two closed loops compromises the visibility of this contour (Fig. 1.D4).

VISUAL EFFECTS AND GARDEN DESIGN PRINCIPLES

Below, we introduce a few of the techniques used in Japanese landscape gardens and discuss their relation to principles of visual perception.

Texture effects. Japanese garden designers favor relatively homogeneously textured surfaces. Figure 1.B shows various textures typical in Japanese gardens. Vividly coloured objects and surfaces with high contrast texture markings are avoided. Low contrasts prevent objects from dominating visual attention. Though homogeneous, the textures used are natural and richer than a mere blank slate. Relatively uniform surface regions with even textures simplify the creation of boundary contours, reducing the number of subsegments, interior to an object, thus easing the process of visual segmentation.

Contour junction effects. The arrangement of rocks in gardens places emphasis on the visual appearance of the spaces, or junctions (boundary contours), between the rocks, as well as the visual qualities of the rocks themselves (surface regions). Junctions in which an odd number of contours meet (e.g. fig. 1.F1) are preferred to those in which an even number of contours meet (fig. 1.F2). The Gestalt law of continuation predicts that an even junction will be more perceptually salient than an odd junction, particularly if surrounded by texture elements (figures 1.F1 and 1.F2). Manipulating the formation of odd and even junctions affords control over which contours become salient in visual segmentation. A design with many even junctions is potentially highly ambiguous: instead of seeing one surface with a homogeneous surface, visual attention is erratically grabbed by boundary contours of different competing figures.

Extending the spatial range of grouping. Contour junction effects are also used to influence the grouping of rock arrangements. For example, stones placed at the foot of a larger stones (fig 1.E3) extend its base, reinforcing the grouping of stones within a cluster. Though four stones are used here, they create a single group with a triangular composition. Removal of the base rock (fig. 1.E5) weakens the grouping between the left and right side of the composition so that it actually appears as two separate clusters which compete for visual attention.

Figs. 1.E1 and 1.E2 demonstrates another effect for the control of grouping using "Sute Ishi." Literally meaning "thrown away stones", "Sute Ishi" are low, inconspicuous rocks placed around a rock composition, extending its base to promote grouping with the rest of the garden composition. Without these stones the composition is much more visually salient and tends to stand alone rather than visually grouping with other elements (not shown) in the overall design.

Self-similarity and multi-scale grouping. Natural patterns are often self-similar, the outcome of the application of the same organizing principle at multiple spatial scales. Both examples given above display self-similarity, in that a triangular theme is repeated at several scales. In figure 1.E3 each rock is itself roughly triangular; the three closest rocks group easily into a triangle; and the fourth stone extends the composition into a larger triangle. In Fig. 1.E4 the composition is arranged in a semi-circle, breaking self-similarity, with a less natural looking result. The "Sute Ishi" of figure 1.E1 provides another example: the added stones echo the triangular appearance of the central composition, supporting self-similarity.

In figure 1.G4, showing Dokuzatei garden, the self-similarity of the rock composition extends right down to the texture of the rock. In fig. 1.G1 the textural markings of a rock shown in close-up mimics the triangular shape of the rock itself. Figs. 1.G2, 1.G3 and 1.G4 show how this triangular shape is repeated at increasingly larger scales. The Gestalt law of similarity predicts that the repetition of these shapes and their junctions facilitate grouping. Though

similarity is repeated on multiple scales, the shapes themselves are irregular, preserving the asymmetrical, natural appearance of the overall design. The same set of figures shows how the pattern of overlap between the rocks is also repeated at multiple scales. Note that the junctions created by overlap are all odd, avoiding rivalrous segmentation at any single junction. The arrangement of junctions forms a tree structure with repeated dichotomous branching, typical of geological formations such as a range of mountains and valleys.

CONCLUSION

Four major aesthetic ideals displayed by karesansui gardens are asymmetry, tranquility, simplicity and naturalness [3]. In this work, we applied Gestalt principles of visual grouping, to gain insight into how karesansui design achieves these aesthetic qualities. Our major thesis is that by careful choice and controlled use of various design elements, the process of visual segmentation into figure and ground may be intimately manipulated to engender naturalness and avoid excessive local "pop-out". Likewise, symmetry, even junctions, and excessive heterogeneity with respect to scale transformations lead to unnaturally complicated scenes which disrupt visual tranquility.

Significantly, a Muromachi-era gardening manual [5] contains both verbal descriptions and drawings of a corpus of rock configurations causing various expressive effects. The realization that these guidelines are somewhat analogous to the Gestalt laws is one of the inspirations for the present study.

In conclusion, we have discussed some major design features of karesansui gardens, but we do not consider this paper exhaustive. For example, we have not discussed "Ma" (interval or "empty space"), which is highly valued in karesansui design. In a forthcoming paper [4] we apply a model of figure ground analysis to the design of the famous Ryoanji garden to discover that the "empty space" which composes much of the garden is, in fact, highly ordered.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the support of the Japan Society for Promotion of Science and the Japanese Ministry of Education.

REFERENCES

[1] Koenderink, J.J., Van Doorn, A.J. & Kappers, A.M., Surface perception in pictures, *Perception & Psychophysics*, 52(5), pp. 487-496 (1992).

[2] Koffka, K., *Principles of Gestalt Psychology*. (Harcourt, Brace & Co., New York, 1935).

[3] Nitschke, G. *Japanese Gardens*. (Koln:Benedikt Taschen Verlag GmbH, 1993).

[4] Van Tonder, G. J., M. J. Lyons, & Y. Ejima, Perceptual Sensitivity Maps and the Structure of Empty Space in a Japanese Dry Landscape Garden (working paper, 2002).

[5] Zouen, *Senzui Narabi ni yagyou no zu* (Illustrations for designing mountain, water and hillside field landscapes). Manuscript dated 1466 published in Sonkeikaku Library, published in Sonkeikaku Soukan series. (Tokyo:Ikutoku Zaidan 1930).

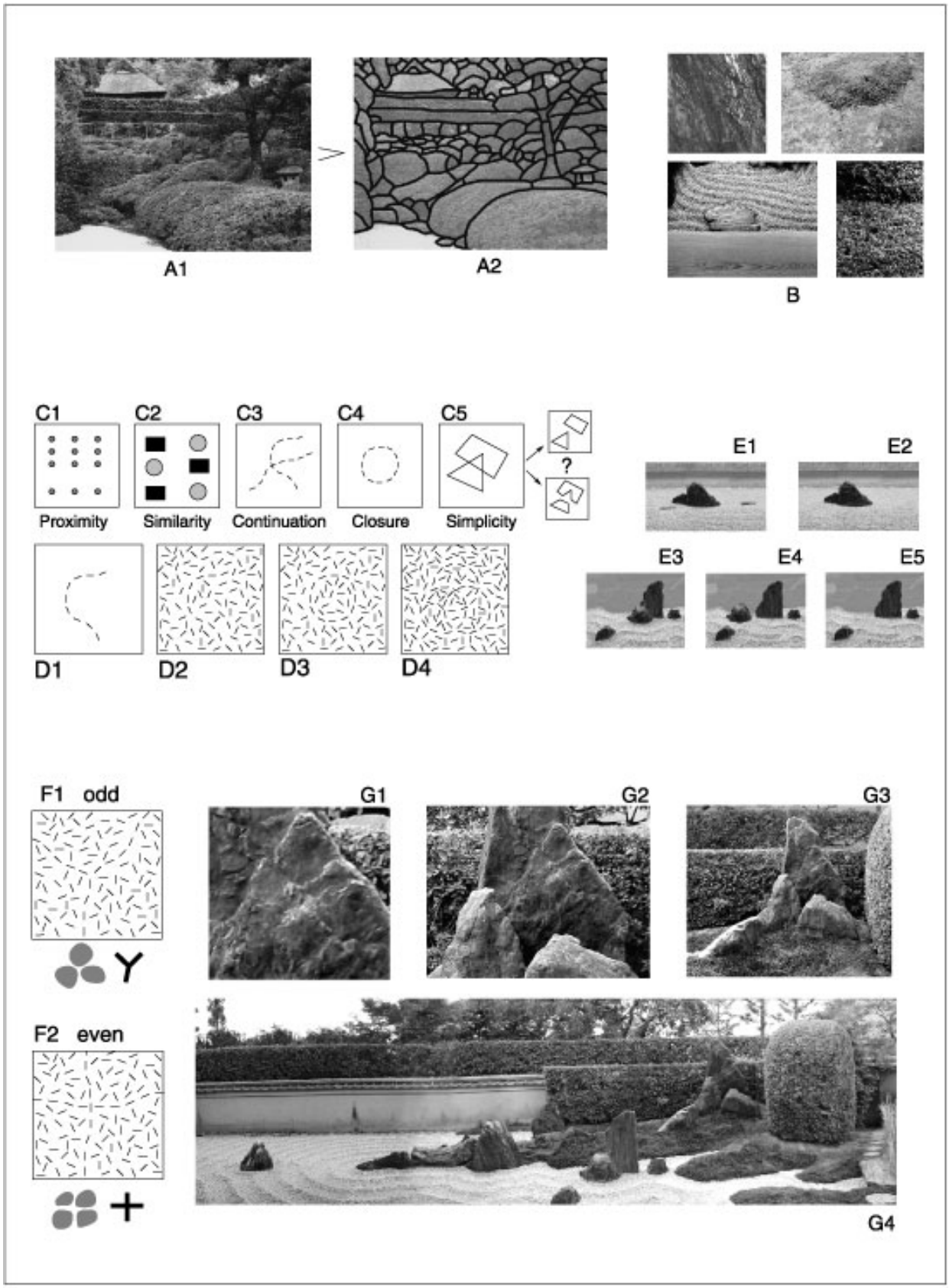
A1
A2
B
C1
C2
C3
C4
C5
Proximity
Similarity
Continuation
Closure
Simplicity
?
E1
E2
E3
E4
E5
D1
D2
D3
D4
F1 odd
Y
F2 even
+
G1
G2
G3
G4

Figure 1