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One of the most famous Japanese landscape of dry stone Zen gardens in Ryoan temple established AC 1450 at Kyoto by the deputy Shogun Katsumoto Hosokawa, a UNESCO World Heritage Site, has the small 248 m2 empty rectangle where white sand was laid in between, in the abstract, placements of 15 rocks with mosses that seem to be scattered in seemingly haphazard. The landscape attracts many visitors, including Queen Elizabeth II, 1975, to hundreds of thousands for long years. The stone placements designed by the ancient anonymous landscape designer look random at a glance, however, the placement structure is hidden in white sand of the garden space in sophisticated manner, and that we are in perfect harmony with the temple buildings and landscapes. The stone structure looks puzzling at glance. However, the general stone placement structure can immediately be revealed by understanding the ancient garden design rule texts described in, for example, “Sakuteiki” (“Landscape Design” in Japanese, published around AC 1200). According to this instruction text, the stones are placed recursively and in fractal as an obtuse inequilateral triangle in different three level scales. The three stones are placed eye vertex entitled “a” (very formal) at the obtuse angle, “b”(formal) at the vertex closest to “very formal”, and “c”(Casual) at the remaining vertex. These three stones form a cluster and three clusters form a different obtuse inequilateral triangle, recursively, as shown in Image (lower). If we plot the size and the rank of the three level obtuse triangles in log scale, we obtain the perfect Zipf’s law[Gabaix 1999] or 1/f noise[Voss 1985]. This means that the stones are placed in a perfect fractal manner, and this fractal stone placement is completely understood by the garden viewers unconsciously in our eyetracking measurements shown in Image (upper). Eye tracking experiments are performed and the visual “PageRank”[Page et al. 1998] of eye movement are measured. We measured 10 testers’ eye movement trajectories while they were watching the landscape garden. All testers spend more than 90% of their time to watch the stone objects, and move their eyes from a stone vertex to another, following the triangles, recursively. Image (upper) shows a typical eye movement trajectory in 20 seconds, and the trajectory follows the three level of fractal triangle structure displayed in Image (lower). Five human figures 1 to 5 in different colors represent different viewing positions corresponding to different eye movement trajectories in their colors. We assume that the eye movement from one stone or one cluster to another is a forward “link”. Using the same technique as “PageRank”, the eye movement from one stone to another is taken as a directed graph. First, we generate an adjacency matrix of this graph structure with weighted sum of the number of eye visits. Next, we obtain the largest absolute eigenvalue of this matrix and its eigenvector. Third, the normalized component values of the eigenvector are the visual “PageRanks”, and now we rank the stones or the cluster in order. The visual “PageRank” in the Japanese dry stone Zen garden reveals the amazing hidden structure in this old landscape garden, which cannot be discovered by a simple hot spot diagram that only represents the length of fixation time. Figure 1 indicates that the “PageRanks” in two “a” (very formal) stones (number 2-2 and 3-2) are significantly higher than the others, where the general fractal placement manner is somehow violated. At these stones circled in red in Image, the eye trajectories are strongly disturbed and some psychological tension caused by a disparity between what one expects to see and what one actually sees is observed. This is a well-known phenomenon in social psychology today called “cognitive dissonance” or “visual dissonance” although totally not known in 560 years ago when the temple was build. The cognitive dissonance happens when we perceive a discrepancy between our attitudes and our behaviors. Our eye sees the world of art with a thousand of expectations based on our personalities and our cognitive structure or knowledge system. Sometimes those expectations are fulfilled, sometimes not. In the case of unfulfilled expectations, the viewer is required to resolve his or her tension, or simply abandon the piece and consider another. An important part of human motivation is found in “dissonance reduction”, in that people do not normally choose to live in a state of psychological tension. In psychological terms, it is better to be avoided or resolved such an aversive state. The technique to produce unexpected visual forms is widely practiced by modern artists who seek to gain our attentions. However, the most striking feature here is that this cognitive dissonance was implemented in a very naïve way and viewer observe this only unconsciously, not like many visual dissonance in modern arts. When people view this garden people feels deep serenity and perfect harmony with very small “disharmony”. i.e. “dissonance” like in much beautiful music.

Figure 1: Visual “PageRanks” and eye movements transition possibilities. Here “1” is “formal”, “2” is “very formal”, “3” is “casual”, “1-1” is “formal” in formal triangle etc. This eye movement transition diagram shows the second level of fractal recursion.