

Chapter 13

Natural Effect of Spatial and Temporal Color Sequence on Human Color Impression

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ABSTRACT

The way in which a signal sequence of several colors (temporal information), as well as how a linear, toroidal, or circular sequences of several colors (spatial information) affect human color impression is examined. To investigate spatial or temporal effects of color sequences, a hexagonal projection of an RGB color space is considered. The projected route area indicates the magnitude of naturalness (as in rainbows) of color sequences, with the minimum sequence being similar to the order of rainbow colors. Using the projected route area with route complexity, a simple fuzzy model of human color impression is proposed. Clarifying the relationship between route complexity and the impressions of subjects for a projected route area revealed that the majority (>26%) of subjects of nearly all ages have natural impressions when the minimum route area is large. Thus, this model describes the spatial or temporal nature of natural (or unnatural) multicolored sequences.

1. INTRODUCTION

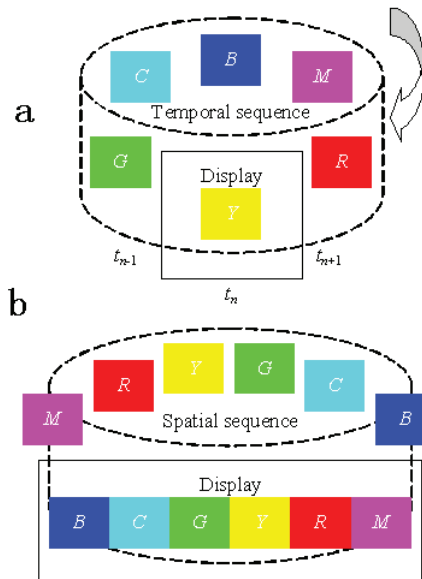
The degrees of pairs of terms applied to color sequences, such as natural-unnatural, have been investigated previously. Two terms, natural and complex (or unnatural), were described by Ohi & Kawasaki (1996), where after several terms were commonly used to describe the characteristics and associative meanings of colors (Sivik, 1997). In

previous studies by this author, the various effects of temporal color sequences of several colors on human color impression were examined and a hexagonal color model was constructed (Sugano, 2001; Sugano & Matsushita, 2002). To analyze these effects in the current study, human subjects were tested to determine whether a several-color cyclic sequence has a minimum distance in the red, green, blue (RGB) color space.”

The various effects of six-colored spatial color sequences on human color impression and

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Figure 1. Relationship between temporal and spatial information



its model (hereafter referred to as the hexagonal color model) have recently been examined using the following four groups of six colors (Sugano et al., 2004; Sugano et al., 2007a):

- Type A: six fundamental colors
- Type B: five fundamental colors and orange
- Type C: six intermediate colors
- Type D: six magenta-blue relevant colors

These studies showed that the largest group of subjects (approximately 20%-50%) preferred the minimum sequence when selecting a natural color sequence. However, since only the minimum sequences of the four groups (Type A-D) of six colors were tested (Sugano et al., 2006), a larger projected minimum route area was preferred. That is, the relationship between the route area and the response of subjects was proportional.

More recently, we introduced experiments of human color impression using a tournament-like task (composed of a choice between two alterna-

tives) to compare human color impression and a fuzzy model of human color impression using the projected route area or envelope route with route complexity (Sugano et al., 2009). Since complexity is defined as the ratio of the square of the envelope route distance to the route area, a simple fuzzy model of human color impression is proposed. This model provides spatial (or temporal) color sequences for emotional control, color coordination and similar applications.

2. SPATIAL AND TEMPORAL INFORMATION

Previous studies (Sugano & Nasu, 2000; Sugano, 2001) suggested designs for rows of suitable colors as spatial information and color signal sequences as temporal information for the control of feeling and emotion based on single color effects (Ohmi, 1999). Figures 1(a) and (b) display only one color as temporal information and the simultaneous display of a linear sequence of several colors, respectively, and present these as spatial representations of a several-city Traveling Salesman Problem (TSP) (see Appendix). The letters in Figure 1 denote the following: *B*; blue, *C*; cyan, *G*; green, *Y*; yellow, *R*; red, *M*; magenta, and the time interval is given as $T = t_n - t_{n-1}$.

The system used in this study to represent the three primary colors (red, green, and blue (RGB)) is presented in a cubic color space. As shown in Figure 2, blue, cyan, green, yellow, red, magenta, white, and black are abbreviated as *B*, *C*, *G*, *Y*, *R*, *M*, *W*, and *S*, respectively. Several color coordinates— $(r_1, g_1, b_1), (r_2, g_2, b_2), \dots, (r_n, g_n, b_n)$ —are selected, where r_n , g_n , and b_n are the red, green, and blue components, respectively, of the n^{th} color. In the cubic color space, RGB values range from 0 to 255, and the minimum distance between coordinates can be computed as shown in Figure 2.

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