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Hue and Tone Effects on Color Attractiveness in Mono-Color Design

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ABSTRACT

In the marketing world, color of a product play an important role to catch a customer's attention. Althought a colorful object is more powerful to be attractive, a mono-color design is considered as competitor due to eco-anxiety. This research, hence, examined the influence of hue and tone on color attractiveness. Thirty-three color chips were chosen from the Munsell notation varying in hues and chromas. The results showed a vivid color was more attractive. In addition. warm colors were greater to draw attention than cool colors. Color appearance mode also affected to color attractiveness. Colors appearing in light source color mode and unnatural ojbect color mode were attracted. Furthurmore, we found that perceived color attributes related to color attractiveness.

1. INTRODUCTION

One cannot deny the fact that nowadays there are serious competitions in the market. Marketing practitioners know that a product's color may play an important role in a consumer's purchase decision (Grossman, 1999). About 62-90 percent of the assessment is based on color alone. So, prudent use of colors can contribute not only to differentiating products from competitors, but also to influencing moods and feelings –positively or negatively- and therefore, to attitude towards certain products (Singh, 2006). For building up a market share, designers must be created products which are interesting and attract the customer's attention.

One of the important roles for catching a customer's attention is to color attractiveness of product package. It indicates a characteristic that which product can be distinguished most clearly among various products. It said to be that a colorful package attracts a subject's attention and to arouse the desire to consume in marketing (Shun, 2001). Regarding the environmental conservation matter, ecological design, eco-design, seeks to conform to the environment and substantially reduce material consumption. Monochromatic design in printing has been noted as alternative technique as eco-design. Amount of ink on substrates for this design is less than that for color printing in the printing process. Moreover, this design reduces the printing troubles and cost of a product. Although monochromatic design seems to conform to eco-design, the color attractiveness is required for a product design. It would like to know how to catch customer's eyes with the monochromatic design. Several factors are said to be responsible for color attraction for instance differences in age, gender, culture and so on (Radeloff, 1990; Zellner, 2010). The major aim of this study, hence, is to investigate the effect of monochromatic color on attractiveness.

2. METHOD

2.1 Experimental Setting

As shown in Figure 1, the apparatus was composed of two rooms separated by a wall with a 1° square aperture (T). The subject's room was covered inside with white wallpaper of about N9 and illuminated by daylight type fluorescent lamps (FL_S). The intensity of the lamps was adjusted by a light controller. The room illumination was measured by an illuminometer (I_S) placed on a shelf below the aperture at distance of 44 cm. Many objects such as artificial flowers, dolls, books, and dolls were put into this room. Color chips to serve as the test stimuli were attached to a rotating wheel placed in the test chart's room. They were also illuminated by adjustable daylight type fluorescent lamps (FL_T).

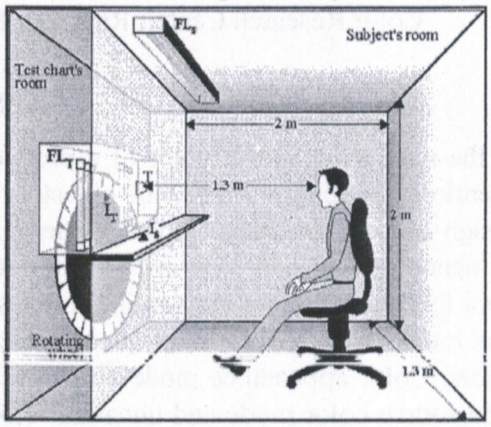

Figure 1: Schematic diagram of the apparatus

2.2 Color Stimuli and Conditions

Thirty-three color chips selected from the Munsell Color notation were used as the test stimuli. The color chips included one achromatic color (N5) and eight hues (5R, 5YR, 5Y, 5GY, 5G, 10BG, 10B, and 5P) varied in different chromas (2, 5, and 8). The Munsell value of all color chips was 5. The experimental conditions were composed of the combination of subject's room.illuminance levels (50 and 500 lx) and test chart's room illuminance levels (500 and 700 lx).

2.3 Subjects

Five subjects ranging from 22 to 27 years in age took part in this experiment. All subjects had normal or corrected-to-normal visual acuity. They were screened for color deficiencies using the Ishihara plate.

2.2 Experimental Procedure

The subject sat in subject's room and looked at the test stimuli through the aperture from a distance of 130 cm. There were three tasks for each subject. In the first task, the subject was asked to assess the degree of color attractiveness for each color by using the scale which was divided into 6 levels, as -3 (do not attract) to +3 (extremely attract). The word "attractiveness" here means salient or conspicuous, which is to get attention of viewers. In the second task, the subject judged the color appearance mode of each color chip as object color mode (OB-mode), unnatural object color mode (UN-mode), and light source color mode (LS-mode). And the last one, the subject was asked to assess the amount of chromaticness, whiteness, and blackness for each color chip base on the NCS. These three components have 100% in total. Within each session, 16 or 17 color chips were randomly presented under four conditions to make 96 or 102 judgments. Each subject has done three

sessions per condition. No time limits were set for making the judgments. Subjects were tested individually.

3. RESULTS AND DISCUSSION

For each color chip, the attractiveness scores for the five subjects were averaged. As shown in Figure 2, the mean score for each color chip is plotted against different Munsell chromas. Results showed that the higher the chroma of the color chip, the higher the attractiveness score, regardless of hues. For instance, the mean score of chroma 2, 5, 8 and maximum under $I_S50{:}I_T500$ condition are -0.1, 1.1, 2.0, and 2.7, respectively. Therefore, it was found that the vivid color attracts subject's attention. The same tendency occurred in all conditions. Our result agreen well with previous researches. Tanaka *et al.* (2000) proposed that chroma is linearly correlated to attractiveness. In our results, moreover, warm colors such as 5R, 5YR, 5Y and 5P were greater to draw attention than cool colors. Many previous researches reported that warm colors are considered arousing (Bellizzi and Hite, 1992; Cahoon, 1969) and active (Madden *et al.*, 2000; Richards and David, 2005), and lead to higher levels of anxiety (Jacobs and Suess, 1975). Tanaka *et al.* (2000) suggested that the closer the hue of a color to red was, the more salient the color would be.

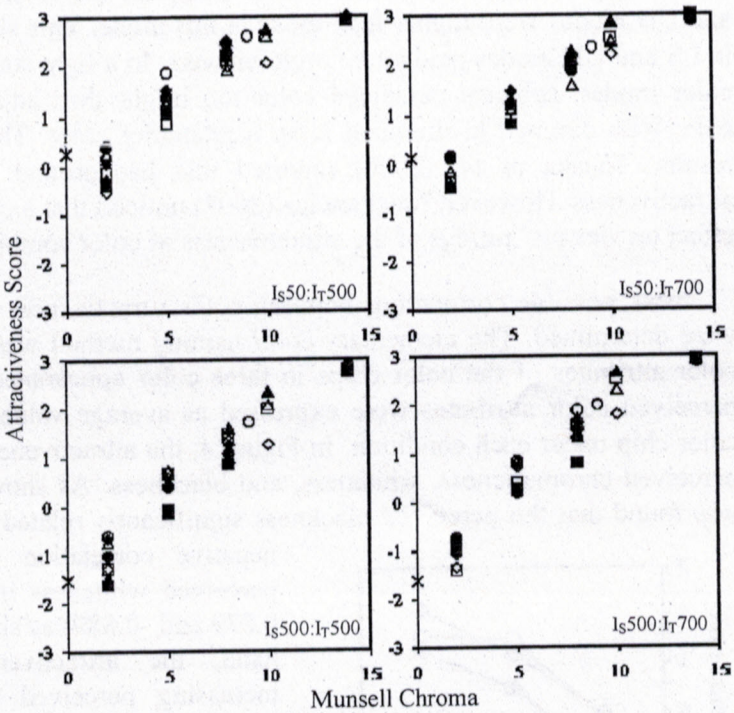

Figure 2: The attractiveness score from average result across all subjects by plotting against Munsell chroma for different Munsell hues; 5R(◆), 5YR(●), 5Y(■), 5GY(▲), 5G(◇), 10BG(○), 10B(□), 5P(△), N5(×).

Because a perception of color varies in a different illuminations, an effect of color apperance mode on attractiveness was considered. The color apperance mode judgment accummulated from all subjects were expressed in term of the color apperance mode index (i_{CAM}) by following equation:

$$\text{Color appearance mode index } (i_{CAM}) = \frac{-1(N_{OB}) + 0(N_{UN}) + 1(N_{LS})}{N_{OB} + N_{UN} + N_{LS}} \quad ,(1)$$

where N_{OB}, N_{UN}, and N_{LS} are the numbers of response in OB mode, UN mode, and LS mode. If $i_{CAM} > 0.5$, the color chip is classified in LS mode; if $i_{CAM} < -0.5$, UN mode; and if $-0.5 < i_{CAM} < 0.5$, OB mode.

Table 1. Mean and Standard Deviation of the attractiveness score across eight hues.

	$I_S50:I_T500$		$I_S50:I_T700$		$I_S500:I_T500$		$I_S500:I_T700$	
Chroma	Mean	SD	Mean	SD	Mean	SD	Mean	SD
2	-0.1	0.26	-0.1	0.34	-1.1	0.38	-1.0	0.25
5	1.1	0.24	1.3	0.31	0.4	0.34	0.6	0.29
8	2.0	0.21	2.2	0.21	1.2	0.25	1.5	0.32
Maximun	2.7	0.31	2.7	0.30	2.2	0.56	2.5	0.43

Note. For each chroma, $n = 120$

In Figure 3, the mean attractiveness score for the color chips that appeared in the LS and UN modes were higher than those in OB mode. This showed that color that appeared in LS and UN modes paid attention to viewers. In a light source color and unnatural object color modes, subjects perceived color too bright than adjacent surrounding. The bright color with dimmed background is an outstanding color. This result agrees with previous results. Tanaka *et al.* (2000) reported that background has an influence over color attractiveness. However, Mackiewicz (2007) noticed that a color of background had a little effect on viewers' ratings of the attractiveness of color combinations.

Next, possible correlations between color attractiveness and perceived color attributes were determined. The elementary color naming method was used to assess the perceived color attributes of the color chips in three color appearance modes. The amounts of the perceived color attributes were expressed as average values across all subjects for each color chip under each condition. In Figure 4, the attractiveness scores were plotted against perceived chromaticness, whiteness, and blackness. As shown in Figure 4 (a) and (b), it was found that the perceived blackness significantly related to the attractiveness score as negative correlation in OB mode (-0.854) and perceived whiteness in UN mode and LS mode (-0.879 and -0.889) as shown in Table 2. On the other hand, the attractiveness score increased with increasing perceived chromaticness as shown in Figure 4. There was a significant correlation between the perceived chromaticness and the attractiveness score in all color appearance modes. This result corresponded with the results of Munsell chroma. This showed that both physical chromaticness and perceived chromaticness have an influence over color attractiveness. Our result indicates that the color attractiveness may be described as the perceived color attributes.

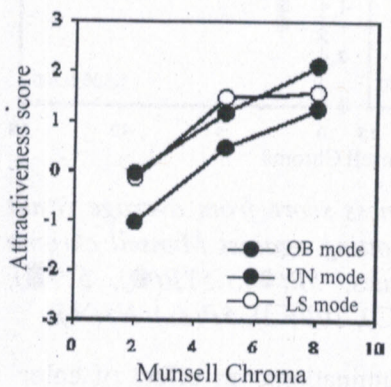

Figure 3: Mean color attractiveness plotted against Munsell chroma for different color appearance modes.

Table 2. Pearson correlation coefficients between attractiveness score and perceived color attributes.

	OB mode	UN mode	LS mode
Perceived chromaticness	0.924	0.960	0.948
Perceived whiteness	-0.785	-0.879	-0.889
Perceived blackness	-0.854	0.490	-0.698

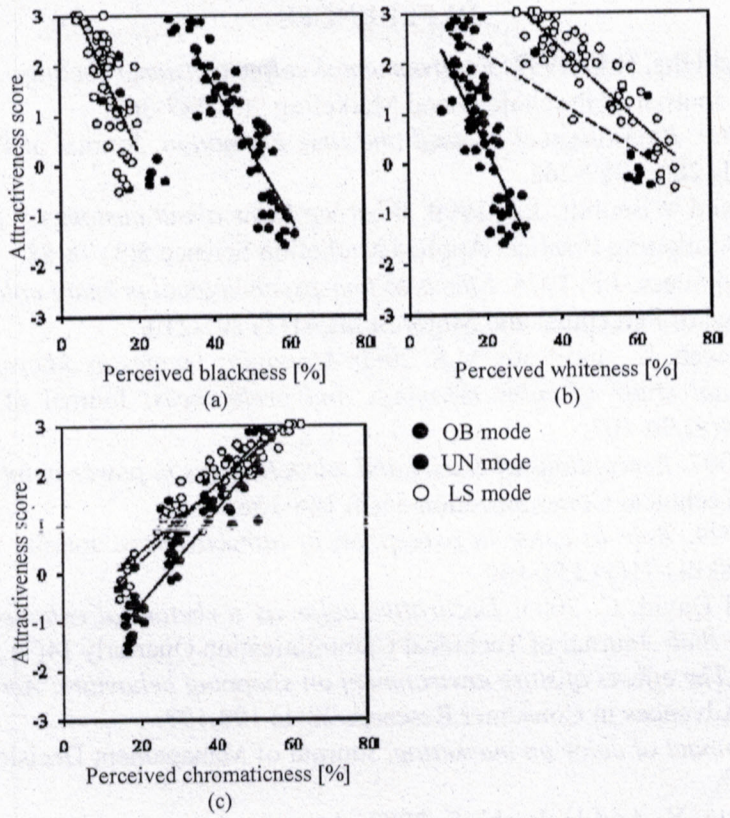

Figure 4: Scatter plot of attractiveness score and perceived color attributes: (a) perceived blackness, (b) perceived whiteness, and (c) perceived chromaticness.

4. CONCLUSIONS

In this study, thirty-three color chips varying in hues and tone were assessed under four conditions covered three color appearance modes. Findings showed that color with high chroma yielded higher attractiveness scores and warm color is to get attention of viewers. In a comparison among three color appearance modes, the color attractiveness in the unnatural object color mode and in light source color mode were significantly higher than those in the object color mode. Furthermore, the color attractiveness was significantly related to the perceived color attributes. They play a role as underlying mechanism on the determination of color attractiveness. Thus, it may be possible to use these components as a scale for predicting color attractiveness on the different color appearance modes. Our empirical finding delivers the idea to choose a proper hue and tone to get more attractiveness in mono-color design. However, this study is limited in color stimulus and a small number of subjects. In further research other factors are required for instance color combinations, tone combinations, a great number of subjects, circumstances, and so on.

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