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The Influence of the Background Color "Red" on the Appraisal of Pictures

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ABSTRACT

It is assumed that color has an influence on human cognition and behavior. The red effect has been taken up by a large body of research and the purpose of the study was to test the influence of red as a background color on the appraisal of pictures. Participants were randomly divided into two conditions: red or white. They appraised the levels of valence and arousal of four pictures with background colors of red or white. Results demonstrated that the levels of arousal were significantly higher when negative pictures with background color red were presented than when they were presented with background color white. This study's results are consistent with previous studies that have demonstrated a context-dependent manner of color effects on human cognition and behavior.

Keywords:
Red, valence, arousal, appraisal of pictures

1. Introduction

It is assumed that color has an influence on human cognition and behavior. The red effect has been taken up by a large body of research especially because red is a color which captures our attention (e.g., Buechner, Maier, Lichtenfeld, & Schwarz, 2014; Lindsay et al., 2010; Pomerleau, Fortier-Gauthier, Corriveau, Dell'Acqua, & Jolicœur, 2014; Sokolik, Magee, & Ivory, 2014; Tchernikov & Fallah, 2010). Red is used in warning and hazard signs such as stop signals and fire alarms (e.g., Borade, Bansod, & Gandhewar, 2008; Elliot & Maier, 2007; Griffith & Leonard, 1997; Luximon, Chung, & Goonetilleke, 2008; Pravossoudovitch, Cury, Young, & Elliot, 2014; Serig, 2000; Smith-Jackson & Wogalter, 2000; Wogalter, Kalsher, Frederick, Magurno, & Brewster, 1998) and is often associated with anger (e.g., Fetterman, Robinson, Gordon, & Elliot, 2011; Fetterman, Robinson, & Meier, 2012; Guéguen, Jacob, Lourel, & Pascual, 2012; Hupka, Zalesku, Otto, Reidl, & Tarabrina, 1997; Young, Elliot, Feltman, & Ambaby, 2013). The association between red and anger is founded by experiential correlation, which means that people who are angry experience a rush of blood to the head and turn red. The association is also explained from the perspective of conceptual metaphor (Lakoff & Johnson, 1980). Lakoff and Johnson (1980) explained that "the essence of metaphor is understanding and experiencing one kind of thing in terms of another". In fact, metaphor is not only a figure of speech but also an important part of the conceptual system used to understand abstract concepts. The conceptual metaphor theory asserts

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that metaphors provide conceptual mappings between more concrete, embodied, and common "source concepts", and more abstract, disembodied, and less perceptual "target concepts" (Landau, Meier, & Keefer, 2010; Meier, Scholer, & Fincher-Kiefer, 2014). In a nutshell, the word derivation from red to anger is explained by conceptual metaphor "EMOTION IS COLOR". Kövecses (2005) suggested that actual linguistic metaphors are expressions of conceptual metaphors. For example, seeing red or being red with rage is used for describing angry people and is based on conceptual metaphor "ANGER IS RED". In fact, the association is robust and these studies have found that the activation of red facilitates anger concepts. Therefore, red can be a negative stimulus which motivates our avoidance behavior (Maier, Elliot, & Lichtenfeld, 2008). The avoidance tendency enhanced by red can also influence our actual behavior. For example, Elliot, Maier, Moller, Friedman, and Meinhardt (2007) found that red impaired performance on achievement cognitive tasks. Attrill, Gresty, Hill, and Barton (2008) and Hill and Barton (2005) found that red enhanced performance in a variety of competitive contexts. These results are apparently contradictory in that sometimes red enhances performance and sometimes impairs, but in fact they are not inconsistent. Red informs individuals the existence of threat and they try to brush it away or to prepare for the coming threat by increasing the levels of arousal. As a result, simple physical activities are enhanced, whereas complicated cognitive activities are impaired because of physical responses (e.g., an increase of adrenaline, fight-or-flight response).

On the other hand, in the context of sexual allurement and sexual attraction, red can be a positive stimulus which motivates our approach behavior (e.g., Elliot & Niesta, 2008; Guéguen, 2008, 2010, 2012a, 2012b; Guéguen & Jacob, 2012a, 2012b, 2014; Lin, 2014; Niesta-Kayser, Elliot, & Feltman, 2010; Roberts, Owen, & Havlicek, 2010). These studies reported that men felt more attraction to women who wore red or even had something red (e.g., a laptop computer) because of the association between red and sexual attraction and sexual arousal to women. Similarly, women felt more attracted to men who wore red (e.g., Elliot et al, 2010; Roberts, Owen, & Havlicek, 2010) because of the association between red and high male status, dominance, and testosterone levels(e,g., Changizi, 2009; Muehlenbein & Bribiescas, 2005). In fact, research has found that some male animals show their dominance by displaying red on parts of their bodies (e.g., Bakker & Milinski, 1993; Pryke & Griffith, 2006; Setchell & Wickings, 2005). Therefore, the dual effect of the color red shows that red influences our cognition and behavior in *a context-dependent manner* (Meier, D'Agostino, Elliot, Maier, & Wilkowski. 2012). Elliot and Maier (2012) proposed CIC (color-in-context) theory as the context dependence of colors. CIC theory suggested that color meanings and effects are context specific and the same color can result in opposite meanings in different contexts. As previous studies mentioned above indicate, red has positive and negative (approach and avoidance) meanings.

Just as an experiment demonstrating color's context-dependence, Rohr, Kamm, Koenigstofer, Groeppel-Klein, and Wentura (2015) found that red enhanced avoidance tendency only for unhealthy food (negative stimulus) and had no effect for healthy food (positive stimulus) by adopting the approach-avoidance paradigm. However, how the color red influences the appraisal of valence and arousal of things remained in question.

The purpose of the study was to test the influence of red as a background color on the appraisal of pictures on the premise of color's context-dependence.

2. Method

2.1. Ethics Statement

The experiment was approved by the Academic Committee of the School of Psychology at Koshien University. All participants provided written informed consent before participating in the experiments. At the end of the experiment, they were debriefed.

2.2. Participants

Twenty-nine university undergraduate students (18 male 11 female, *Mage*=20.10, *SD*=2.04) participated in the study. No participants realized the purpose of the study.

2.3. Design

A 2 (background color: red or white) × 4 (pictures) between-subjects design was implemented.

2.4. Stimuli

Pictures were selected from Open Affective Standardized Image Set (OASIS), which was made by Kurdi, Lozano, & Banaji (2016). Among the OASIS, four pictures were selected according to the combination of low and high levels of valence and arousal (2 pictures of low or high valence × 2 pictures of low or high arousal). The levels of valence and arousal of each picture are as follows ; picture 1 (Fire 9) : low valence (1.47) × high arousal (5.15), picture 2 (Destruction 2) : low valence (2.19) × low arousal (3.06), picture 3 (Beach 5) : high valence (5.59) × low arousal (3.36), picture 4 (Cat 5) : high valence (6.22) × high arousal (4.86). A seven point scale was used to appraise the levels of valence and arousal of each picture in OASIS. Consequently, more than 3.5 was treated as upper level and less than 3.5 was treated as lower level in the study.

2.5. Apparatus

Pictures were presented using a tablet PC (22cm wide × 13.5cm long). The size of the pictures was 11cm wide × 9cm long. The luminance of the screen was constant.

2.6. Procedure

Participants were randomly divided into two conditions (red: N=13, white: N=16). They looked at four pictures one by one presented on a tablet PC for five seconds and appraised the levels of valence and arousal of each picture on a seven point scale. They answered from 1: very negative to 7: very positive about the levels of valence. In order to appraise the levels of arousal, the Self-Assessment Manikin (SAM) scale of seven grades (Lang, 1980) was used. This is because the concept of arousal is harder to comprehend intuitively than that of valence (Kurdi, Lozano, & Banaji, 2016) and the prevention of participants' confusion of valence and arousal by using SAM, which is easy to understand visually.

3. Results

The mean values and standard deviations of the levels of valence and arousal are presented in Table 1.

A 2 (background color)×4 (pictures) ANOVA was performed with the levels of valence given as the dependent variable. A main effect of the pictures was found ($F(3,81)=47.91$, $p<.001$, $\eta^2=.64$). As a result of multiple comparisons, a significant difference was found in all pairs of pictures except pairs of pictures 3 and 4 ($p<.01$). Neither a main effect of background colors ($F(1,27)=.47$, $p=.50$, $\eta^2=.02$) nor the interaction between background colors and pictures ($F(3,81)=1.20$, $p=.32$, $\eta^2=.04$) was found.

A 2 (background color)×4 (pictures) ANOVA was performed with the levels of arousal given as the dependent variable. Neither a main effect of pictures ($F(3,81)=1.19$, $p=.32$, $\eta^2=.04$) nor background colors ($F(1,27)=1.17$, $p=.29$, $\eta^2=.04$) was found. The interaction between background colors and pictures was significant ($F(3,81)=4.36$, $p<.01$, $\eta^2=.14$). Since there was a significant difference in the interaction, a simple main effects test was conducted. Results indicated that the simple main effect of the background color red was significant in pictures 1 and 2 ($p<.05$) (Figure 1.).

Table 1. Mean values and standard deviations of the levels of valence and arousal

valence	M	SD
picture 1 red	3.15	1.34
white	3.69	.79
picture 2 red	2.46	1.05
white	2.88	.81
picture 3 red	5.69	1.18
white	5.13	1.54
picture 4 red	5.85	1.77
white	6.13	1.20

arousal	M	SD
picture 1 red	4.00	1.78
white	2.75	1.13
picture 2 red	3.92	2.10
white	2.44	1.21
picture 3 red	2.46	1.33
white	2.94	1.84
picture 4 red	2.77	1.64
white	3.31	1.70

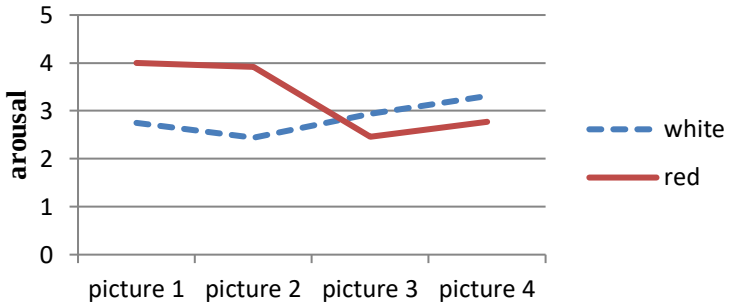

Figure 1. Background color and the levels of arousal

4. Discussion

It was found that the background color red had no effect on the levels of valence and the levels of arousal were significantly higher when red negative pictures were presented than when white negative ones were presented. This is consistent with results of Rohr et al. (2015) in that red had an effect on appraisal of only negative targets (e.g., unhealthy food, negative pictures).

Red influences our cognition and behavior in a context-dependent manner (Meier et al., 2012). However, the approach-effect of red occurs only in a very specific context (i.e., romantic context), and instead, red is predominantly associated with avoidance tendency (Rohr et al., 2015). It appears that low valence (negative pictures) is associated with avoidance tendency and high valence (positive pictures) is associated with approach tendency, respectively. Therefore, negative pictures and background color red are both associated with avoidance tendency, and when these two attributes come together, avoidance tendency could be facilitated because they both have same attributes (avoidance). On the other hand, positive pictures and red have opposite attributes (positive pictures for approach vs. red for avoidance). Consequently, the arousing effect of red was offset by positive pictures and no difference was found between arousal levels in white background (pictures 3 & 4). The state of increased avoidance tendency means that a threat is imminent and individuals need to prepare for the threat by increasing the levels of arousal, for high levels of arousal is essential for flight tendency. As a result, this study showed the increase of the levels of arousal when negative pictures which are background color red were presented.

On the other hand, red had no effect on the valence levels of pictures in this study. More research is needed about the reason, but there may be a possibility that the red-negative or red-positive association is always dependent on a context and default evaluative response to red is neither negative nor positive. Some research pointed out the red-negative association (e.g., Gil & Le Bigot, 2016), but definitive conclusions on the matter should not be made as Moller, Elliot, and Maier (2009, p.901) indicated “it seems prudent to continue to entertain the possibility that the red-negative association is achievement-specific”. Hence, it is considered that the negativity of red was not activated because the appraisal of the levels of valence of pictures is not achievement-specific context.

5. Limitation

The study has some limitations. First, only four pictures were used for appraisal and future research should adopt more pictures and standardize the value of valence and arousal of each picture when they are classified into high level or low level. In fact, as a result of multiple comparisons, a significant difference was found between the levels of valence of pictures 1 and 2. Pictures 1 and 2 were both treated as low valence stimuli in the study and it was not desirable to find a significant difference between them. This implies that the selection of pictures did not function very well. Second, extreme negative pictures (e.g., a dead body) in OASIS were not used out of consideration for ethical reasons and portrait photographs were also not used in this study.

Future studies should also investigate attributes of subjects (e.g., persons, landscapes, things) given that color effect is context-dependent.

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