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The universal and automatic association between brightness and positivity☆

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ABSTRACT

The present study investigates the hypothesis that brightness of colors is associated with positivity, postulating that this is an automatic and universal effect. The Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) was used in all studies. Study 1 used color patches varying on brightness, Study 2 used achromatic stimuli to eliminate the potential confounding effects of hue and saturation. Study 3 replicated Study 2 in a different cultural context (Japan vs. Austria), both studies also included a measure of explicit association. All studies confirmed the hypothesis that brightness is associated with positivity, at a significance level of $p < .001$ and Cohen's D varying from 0.90 to 3.99. Study 1–3 provided support for the notion that this is an automatic effect. Additionally, Study 2 and Study 3 showed that people also have an explicit association of brightness with positivity. However, as expected, our results also show that the implicit association was stronger than the explicit association. Study 3 shows clear support for the universality of our effects. In sum, our results support the idea that brightness is associated with positivity and that these associations are automatic and universal.

1. Introduction

The notion that brightness is positive and darkness is negative can be traced back to mythical time. The famous story of Theseus and the Minotaur features the agreement between Theseus and his father, Aegeus, to hoist a white flag for success (defeat of the Minotaur) and a black one for defeat. As the art historian Gombrich (1963) mentions: "Surely it was no accident that black rather than white was the sign agreed upon for failure. Black seems to us a more 'natural' sign for grief, and white for a 'brighter' mood: and even though we know that cultural conventions also play their part (and that black is not everywhere the color of mourning), the correlation makes sense in terms of expressiveness (p.61)."

Historically there has been great interest in studying the aesthetic effects of different colors in literature on art as well as in psychology (Bullough, 1907; De Camp, 1917; Fechner, 1876). Artists and art historians often use the term "effect" or "aesthetic effect" (e.g. Gombrich, 1963; Itten, 1961; Kandinsky, 1911; Schwitters, 1918), whereas in psychology it is more common to speak of associations. Basically both terms refer to the same experience. Kandinsky (1946) for example, specified different associations for the color black: "Black is something extinguished like a burned pyre, something immobile, corpse-like, which has no connection with any occurrences, and accessible to all things. It is like the silence of the body after death, the end of life (p.68)."

Even though early psychological studies (e.g., Alexander & Shansky, 1976; Bullough, 1907; De Camp, 1917; Mogensen & English, 1926; Monroe, 1925; Pinkerton & Humphrey, 1974; Tinker, 1938) show a great interest in color associations, the methodological quality is poor (Gelineau, 1981; Valdez & Mehrabian, 1994). More recent work has neglected associations somewhat and has a greater focus on color preferences (Hurlbert & Ling, 2007; Osborne et al., 2016; Palmer & Schloss, 2010; Wei, Houser, Allen, & Beers, 2014) despite this there have been studies conducted that looked at associations (Adams & Osgood, 1973; Albertazzi et al., 2013; Chen, Tanaka, & Watanabe, 2015; Dael, Perseguers, Marchand, Antonietti, & Mohr, 2016; Lazreg & Mullet, 2001; Saito, 1996).

Most color conceptualizations define color as having 3 features: hue (i.e. wavelength), saturation (i.e. vividness, with lower saturation containing more grey), and brightness (i.e. black-to-white quality).

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Psychologists studying color and its associations, have almost exclusively focused on the effects of hue. In addition, results vary greatly between as well as within studies. Variation in associations connected to hue are often due to cultural variation, such as the influence of language on color discrimination (Regier & Kay, 2009; Winawer et al., 2007), cultural differences in affective/symbolic meaning and associations related to different *hues* (Adams & Osgood, 1973; Saito, 1996). In contrast, there seems to be less (cross-cultural) variation in the influence of brightness. Brightness seems to be associated with positivity across cultures (Adams & Osgood, 1973; Saito, 1996; Valdez & Mehrabian, 1994). In relation to the emotional effect of color, Gao et al. (2007) even concluded that influences of hue and cultural background are limited, whereas brightness was seen as an important influence. It has to be mentioned though that the majority of these studies used color words ("Blue", "Red", etc.) rather than color stimuli (i.e. an image of a color), however, these studies are not strictly about hue. Nevertheless, this research suggest that an association between brightness and positivity exists. There are only a handful of studies (Hemphill, 1996; Lakens, Fockenberg, Lemmens, Ham, & Midden, 2013; Lakens, Semin, & Foroni, 2012; Meier, Fetterman, & Robinson, 2015; Meier, Robinson, & Clore, 2004) that tested this association directly. In the studies by Meier et al. (2004, 2015) positive and negative words were printed in either black or white font. In the study by Lakens et al. (2012) participants had to indicate the correct translation of a word into Chinese by selecting a Chinese character printed in either black or white. Both found an association between brightness and positivity. The other two studies, Lakens et al. (2013) and Hemphill (1996), didn't use font colors (black vs. white) as the basis for associations.

The study by Hemphill (1996) asked participants to associate emotional responses with a various range of hues, in this case people tended to associate bright colors (e.g., white, pink) with positive emotions and dark colors (e.g. black, brown) with negative emotion. The Lakens et al. (2013) study looked at overall brightness of naturalistic pictures. They found an overall "brightness bias", meaning that brighter pictures were evaluated as more positive.

We use color patches as stimuli in the current study. Using different stimuli can provide evidence for the stimulus independence of the effect, that is, the notion that the effect is there and can consistently be found when using a variety of stimuli.

One remaining question is why effects of brightness seem to be consistent even across cultures when effects of hue seem more likely to vary. A way to understand this would be through the structure of our visual system. Our visual system employs two pathways, a chromatic one that processes color contrasts and an achromatic one that processes luminance contrasts (for a more detailed account see Gegenfurtner & Kiper, 2003). While the development of the achromatic response appears to be stable in infants after a few months of age (Crognale, 2002) the development of the chromatic response continues to change from birth until puberty (Boon, Suttle, & Dain, 2007). Furthermore, Page and Crognale (2005) suggest that both pathways age differently, with the chromatic pathways being more significantly affected by age-related changes. These studies indicate that the chromatic system may be more sensitive to cultural influence than the achromatic system.

This earlier biological onset of stability of achromatic responses might be related to cultural development in language. Anthropological research has shown that in Indo-European cultures (old English for example) there used to be a brightness-oriented color paradigm. In such a paradigm, color discrimination is done based on brightness rather than hue (Biggam, 2014; Borg, 2014). In this case all the bright colors would group together (bright blue, bright yellow, bright red) and all the dark colors would group together (dark blue, dark yellow, dark red). Rather than grouping based on hue where, for example, bright and dark blue together. Later, many of these languages shifted to a hue-based paradigm of color discrimination, like we all know from Modern English today. Interestingly, there are still modern languages such as Russian (Winawer et al., 2007) that use a brightness-oriented color discrimination paradigm (Biggam, 2014; Borg, 2014). It is notable, however, that large-scale studies such as the World Color Survey (Kay & Cook, 2015) have found that industrial cultures have very similar chromatic discrimination.

Following this reasoning, we hypothesize that the effects of brightness should be universal as well as automatic. If brightness triggers an evolutionarily earlier developed system then consistent effects of brightness should be found across cultures and these effects should be automatic. Based on previous research, one potential effect of brightness seems to be that brightness is associated with positivity. Saito (1996) found cross-cultural similarity for a preference of white amongst East Asians. Valdez and Mehrabian (1994) found that white (in comparison to grey and black) was seen as more positive in an American sample. Similarly, Adams and Osgood (1973) found a high-level agreement on ratings of black. Research by Meier et al. (2004, 2015) and Lakens et al. (2012, 2013) have found support for the idea that brightness and positivity are associated.

In this study, we therefore want to test the hypothesis that brightness is associated with positivity and, in addition, test the claim for universality and automaticity. To test for automaticity we used an Implicit Association Test (hereafter: IAT, Greenwald, McGhee, & Schwartz, 1998) to measure the implicit association between brightness and positivity. The IAT is a well-known measure of social attitudes and has also been used in previous studies to investigate color associations (e.g. Soriano & Valenzuela, 2009). In Study 2 and 3 we additionally included an explicit measure. In Study 1 we use chromatic stimuli in order to see if the brightness-positivity association can be found in chromatic stimuli. In order to exclude alternative explanations based on hue or saturation we use achromatic stimuli in Study 2 and Study 3. All studies used images to represent the color stimuli. In order to test for universality we used an Austrian sample in Study 1 and 2 and a Japanese sample in Study 3.

2. Study 1

2.1. Participants

We used a small to medium effect size in our power analysis. This indicated that we needed 71 participants to achieve a power of 0.80 with an error rate probability of 0.05. We therefore collected data from 71 participants. All participants were psychology students of the University of Vienna and received course credit for their participation. Fifty-three participants were female and the mean age was 22.11 (SD = 3.5). The experiment was carried out in accordance with the Declaration of Helsinki and in a procedure which was approved by the local ethical committee of the University of Vienna.

2.2. Method

We used a within-subjects design. All participants completed an IAT task and then reported demographic information. The IAT is a reaction based task where two concepts (in our case bright and positive) either share a response key (congruent block) or have different response keys (incongruent block). The idea is that if two concepts are implicitly associated reaction time will be faster in congruent blocks as opposed to incongruent blocks. If there is no implicit association, people should perform equally well in both blocks. For a detailed description of the task see Table 1. The IAT is a widely used test, it is robust and easy to administer, and has good reliability compared to other implicit measures (Fazio & Olson, 2003; Nosek, Greenwald, & Banaji, 2005). Explicit ratings of the positivity of the stimuli were also collected but due to a data logging error cannot be reported here.