

The Effects of Color on Memory

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ABSTRACT

This study examined whether color has an effect on memory. Participants were 115 college undergraduates enrolled in an introductory psychology course. They were each given a packet consisting of a list of 20 words, a mathematical task, a blank recall sheet, and a demographic questionnaire. All sheets within each packet were the same color, but different participants received warm colored (red and yellow), cool colored (green and blue), or white packets. The participants were given one minute to memorize the list of words. They then completed the mathematical task. Lastly, they tried to recall as many words as possible on the blank recall sheet. The percentage of words recalled correctly was the dependent variable. It was hypothesized that participants who received warm-colored packets would recall more words than participants who received either the cool-colored packets or the white packets. A one-way ANOVA was conducted and the results indicated that there was not a statistically significant difference in percentage of words recalled based on packet color. Possible explanations are examined.

INTRODUCTION

We live in a world of color. The rapid rise in technology utilizing full color spectrums such as televisions, the internet, and cell phones, has intensified research on the impact of color on psychological processes such as arousal (Greene, Bell, & Boyer, 1983; Wilson, 1996). Previous research has shown that moderate arousal can increase memory retention (Myers, 2006). Given the amount of color with which individuals engage while comprehending information, it is logical to question whether arousal due to color has enough impact to increase memory retention. The proposed study explored the relationship between color and memory hoping to add to a paucity of research in the area.

Color and Arousal

Color has been found to increase a person's arousal. It was proposed by Faber Birren (1950) that warm colors, such as red and yellow, increase arousal more than cool colors, such as green and blue. Warm colors are those that are vivid in nature. Artistically speaking, they are said to advance in space, opposed to cool colors that are soothing and tend to recede in space. Birren's finding was supported by further research done by Greene, et al. (1983). They found that warm colors increase arousal compared to cool colors. Participants were issued three different scales measuring emotional response, personal feelings, and quality of place. They were then seated in a small room with one of ten different colors mounted on the walls. They then filled out the scales again and were given a task to measure boredom. Greene et al. found that yellow and orange (warm colors) elicited more arousal than other colors like brown and gray.

Wilson (1966) reported similar findings in his study. He exposed 20 undergraduate students to a slideshow of alternating red and green colors. They were instructed to look at a cross that was in the center of each slide. During the course of the experiment, conductance level and galvanic skin response (GSR) served as measurements for physiological arousal for each participant. Conductance level was defined as an average of five conductance readings, while GSR was defined as the maximum increase in conductance. Wilson found that both measures of physiological arousal were higher during the viewing of the color red than they were for green. Several other researchers have supported these findings (Jacobs & Hustmyer, 1974; Levy, 1984; O'Connell, Harper, & McAndrew, 1985).

Arousal and Memory

It is widely accepted in the scientific community, that arousing events have the ability to increase memory (Roosendaal, 2002). When undergoing these arousing events, hormonal changes in the brain lead to enhanced memory. Wolters and Goudsmit (2005) studied the effects of arousing events on memory. They questioned both college students and a group of elderly citizens regarding information about an arousing event both two weeks and

two months after the event. They found that regardless of the age or time period, both groups showed a high level of recall for details of the event. In addition, many participants described the memories as “very vivid”.

While the Wolters and Goudsmit (2005) study showed that arousal can increase memory, the event they used was traumatic and very arousing. Colors, on the other hand, are not so traumatic. A new study by Otani, Libkuman, Widner, and Graves (2007) looked at the effects of less arousing events on memory. Otani et al. (2007) split the participants into two groups. Both were shown a set of slides depicting a story and accompanied by a taped narrative that described each slide. One set showed arousing content, while the other showed neutral content. Otherwise, both were matched as closely as possible for content.

After viewing the slideshow, participants rated the show on a 9-point scale of whether or not they agreed that the show was emotional and that their reaction to the show was emotional. They were then given a filler task to prevent rehearsal, followed by the recognition test. Otani et al. (2007) found that the participants appropriately rated the arousing story as more arousing. More importantly they found that recognition for the more arousing story was significantly higher than recognition for the neutral story.

Both Wolters and Goudsmit’s (2005) study and Otani et al.’s (2007) study indicate that arousing events can increase memory. Consequently, it is reasonable to assume that color can act as a memory aid if the colors used are emotionally arousing.

Color and Memory

If color can increase arousal, and arousal can increase memory, then it is possible that we could find that color can increase memory. In 2006, Spence, Wong, Rusan, and Rastegar found just that. In their study, 120 participants viewed a sequence of images of natural scenes on a computer monitor. The participants were either shown colored scenes or gray scale scenes. The same scenes were then shown again, either in color or in gray scale. The participants were asked to rate the scenes as old or new. Spence et al. (2006) found that color increased the recognition of the natural scenes by approximately 5%.

McConnohie (1999) created a slideshow with alphanumeric characters such as a “B” or a “2”. He showed the slideshow to a classroom of middle schoolers and asked them to recall as many characters as they could immediately after seeing the slideshow and then again an hour later. He repeated this three times, each time using a different color for the background of the slideshow (white, blue, or green). The character color for all three slideshows was black. McConnohie found that the slideshow with the white background resulted in higher retention rates both immediately, and one hour after viewing the slideshow. This would be an expected result since blue and green are both cool colors and therefore won’t have as much of an arousing effect as white would.

Although McConnohie’s study more directly examines the effects of color on memory, the sample size was relatively small and varied from day to day because a classroom of students was used. Therefore, if any students were absent, the sample size would have changed. In addition, although much educational stimulus is electronic, many students continue to gain information from paper syllabi, worksheets, and handouts. Finally, this is only one study and it did not include any warm colors.

The current study looked at the effects of colored handouts on memory retention of undergraduate college students. As compared to K-12 studying, collegiate level studying requires more time without guidance from others. Participants were given either a warm, cool, or white-colored word-list and after a filler-task, were asked to recall as many words as possible. It was predicted that students who received the warm colors (red and yellow) would recall more characters correctly than those students who received the cool colors (blue and green) or the students who received the white sheets due to the arousing effects of warm colors.

METHOD

Data collection took place in the fall of 2006. Participants were 115 undergraduate students enrolled in introductory psychology from the University of Wisconsin – La Crosse. The University of Wisconsin – La Crosse is a public, Midwestern, medium-sized university. Participants received extra credit for their participation. Informed consent was obtained and all participants were asked to provide standard demographic information.

Participants were randomly assigned into one of five color conditions: two were warm colors, two were cool colors, and the control condition. There were 19 students in the red color condition, 15 in the yellow color condition, 22 in the blue color condition, 25 in the green color condition, and 34 in the white control condition. I also controlled for English as a first language and color-blindness. I wanted all students to have English as their first language so there were no differing interpretations on the instructions given.

Each participant received a packet. The first page of the packet had a list of twenty common 1-3 syllable nouns, such as chair and button. Participants were instructed that they would be given one minute to study these words.

After study, they were then asked to turn the page and work on a 3-digit multiplication task for one minute. The purpose of the arithmetic task was to keep the participants from rehearsing the words before being asked to recall them. Then, the next sheet was a blank page on which they were asked to recall as many words as they could. They were given two minutes to do this. Finally, they filled out a demographic questionnaire.

Both the warm and the cool conditions had two experimental sessions, one for each color. All participants within each session received the same color packet. In the warm condition, participants received either a red or a yellow colored packet. In the cool condition, participants received either a blue or a green packet. In the control condition all participants received a white packet. All of the words in each packet were printed in black ink.

RESULTS

The data were analyzed using a one-way analysis of variance. The independent variable was the color category of the packets (warm, cool, or white). The dependent variable was the percentage of words recalled correctly. The analysis was done with an alpha level of .05. Contrary to the hypothesis, there was no statistically significant difference for percent recall among the color categories, $F(2, 112) = 0.18, p > .05$. Overall, percent correct recall was 44.8%. Correct recall percentages for each category were 43.5% for the warm condition, 45.7% for the cool condition, and 44.8% for the control condition. The results were also analyzed by each color separately with no statistically significant difference found here either, $F(4, 110) = 0.12, p > .05$.

DISCUSSION

Contrary to what was expected, there was no significant difference for percent recall among color categories. These results are also inconsistent with previous research (Spence et al., 2006; McConnohie, 1999). One possibility is that the participants weren't exposed to the colors long enough. In the Greene et al. (1983) study, for instance, participants took three different scales as well as the boredom task while being exposed to the color.

Another problem could have been the color selection. Unfortunately, the colors provided from document services were all very bright. So in order to have all of the packets of the same type of paper, the blue and the green used in this study were very bright, rather than what I would call "true" colors. The brightness of the hue could have had an arousing effect, rather than a calming effect.

Finally, perhaps the amount of arousal that color induces isn't great enough to cause an increase in memory. In the Wolters and Goudsmit (2005) study, they were testing recall based on very arousing and traumatic events. Exposure to warm colors will not have such an impact and therefore might not cause enough arousal to trigger the corresponding increase in memory.

In conclusion, a repeat of this experiment might prove useful if given a slightly different design. One could increase the time of exposure to the color or choose a different selection of colors to print the packets on. There are many benefits to this research including benefits to both the fields of advertising and education. In advertising, for instance, knowing which colors will allow consumers to retain more information would greatly impact the way marketers go about showcasing their products. In the field of education, teachers and professors could color coordinate their handouts and slideshows to emphasize the most important points for students. And students, in turn, could use colored note cards and highlighters to aid in their studying. Overall, this topic is still an important one and one that I feel deserves more study.

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