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The Effect of Color, Preference, and the Interaction of Color and Preference on Short-Term Memory

Shreya Patel
Butler University

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Shreya Patel

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Abstract

The link between color and memory has sparked a lot of curiosity over the past few years. Previous research suggests that color can affect short term recall of word lists (Singg, 2017). Other studies have shown that color can generally help increase object memory (Lloyd-Jones & Nakabayashi, 2009). Color increases attention and emotional arousal, which can lead to better memory of certain objects, words, and ideas (Dzulkifli & Mustafar, 2013). This study aimed to determine if there was a relationship between color, color preference, and short-term recall of a list of words. A total of forty participants were randomly selected. Half of the sample population was given the choice to choose between control black, red, green, or blue pen. The other half was assigned to either a color pen or black pen. Participants were then given a blank sheet of paper and prompted to write down a list of thirteen random words as the words were dictated to them. Upon finishing this task, participants were immediately given a new blank sheet and the sheet with written words was taken away from them. Participants are then asked to write a brief, coherent story using as many words that they can remember from the list. Responses were then collected, read, and the number of words used in the participant response was recorded in a Microsoft Excel spreadsheet. Statistical analysis indicated that there was no correlation between color, color preference, and word recall, suggesting that color and color preference do not affect short-term memory.

Introduction

Human memory is one of the most interesting topics studied in psychology. While today psychologists understand memory better than they did fifty years ago, there are still many unanswered questions in this field. One of those questions is if it is possible to improve one's

memory. What kind of things can help retain memory? For undergraduate students, one of the most important skills is having a good memory. Students spend countless hours on many nights studying for various exams during their college years. Throughout their studying, many have surely explored and tried to find ways to remember course material better. Most techniques on the internet involved things like reading notes before going to sleep at night (Curtis 2013), eating foods that improve memory retention (Jennings 2017) , or simply doing physical flashcards. One of the most popular myths about memory retention is writing in colored ink (Purdy 2013). Does writing in colored ink improve memory retention? Specifically, if a student were to take notes in color and then immediately have a pop-quiz in class, is the student more likely to recall the information? In this study, this question is explored further, and it is tested whether color and color preference have an effect on short-term memory or not.

Improving and retaining human memory is a question that scientists have faced for many years. Color is one of these factors that could possibly play an important role in memory. Short-term memory involves information that is stored in our memory for short periods of time (Cowan, 2008). It is best known to be stored in chunks of approximately 5-7 pieces of information (Miller, 1956). The next type of memory is working memory. This type of memory usually involves information having to repeated/rehearsed in order to keep it fresh. For example, a phone number or a short grocery list, things that need only be remembered for a short time period, are stored in our working memory. Finally, long-term memory is the third kind of memory storage. Long-term memory is longer in duration compared to short term memory. It is also greater in capacity, because one can store more items in their long-term memory (Cowan, 2008). There are three main steps to storing short-term memory-encoding, maintenance, and retrieval (Jonides, 2008). Encoding is the process of converting perceived information into a

usable form for memory. Maintenance or storage is keeping that memory available for use. Finally, retrieval is bringing that memory into awareness and being able to remember it. It is important to understand how the mind understands color and incorporates it into memory. Color is recognized and processed by the color center located in the occipital lobe of the brain. The brain processes various wavelengths of light that pass through the eye as color and associates these colors to different emotions, meanings, and thoughts. These thoughts are then stored as information into memory.

Various studies and research have presented ways that have been shown to potentially improve short-term and long-term memory. Research has shown that incorporating multiple senses such as sight, sound, taste, touch, and smell can help strengthen a memory (Matusz, 2017) (Miranda, 2012). For example, writing a word physically on paper, hearing the sound of the pencil on the paper, and seeing the word as it is being written involves three different senses, which all contribute to better memory of that word. Smoker et al. (2009) found that writing words by hand resulted in better memory than typing words. A very interesting study done by Smilek et al. (2002) involved using a 21-year-old female who experienced synesthetic color and found that synesthetic color greatly influenced her memory of numbers. A related study discussed how individuals that experience synesthesia show signs of enhanced visual memory (Rothen & Ward, 2012). It is clear that memory has been shown to being affected by a wide range of variables.

Color is one of the many things that can potentially play a very important role in enhancing memory. A review by Dzulkifli and Mustafar (2013) discusses many important topics about color and memory. It summarizes many other studies that found important correlations between color and memory, and they all generally supported color having a positive effect on

memory. They found that color increases human attention levels which then leads to stronger memories. Color also enhances the relationship between arousal and memory. When the colors used during the encoding and retrieval phases are the same, this is predicted to result in the greatest memory retention (Dzulkifli & Mustafar 2013).

Color in nature has also been shown to improve memory of natural scenes. Spence (2006) studied color and gray-scale images of neutral scenes with 120 participants. They found that participants' recognition of scenes was 5% higher in the colored images than the gray-scale images (Spence, 2006). Object-color pairings have been studied in the past and have been shown to play an important role in object memory (Lloyd-Jones & Nakabayashi, 2009) In this study, participants were asked to determine if an object is correctly paired with a color. Researchers found "independent effects of color whereby colored-object decision performance were more efficient for correctly than for incorrectly colored objects when color fell on the object surface" (Lloyd-Jones & Nakabayashi, 2009).

Finally, there are many cases in which no effect was seen at all of color on memory (Vernon & Llyod-Jones, 2003). In this experiment, researchers used 30 participants to study the "effects of color on the processing and priming of diagnostically colored- objects in implicit tasks." Results showed that the "effects of priming were equivalent for correctly colored and incorrectly colored- objects and that changes in color did not influence priming" (Vernon & Lloyd-Jones, 2003).

Choice and control over one's learning has also been thought to influence memory. In study done by DuBrow et al. (2019), researchers studied the effect of choice on memory. There were two conditions used in the experiment-assigned cues and cues based on choice. Researchers found that memory recognition was higher for items encountered in the choice condition. From

this, it was concluded that choice plays a valuable role in learning enhancement and memory. Relating to study habits, many students like to choose different color when writing their notes. It is possible that the ability to choose plays a role in better memory recognition of notes.

Current Study and Hypotheses

This aim of this study is to determine if color and preference of color have an effect on word list recall. I predict that the color with preference condition will generate the greatest number of responses, while the black ink with no preference condition will generate the least number of responses.

Method

Participants

A sample of 40 undergraduate Butler University student participants were used in this study. All participants were between 19-22 years in age.

Design

Ink color (black, red, green, blue) and presence of choice (ability to choose vs. assigned an ink color) were the primary independent variables of this study. The number of words recalled was the dependent variable of this study. All participants were randomly assigned into the preference or non-preference group. Half of the sample population was given the choice to choose between control black, red, green, or blue pen. The other half was assigned to either a color pen or black pen. When allowing participants to choose their color, the color choices were verbally presented to them rather than physically placing pens in front of the participants. Condition were “black, no preference,” “green, no preference,” “red, no preference,” “blue, no preference,” “black, preference,” “green, preference,” “red, preference,” and “blue, preference.” In the end, there were five participants in each condition.

Materials and Apparatus

To carry out this study, Paper Mate Profile Retractable Ballpoint Pens in red, blue, green, and black ink were used. I used plain copy paper in bright white (8 1/2" x 11") for all participants. While location was not always the same, it was consistently a low-noise level, low-crowd setting such as a study room, library corner, or office setting. Participants were always seated at a table and chair to emulate a class-like setting. A MacBook Air (13-inch, Early 2015 model) and Microsoft Excel (Version 16.35) were used to store all the participant data associated with the study.

Procedure

As soon as participants arrived in the testing area, informed consent was obtained. Participants were seated at an empty table and chair. They were given a blank sheet of paper and a choice of ink color (in some cases, color was randomly assigned). Ink color choices were verbally stated to the participant and they were allowed to choose their color. Participants were given instructions about their task. The following instructions were stated directly to all participants: “I (the researcher) will read you a short list of words, which I want you to write down on this sheet of blank paper as I say them to you. After you (the participant) have written all of the words, you will receive a new blank sheet of paper and the old sheet will be taken away from you. On this new sheet of paper, I want you to write a short, cohesive story that uses as many of the dictated words that you can remember. You will not be timed.” Participants were then prompted to write down a list of 13 random words (such as ‘mountain, cake, salon”) as the words were dictated to them. Upon finishing this task, participants were immediately given a new blank sheet and the sheet with written words was taken away from them. Participants then wrote a brief, coherent story using as many words that they could remember from the list.

Responses were then collected, read, and the number of words used in the participant response was recorded in a Microsoft Excel spreadsheet.

Results

Participant responses analyzed to test for a correlation between number of responses and the color of ink used to write the list and a correlation between number of responses and color preference.

Results suggest that there is no significant effect of color or color preference on short term memory recall. Preference and responses generated had no correlation (see Figure 1). Upon conducting a two-tailed paired t-test, the p-value was 0.3693, which indicates that color preference had an insignificant effect on word recall. The average number of responses for the preference group was 7.55, while the average number of responses for the non-preference group was 7.40. Color and responses had no correlation. While the average responses generated by the groups that used a colored ink was higher than that of those that used black ink, the difference was not statistically significant. The average number of responses generated by all participants that used black ink was 7.5. The average for both green and red ink was 7.8, and the average for blue ink was 7.2. Average of all color groups (red, blue, and green) was 7.6 (see Figure 2). Results were not statistically significant for any color group. The average response number for all 40 participants was 7.475. Overall, the highest number of words were used by the preference green group. However, differences in response numbers among all groups were not statistically significant (see Figure 3).

Discussion

The results of this study suggest that there is no correlation between color or color preference on short term memory. Results were not statistically significant for any color group. The average number of responses among all 40 participants was 7.475 words out of 13 words. The highest number of responses were generated in those individuals that were given a preference and used green ink, however, these results were not statistically significant for any decision claims to be made.

One of the potential flaws of this study could be the relatively small sample size (n = 40), which placed five participants in each different condition group. In future experiments, this will be one of the changes made to generate more reliable data. In terms of actual responses, the most common words missed were those in the middle of the list. Words near the beginning and end of the list were best recalled. This is a phenomenon known as the serial position effect, in which people tend to remember things near the start and end of a list (Wiswede et al. 2007) The results of this study provide further support for this phenomenon.

Most stories that were written generally described a newly married couple making a trip to the mountains in Canada and seeing turtles/marine life. Responses were generally made up of four to six sentences. Participants usually took only four to five minutes to generate a story.

While this study does not support color having an effect on memory, it is still important to continue research on this idea. This study did not have enough participants and was conducted on a much-smaller scale compared to what a proper psychological research facility is capable of doing. Hopefully, future research can reveal interesting links between short term memory and color and color preference.

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Appendix A

Word list:

Mountain

Cake

Judge

Salon

Boat

History

Skyscraper

Turtle

Marriage

Library

Canada

Creation

Marine

(Words that were included in responses in the plural form, such as boats or mountains, were counted as accurate responses. Spelling errors were not considered inaccurate responses.)

Appendix B

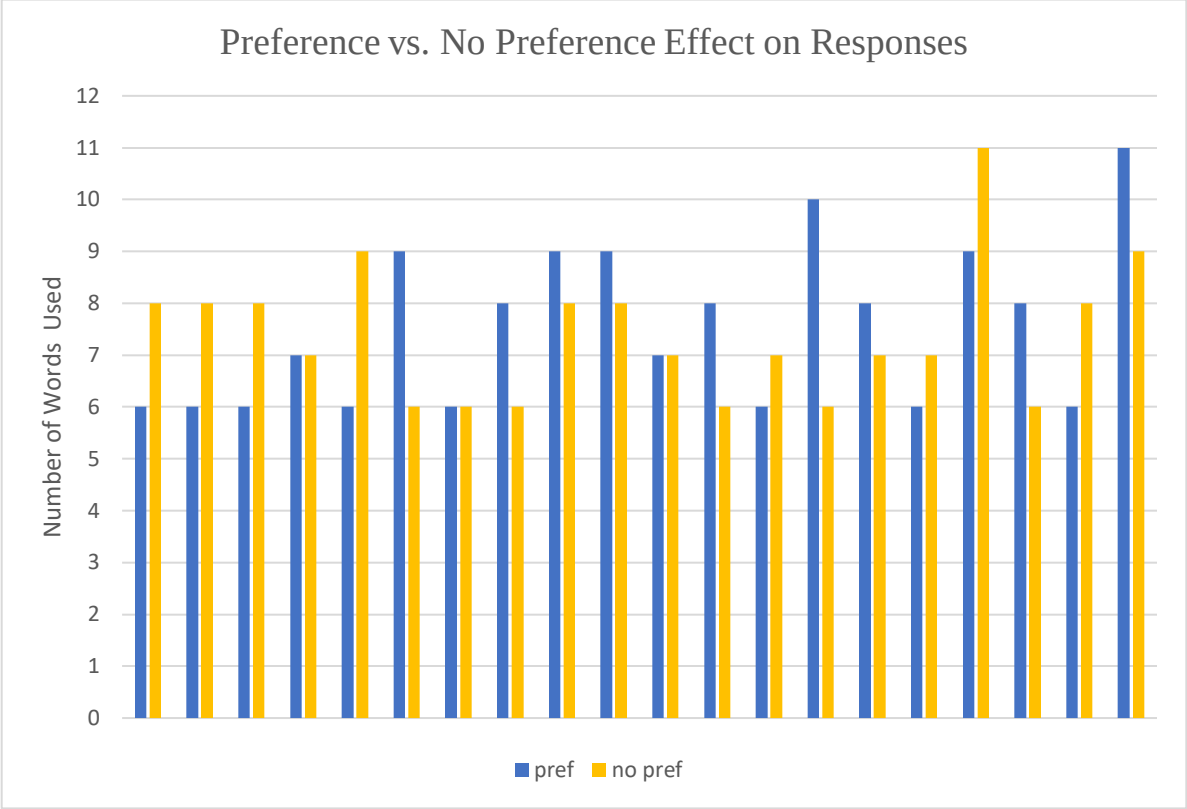

Figure 1: Preference vs. No Preference Effect on Responses. Differences in response numbers were not statistically significant.

Appendix C

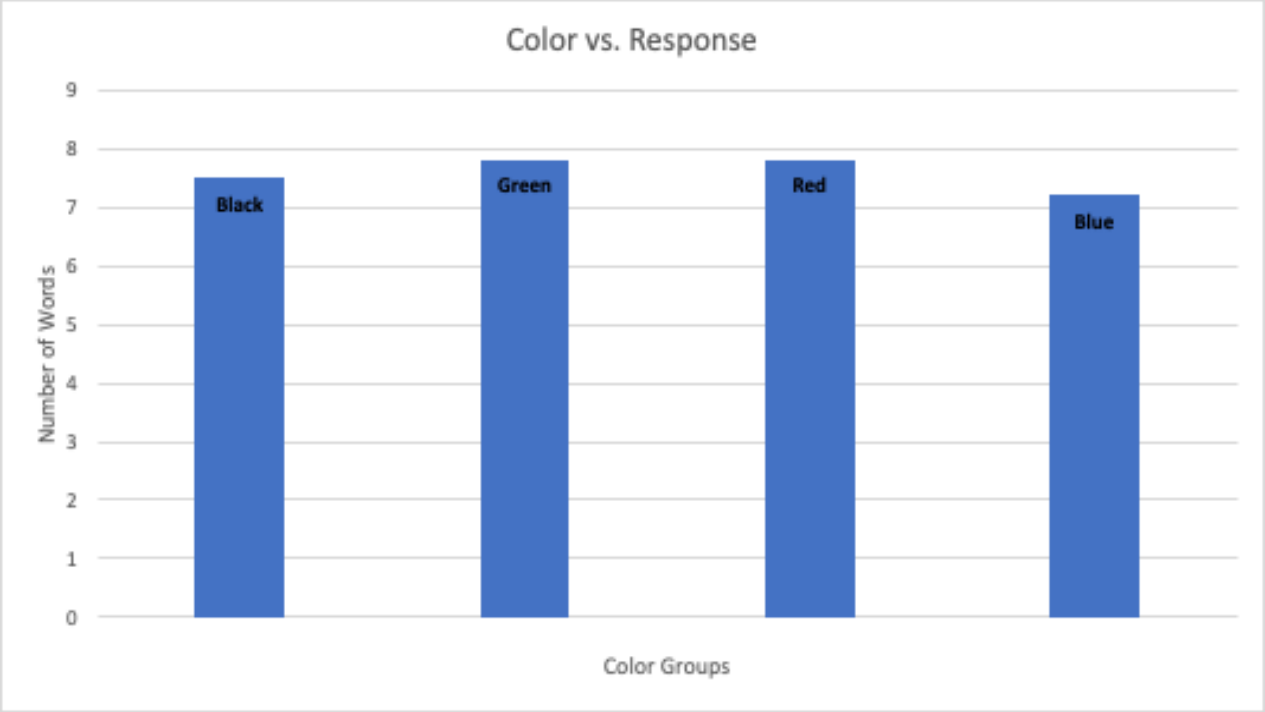

Figure 2. Effect of color on word responses.

Appendix D

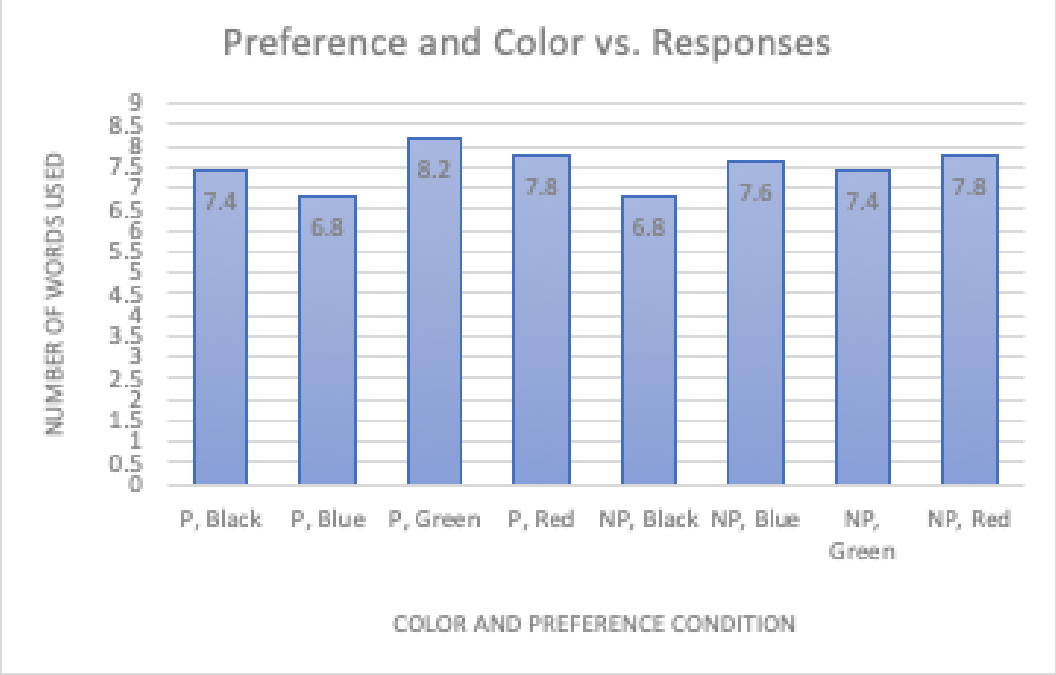

Figure 3. Effect of Color and Color Preference on Word List Recall. NP indicates no preference among groups, while P indicates preference among the group.