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The Effects of Letter Sequences Verses Color Sequences on Short Term Memory

Abstract

 The purpose of this study is to measure one’s ability to remember different sequences using short-term memory. Fifteen participants were chosen and asked to memorize and record letter sequences, color sequences, and both letter and color sequences shown on a scratch program. The results of the obtained information were used to determine if letter or color sequences were more accessible for the short-term memory to hold in comparison to a combination of letters and colors. A t-test was performed, and the p-values obtained from the t-test gave statistical validation when comparing letters to colors and letters. However, the p-values when comparing colors to the colors and letters there was no statistical evidence until a higher sequence was remembered.

Introduction

Short term memory allows one to repeat information minutes after perceiving it. Miller (1956) found that an adult can store approximately 5 to 9 items in their short term memory. Miller named this notion the magic number 7. Miller had found this notion after considering short term memory only had a certain number of “slots” where items could be stored. Atkinson and Shiffrin (1971) found the duration of short term memory is around 15 to 30 seconds by using the “Multi Store Model of Memory.”

According to Alvarez et al. (2004), visual short term memory is defined by the total amount of visual information that the memory stores and the complexity/similarity of the number of objects stored in the memory. However, visual short-term memory also relies on the inactivation of distractors, so the memory capacity increases, according to Sauseng et al. (2009).

Cabal (2005) did a study on the difference in memory between genders. In their method, 12 boys and 12 girls were asked to memorize a list of 15 words in 2 ½ minutes. 6 girls and 6 boys were givens a list of words in black ink and the other 6 girls and 6 boys were given a list of words in colorful ink. As a result, boys were more likely to remember words written in black ink or a black font than colorful words; while, girls remembered the same amount of words written in black and words written in color. A similar experiment was conducted by the Wichmann et al. (2002) on how color effects a person’s short term or long term memory. Their method involved 5 different experiments. In experiment 1, they showed 48 pictures and then mixed them up with 48 new pictures. The pictures included black and white and colored pictures. People were then asked to identify the pictures they had already seen. As a result, the subjects performed 5-10% better for colored than black and white images independent on how much time they saw the picture. In experiment 2, they tested if contrast affected the memory by using different levels of contrast in each pictures. The results showed that there was no contrast between black and white images and colored images if the images were suprathreshold (strong image). In experiment 3, they segmented sensory perception from people’s cognitive perceptions (same method as experiment 2). As a result, long term memory declined when testing with false colors. In experiment 4, they tested the effect of salience, similar to experiment 1, but they presented pictures in a different order and used different colored frames around the pictures. As a result, experiment 4 concluded that the presence or absence of a black frame had no effect on the subject’s short-term memory. Experiment 5 tested the difference between natural versus false colors (mixed red and green and blue and yellow). The same method was used in experiment 5 as in experiment 1, but experiment 5 used false colors. New false colors were added in experiment 5 along with the black and white and full colors used in experiment 1. As a result in experiment 5, Wichmann discovered that black and white images were easier to recall than false colored images. Throughout all 5 of Wichmann’s experiments, colored images were easier to remember than then black and white images.

Building on previous tested research, we tested whether memorizing an increasing sequence of letters or colors was easier to retain with the control being memorizing both colors and letters.

Method

We tested 15 subjects. Subjects ranged in age from 12 to 57 years and were both men and women. Each subject had normal or corrected vision. The experiments were run on Lenovo Think Pad laptop. The participants did not use headphones as they completed the test. The program Build Your Own Block scratch was used. To start the test the participant would press a green flag at the top of the scratch screen. Once the participant read the instructions (see image 2), they would press the space bar to start the letter sequences. A letter sequence would appear for 15 seconds. Then for 30 seconds the participants wrote down the requested sequence.

We showed a sequence of letters which were provided in the scratch program (see image 1). The graphic that showed the letter sequencing had a background of flashing colors which were set to “change color by the effect of 25.” We used red, pink, orange, yellow, green, blue, purple, brown and white colors. For each graphic 1-4 two letters were added to each slide. Each letter is a different color. A color can be repeated on a letter but a letter cannot be repeated. In the first trial, the person was asked to record the letter sequence. In the second trial, the person was asked to record the sequence of the colors of each letter. Finally, in the third trial, the person was asked to record the letter sequence and the sequence of the colors of each letter. For each trial the letter sequence was the same.

Image 1: First Sequence of Letters in Each Trial



Image 2: Instructions to Participants



 Results

For all 3 tests, as the number of letters in a sequence increases, the percent correct decreases (see image 3). However, one’s ability to remember a letter sequence has a higher overall percent correct that of than the ability to remember colors. The ability to remember colors and letters is the least overall percent correct. By completing a t-test, p-values were calculated (see image 4). P-values distinguish the difference between two groups of data. When a p-value is below 0.05, two groups of data are different. When comparing letter sequences and color and letter sequences, each p-value was below 0.05. When comparing color sequences to color and letter sequences, the p-values did not follow any pattern. They ranged from 0.9767 to 0.0282, where only trial 3 was below the accepted value of statistical difference.

Image 3: Graph of Averages of Correct Answers

Image 4: Calculated P-Values Comparing Letters and Colors to the Control

|  |  |  |
| --- | --- | --- |
| Trials | Letters/color letters  | Colors/color letters |
| 1 | 0.0322 | 0.52009 |
| 2  | 0.000000238 | 0.4620569181 |
| 3 | 0.0014167404 | 0.028172279 |
| 4 | 0.00001129 | 0.9767 |

Discussion

The patterns observed in the graph and the calculated p-values indicate that a sequence of letters yields a higher percentage of correct responses than a sequence of colors or a sequence of letters and colors. When a p-value is below 0.05, it demonstrates a 95% confidence that the results of the test are statistically different, indicating it is easier to remember a sequence of letters rather than a sequence of colors. However, when the p-values are above 0.05 it indicates there is no statistical difference between the two sets of data. Without a statistical difference, two sets of data yield the same results. Our p-values support that there is a statistical difference between the memorization of letter versus letters and colors. Each p-value for trials 1-4 are below the acceptable number of statistical difference. Therefore, letters effect memorization differently than memorizing both colors and letters. When comparing letter sequences to color and letter sequences the p-values range from 0.9767-0.0281. For trials 1, 2, and 4 there is not a statistical difference between remembering a color sequence and remembering a letter and color sequence, but in trial 3 there is a statistical difference between remembering a color sequence and remembering a letter and color sequence. Trial 3’s sequence is set up in a circular arrangement rather than a straight line which the testers had been accustomed to seeing in trial 1 and trial 2. This difference in letter presentation could have caused this discrepancy because the subjects were not expecting to memorize a circular sequence. In trial 4 though, the subjects were also shown the letters in a circular shape so they may have been used to the sequence shape causing the p-value to increase above 0.05.On average, it was found that there is not a statistical difference between the memorization of a color sequence and the memorization of a letter and color sequence. In conclusion, a sequence of letters yielded a higher percentage of correct responses than a sequence of colors when recalled.

 In the future, we would take out the flashing background since the background played no role in the experiment but may have unknowingly impacted results. We would also keep a consistent number of letters in the sequence (example: 2, 4, 6, 8) instead of the sequence used (3, 5, 6, 9).  The inconsistency of the numbers did not allow us to determine when in the increasing sequence the subjects were impacted by the number of items to remember. We would also change the colors of the letters in the sequence by only using primary and secondary colors because these colors are universally known as opposed to using colors such as magenta which can be subjective based upon one’s vision or idea the identity of the color. We would also keep the arrangement of the letters the same. Rather than the first two trials being in a straight arrangement and the last two trials being in a circular arrangement, we would keep all sequences in a straight arrangement in order to improve the control on the experiment.

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