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A Study of Cognitive Interference Using the Stroop Effect

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ABSTRACT: *In a test of the famous Stroop Effect in Psychology, it was hypothesized that it would take people longer to recognize mismatched colors than matched colors. To test this hypothesis, seventeen college students completed the Stroop test wherein they were asked to identify the name of the ink in which the matched-color block or mismatched-color word was printed. The data were subjected to a repeated measures t- test which showed a statistically significant difference between the scores of matched and mismatched colors ($p<.05$). The matched color set was completed an average of 6.23 seconds faster than the mismatched color set. Results are discussed in terms of cognitive interference.*

KEYWORDS: *Stroop Effect; Cognitive Interference*

I. INTRODUCTION

If one is seeking out a relatively simple and engaging experiment to examine how the brain recognizes images while being distracted, replicating the Stroop effect can provide interesting results. The famous "Stroop Effect" is named after J. Ridley Stroop who discovered this phenomenon in the 1930s. The Stroop effect refers to the delayed reaction times when the color of the word doesn't match the name of the word (Cherry, 2018). It is very easy to say the color of a word if it matches the semantic meaning of the word. For example, if one was directed to say the color of the word "black" that was also printed in black ink, it would be much easier for the correct color to be identified than if it were printed in blue or green ink. The Stroop Interference Test was originally developed in 1935 by Stroop to measure selective attention and cognitive flexibility. Cognitive flexibility refers to the brain's ability to change from thinking about one concept to another. For instance, the quicker you are able to switch or “shift” your

thinking from one dimension to another, the greater your level of cognitive flexibility. Bower (1992) also provides additional insight into the effect by stating that mental associations or the *strength of connected concepts also play a major part in how strongly it impacts one’s cognition.*

The Stroop Effect is also a measure that can be used in screening for brain damage, simply because the words themselves interfere with the ability to quickly say the correct color of the word (see Bush, Whalen, Shin &Rauch, 2006). The argument here is that automatic reading does require focused attention. The brain simply engages in it automatically and recognizes what the word is but recognizing colors, on the other hand, may take a longer time to process because of knowing what the word is automatically. So, the instructions confuse the brain because it is told to say the color of the word when it naturally is used to reading what the word says. While the brain registers the written meaning automatically, it does require a certain amount of attentional resources to process color, making it more difficult to process color information and therefore slowing down reaction times. Thus the confusion between the color and word should produce a significant difference in the reaction time of identifying the color between matched and mismatched sets. This is primarily due to cognitive interference wherein the reaction time is being affected by causing individuals to take longer to think of the color written in a different color ink (Cherry, 2018). Thus, it is hypothesized that it will take significantly longer to recognize colors in a mismatched set (where color and word do not match) than in a matched set (where color and word do match).

II. METHOD

Participants

The participants were a total of seventeen undergraduate Psychology majors participating in an Experimental Psychology lab at a Historically Black University (HBCU) in the southeast. There were 13 females and 4 males and all were either juniors or seniors. A non-random convenience sampling method was employed in the selection of participants.

III. PROCEDURE

Two separate lists of colors served as the instruments in this experiment. The first was a mismatched list of 20 colors where the word printed did not match the color it was printed in(e.g., the color RED printed in BLUE ink). The second list was a matched list of 20 colors where each color was simply a colored box without any words (e.g., color RED printed in RED ink).

The experiment began with students getting in pairs. The professor then handed each pair two sheets face down; one containing the test list and the other containing the answers. Once all papers were distributed, the class was directed to turn over the sheets and then to flip a coin. Each pair was allowed to determine which of the students would be the testing student and the timing student first; these roles were to be reversed upon completion. The coin toss determined whether the testing student in the pair began with the matched or mismatched list of colors first. The use of the coin toss also served as a counterbalancing tool to diminish any potential impact from a practice effect. Each testing student was to correctly identify each of the twenty colors on each list as the partner kept time with a stopwatch. Timers were directed not to stop should the testers stumble or pause. The times of each test were recorded after all students had been tested.

IV. RESULTS

Data analysis was completed with the implementation of a repeated measures t-test. The alpha level was set at a 0.05 level for testing. Results indicated that there was a significant difference in the reported time for color naming between matched and mismatched colors with an obtained *t* value of 3.30 and the critical *t* value at the 0.05 level being 2.120. Thus, the null hypothesis

($H0_{;\,\mu 1} = \mu 2$) was rejected, [$t(16) = 3.30$; $p < 0.05$]. The mean of matched colors was 16.12 seconds and the mean for mismatched colors was 22.35 seconds. Individuals did take significantly longer to identify mismatched colors than matched colors. See Table 1.

Table1. Repeated Measures t-test of Matched and Mismatched Colors

	N	M	SD	SEM	t	df	p
Matched	17	16.12	5.41	1.31	2.57	16	.02
Mismatched	17	22.35	7.25	1.76			

V. DISCUSSION

The hypothesis guiding this study was indeed supported. It does take significantly longer to recognize mismatched colors than matched colors. Why is this the case? One explanation is that of cognitive interference. According to Bush, Whalen, Shin and Raush (2006), cognitive inference refers to the unwanted and often disturbing thoughts that intrude on a person's life. Cognitive interference plays an important role in stress, poor performance, slow learning, social maladjustment, psychopathology, and behaviors resulting in accidents. Pierce, Sarason and Sarason (1996) indicated that cognitive interference has decreased learning effects due to interference trails. This also is proof of how the brain responds to learning and provide a clear example of how performance data can prove to be a useful guide in analyzing imaging data on the Stroop experiment. This idea is further explained by the Speed of Processing Theory and Selective Attention Theory. The Speed of Processing Theory states that cognitive interference occurs because words are read faster than colors are named (Cherry 2018). The Selective Attention Theory states that the cognitive interference occurs because naming colors requires more attention than reading words(Cherry 2018). Thus the words themselves have a strong influence over the ability to say the color. The interference between the different information the brain receives does indeed create a problem. These findings and theories, however, do add validity to the current experiment.

Further research should address the issue of participant selection.The participants in the present study were not randomly selected. They were all recruited via the convenience sampling method. Thus, one could argue that these findings are only relevant to the particular university, the major, or even the particular class itself. A simple solution to this potential loss of external validity would be to apply a random selection method to a more diverse pool of potential participants. Further testing under these conditions should produce results with greater generality, allowing the development of more focused experiments to find results with more tangible applications.

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