The Effects of the Stroop Interference Phenomenon on Undergraduate Psychology Majors

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Abstract

Created in the 1930s by American psychologist John Ridley Stroop, the Stroop Interference Effect is a set of empirical findings, demonstrating that there is an asymmetry in the observed interference between color-word reading and color naming. The purpose of this study was to use the Stroop Effect to determine if there is an observable effect of color compatibility on color recognition. Our participants consisted of an accidental (convenience) sample of n = 30 undergraduate junior and senior psychology majors enrolled in the same Experimental Psychology Lab class at Alabama Agricultural and Mechanical University. The general procedure involved the participants naming twenty different ink colors on two separate lists, one with matched colors and the other with mismatched colors, as fast as they could without making any errors. It was hypothesized that it would take longer to recognize mismatched colors due to Stroop's observed interference between color-word reading and color naming, in addition to the speed-processing and selective-attention theories, resulting in a significant difference between mismatched and matched colors. The repeated measures t-test determined that there was, in fact, a significant relationship between the two variables, meaning that color compatibility did have an observable effect on color recognition.

The Stroop effect is a phenomenon that involves a set of empirical findings, demonstrating that there is an asymmetry in the observed interference between color-word reading and color naming (Dennis, 1999). Created in the 1930s by American psychologist John Ridley Stroop, the phenomenon's original paper became the most famous, and most frequently cited in the history of psychology, along with being replicated by hundreds of researchers (Cherry, 2018). It is illustrated in experiments where an individual must say the color of a word, but not the word's name. For example, the word "green" might be printed in yellow ink and you must say "yellow" instead of what the word actually reads. The delayed reaction times produced when the color of the word does not match the name of the word is the actual effect that Stroop identified. He predicted that it takes about 75% longer to recognize mismatched colors than matched colors.

Two theories were produced in essence of clarifying the phenomenon: selective attention theory and speed processing theory. The selective attention theory states that naming the color of the ink requires an additional amount of attention than simply reading the text does. This shows that it is easy to ignore some environmental features, but not others.

The speed processing theory recognizes that reading words is applied much more expediently than naming colors. This theory shows how our reading speeds make it more challenging to name mismatched colors after we have already read the word. Automaticity applies to both theories by depicting how the brain engages in reading automatically and does not require focused attention. Color recognition, however, is far less of an automated process because it requires a certain amount of attentional resources, which makes it increasingly difficult to process color information and slows down reaction times (Cherry, 2018).

Hypothetical differences in processing speed, suggested by Stroop interference, are consistent with a distinction between two types of cognitive processes: controlled and automatic (Shiffrin & Schneider, 1977). If process A interferes with process B, but process B does not interfere with process A, then process A is automatic and process B is controlled. Cohen, Dunbar and McClelland (1990) proposed an alternative connectionist explanation of the Stroop effect, which does not distinguish between automatic and controlled processing. Instead, they proposed that automaticity is a continuum, and that Stroop interference depends on the relative degree of learning of the respective tasks, not on processing speed. According to this view, asymmetries in performance such as those observed in the Stroop task can be accounted for by differences in experience (Dennis, 1999). Based on this information, it was hypothesized that it would take longer to recognize mismatched colors than matched colors, resulting in delayed reaction times and a significant difference in color recognition.

Method

Participants

Our participants consisted of an accidental (convenience) sample of n = 30 undergraduate junior and senior psychology majors enrolled in the same Experimental Psychology Lab class at a Historical Black University in the south. Most of our participants were female, with the male to female ratio being about 5 to 19. All participants are African Americans between the ages of 19 and 31.

Procedures

This study was a within-subjects design done in paper and pencil format during normal class time. The instructor told the students to get in groups of two and administered two sheets of paper to each pair of students: the first was a list of 20 color words with mismatched ink colors and another list of 20 color squares with matched ink colors underneath it, and the other was an answer sheet. The instructor explained that the experiment has 2 separate trials, one for each list, and that the objective was to name the colors of the 20 inks as quickly as possible, without making any errors. He directed the participant's attention to the five colors at the top of the first page which read RED, GREEN, BLUE, PURPLE, BROWN, in their corresponding ink colors. He then asked participants to name the five colors as quickly as possible as a warm-up. To control order effects, the participants in every group were to each flip a coin to determine which list they would use first (heads = top list first, tails = bottom list first). When the instructor gave the signal to start, "Ready! Go!", each participant read their designated lists as fast as they could, and their partners followed along the answer sheet for accuracy while also using a stop watch/timer to record the time it took for them to reach the 20th color. The participants recorded their respective times (in seconds) for both the mismatched and matched color lists. The class then compiled the times of each student into two separate categories: one for the amount of time it took to read the mismatched colors and the other for the amount of time it took to read the matched colors.

Results

Once the data were gathered, a repeated measures t-test was conducted to determine the relationship between color recognition of matched and mismatched colors. The results of this experiment showed that there was, in fact, a significant difference between the two treatment conditions. The number of participants were n = 30, in which half randomly read the mismatched colors first, and the other half read the matched colors first. The t-value was calculated as 11.47 Using an alpha level (α) of .05 and degrees of freedom (DF) of 29, the hypothesis testing determined that the null hypothesis (H_0) was to be rejected if and only if $t_{(28)} \geq 2.048$ or ≤ -2.048, with 2.048 being the critical value. We rejected the null hypothesis, and accepted the alternative hypothesis (H_1), because the rule applied to our calculations, $t\ (29) = 11.47$; $p < .05$. The mean time for mismatched colors (M-M) was 21.3 seconds (SD = 5.17), while the mean time for matched colors (M) was 12.3 seconds (SD = 2.84). This means that it took the sample about 21 seconds to read the list of 20 mismatched colors and about 12 seconds to read the list of 20 matched colors. See Table 1.

Table 1. Repeated Measures t-test of Matched and Mismatched Colors

	N	M	SD	SEM	t	df	p
Mismatched	30	21.30	5.17	0.94	11.47	29	.001
Matched	30	12.30	2.84	0.52			

Discussion

It was hypothesized that it would take a longer amount of time to read the list of mismatched colors than it would to read the list of matched colors, resulting in delayed reaction times and a significant difference in color recognition. Based on our findings, the hypothesis was supported, meaning that color compatibility had an observable effect on color recognition. Our findings show that it took the participants almost twice as long to recognize mismatched colors then it did to recognize matched colors. This is due to semantic interference, or anything that blocks the acquisition, recall, or retention of words ("semantic interference", n.d.). If both stimuli (color and meaning) are compatible, then our reaction times will be much faster, as they were with the matched color list. Since reading is automatic for most people, when we are instructed to pay more attention to the color of the word, interference occurs. Our reaction times become much slower because we have to consciously adjust our answers due to the new task not being as familiar to us as reading is (Thompson, n.d.).

The experiment was effective in the efforts of distinguishing between controlled and automatic processes, based on processing speed. As determined by Stroop and explained in the introduction, if process A interferes with process B, but process B does not interfere with process A, then process A is automatic and process B is controlled. In this experiment process A refers to word/color reading (matched) and process B refers to color naming (mismatched). This is also confirmed by Stroop's explanation that it takes longer to suppress prior knowledge of a task, even though it took the subjects about 50% longer to recognize mismatched colors, instead of his predicted 75%.

Future research could involve administering the study to fewer participants, considering that it is a within-subjects design, who have many different majors, classifications, and intelligence levels, to determine if there would still be the same outcome. Both undergraduate and graduate level students would also be used, making sure that there is an even ratio of males and females. These recommendations would decrease limitations while also creating more randomization, which could possibly enhance external validity.

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