The Influence of Color Priming and Forewarning on Anagram Performance

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Abstract

Methods One Students: Typically, authors add their abstract for the paper here on the second page. As you can see, the abstract for this paper is missing. Your job is to supply that abstract! Read over the following paper, which is an actual paper turned in by a former student taking Research Methods and Design II at FIU. This is similar to a paper you will write next semester. Review the studies in this paper, and spot the hypotheses, independent and dependent variables, participants, results, and implications, and write it up in one paragraph (no more than 200 words maximum). Make sure to include keywords as well (keywords are words or short phrases that researchers use when searching through online databases like PsycInfo – they need to be descriptive of the paper, so come up with three or four that seem to suit this paper). Good luck!

Keywords: Methods II Paper, Abstract Assignment, Methods II Preview

The Influence of Color Priming and Forewarning on Anagram Performance

Colors are an essential part of life, from warning us of poisonous creatures to describing our emotions, they have proven their worth. Certain colors can be perceived in specific situations or attributed to a particular emotion. For instance, priming of sadness can lead to perception of the color blue, whereas priming of anger can lead to perception of the color red (Fetterman, Robinson, Gordon, & Elliot, 2011). The central aim of our study is to explore the effect priming with a specific color has on anagram performance.

Priming is defined as the unconscious influence that a stimulus has on the agility or accuracy in performing a task (Schacter & Rajendra, 2001). According to Jefferis and Fazio (2008), priming impacts behaviors by informing the person if they have met the demands of the situation. The influence priming has on behavior is shaped by what one perceives in a particular situation. For example, priming the color red in the context of romantic attraction would have a different response than priming the color red in an achievement situation, situations in which there is a possibility for success or failure and competence is measured (Elliot, Maier, Binser, Friedman, & Pekrun, 2009). In the context of romantic attraction, the color red unconsciously increases perceived attractiveness of another person (Elliot & Niesta, 2008). With regards to achievement, the color red elicits avoidance behavior due to its association with factors such as the red in alarms that suggest danger (Elliot, Maier, Moller, Friedman, & Meinhardt, 2007; Elliot et al., 2009).

To study the influence that red has on achievement, Elliot et al. (2007) designed a study that involved color priming and used anagram performance as a representation of achievement. In one of the experiments conducted, the colors red, green, and black were used to test anagram performance. Participants were assigned to the color conditions (red, green, or black) through the

process of random assignment. First participants were given a practice test and later they were given the real anagram test. Before completing the real anagram test, participants were told to check that all of the pages contained their participant number. The numbers were written in red, green, or black ink at the top of every page of the test. Results showed that exposure to red, compared to green or black, on achievement tasks impaired performance.

In accordance with the idea that color affects performance, Steele (2014) recreated a study that hypothesized that words associated with avoidance were solved faster on a red background and words associated with approaching were solved faster on a blue background. Participants were asked to complete an anagram task in which instructions for the task were written in black letters on a white, red, or blue background. The words were linked to activating either approach, avoidance, or neutral motivation. The findings opposed those of the previous study that Steele (2004) replicated. The previous study reported that a red background would result in faster solution of avoidance words and that a blue background would result in faster solution of approach words. Steele's study found that words classified as avoidance were solved slower on the red background compared to approach and neutral words. Similarly, words classified as approach were solved slower on the blue background. An implication as to why the result of the replicated study were contradictory to those of the original study suggested that words classified as avoidance, approach, or neutral were actually classified in the wrong group.

Study One

To further explore the impact that color priming has on anagram performance, we designed a study in similar fashion to Elliot et al. (2007), in which participants completed an anagram task after priming for a specific color. Each participant was given an identical anagram task to complete but with instructions for the anagram task written in red, green, or black ink. We

predicted that participants given red ink will perform worse on the anagram task than those given green or black ink instructions. That is, red ink participants will correctly unscramble fewer words than participants given both green ink and black ink, whom we do not expect will differ in their anagram performance. We also predicted that participants given red ink (compared to green or black ink) will find the anagram task more challenging for themselves and others and will find it more frustrating. They will also think that they will perform worse on the task when given red ink. However, we predicted that all participants, regardless of ink color, will believe that the ink color did not affect them.

Methods

Participants

There were 115 participants in our study. Of these, 55 were male (47.8%) and 60 were female (52.2%). The age of the sample ranged from 12 to 69 ($M = 26.22$, $SD = 9.63$). This included 19.1% Caucasian ($N = 22$), 59.1% Hispanic ($N = 68$), 6.1% Native American ($N = 7$), 5.2% African American ($N = 6$), 4.3% Asian ($N = 5$), and 6.1% of participants reporting "other" ($N = 7$).

Materials and Procedure

Potential participants were randomly approached and informed of the possible risks and benefits of participating in the study. If the potential participant verbally agreed to take part in the study, he or she was presented with one of three anagram questionnaires. The questionnaires contained instructions written in red, green, or black ink; this color manipulation was our independent variable. Each of the anagram questionnaires consisted of three identical parts and only differentiated in the color with which the instructions were written.

In the first part of the questionnaire, the participants were given a timed anagram task to complete. Without hinting to the color manipulation, participants were reminded to read the questionnaire instructions carefully and to inform the researcher when they were ready to begin so that the researcher could start the timer. The anagram task consisted of 20 scrambled words that the participants had to unscramble by using all of the original letters to form a new word. For example, BMTUH had to be correctly unscrambled to spell out the word THUMB. The participants were given three minutes to unscramble as many words as they could and were notified when they had one minute left to finish the task. After the three minutes, participants were told to stop and to move on to the next part of the questionnaire.

Part two of the questionnaire consisted of six questions about the anagram task that the participants completed. These six questions were part of our dependent variables. In the first four questions the participants recorded their response on a scale of one to nine. In these questions the participant recorded how challenging the task was for them (1 = not at all challenging, 9 = extremely challenging), how challenging they thought other participants found the task (1 = not at all challenging, 9 = extremely challenging), how frustrating they found the task (1 = not at all frustrating, 9 = very frustrating), and how they thought they did on the anagram task (1 = very poorly, 9 = very well). The fifth question gave us insight as to whether the participants did or did not pay attention to the study manipulation. This fifth question asked the participants to recall the color of the ink used for the instructions (red, green, black, or blue). The last question asked the participants the extent to which the color ink on the instructions influenced their performance on the anagram task (1 = decreased my number correct, 9 = increased my number correct).

Part three of the questionnaire asked for the participants' demographic information. The participants were asked about their gender, age, race/ ethnicity, whether or not English was their

first language, if they were a student at Florida International University, and if they were

colorblind. Participants were informed that they were free to leave blank any of the questions

they did not wish to answer in this section. At the end of the study, the participants were

debriefed on the study conditions and hypothesis and were given the answer key to the correct

unscrambled word for the anagram task. Once the study was completed and the participants

debriefed, we used the answer key to determine the number of correct anagrams the participant

solved. Participants were given one point for each anagram they correctly unscrambled so that

the scores would range from zero to twenty.

Our study consisted of seven dependent variables; however, the main dependent variable

of our study is the number of correct anagrams the participants solved. We predicted that

participants given red ink will perform worse on the anagram task than those given green or

black ink instructions. We also predicted that all participants, regardless of ink color, will believe

that the ink color did not affect them.

Results

A chi-square test was done to determine if participants correctly recalled the color of the

ink used in the instructions. Using color manipulation (red, green, or black) as our independent

variable and the color ink participants recalled seeing as the dependent variable, we saw a

significant effect, $X^2(6) = 153.38$, $p < .001$. Participants in the red condition recalled seeing red

(87.2%); participants in the green condition recalled seeing green (84.6%); and participants in

the black condition recalled seeing black (83.8%). Phi showed a large effect. This indicated that

participants were cognizant of our manipulation (the color of the instructions).

To evaluate our main dependent variable, we ran a One-Way ANOVA with color

manipulation (Red v. Green v. Black) as our independent variable and the number of anagrams

participants correctly solved as our dependent variable. The ANOVA was significant, $F(2, 112)$ = 7.20, $p < .05$. In order to investigate differences in the means, we ran a Tukey LSD post hoc test. This showed that participants solved fewer anagrams in the red condition ($M = 4.87$, $SD =$ 1.34) than in both the green ($M = 5.72$, $SD = 1.16$) and black ($M = 6.10$, $SD = 1.81$) conditions. The green and black groups, however, did not differ from each other. This supported our hypothesis that participants given instructions in red ink would perform worse on the anagram task than participants who were given instructions in green or black ink.

Another dependent variable we were interested in was whether or not participants believed that the color of ink used in the instructions affected the number of anagrams they correctly solved. To evaluate this, we ran a One-Way ANOVA with color manipulation (Red v. Green v. Black) as our independent variable and participant belief of color influence as our dependent variable. The ANOVA was not significant, $F(2, 112) = 1.54$, $p > .05$. This supported our hypothesis that, regardless of ink color, participants would believe the color ink used in the instructions did not affect them. In this situation, participants in the red condition ($M = 3.18$, SD = 1.59), the green condition ($M = 3.10$, $SD = 1.41$), and the black condition ($M = 2.65$, $SD =$ 1.23) did not differ from one another. Given the fact that the *p-value* for the ANOVA test was not significant, we did not need to run a post hoc test.

Discussion

We predicted that instructions written in red ink will impair participant performance on an anagram task as opposed to instructions written in green or black ink. That is, participants given instructions written in red ink will correctly unscramble fewer words than participants given instructions written in green ink or black ink, whom we did not expect to differ in their anagram performance. We also predicted that all participants, regardless of ink color, would

believe that the ink color did not affect them. Results supported both of our hypotheses. Participants in our red condition solved fewer anagrams than those in the green and black condition, whose performance did not differ. Also participants did not believe that ink color had any effect on their anagram performance. If participants who were given instructions in red ink were unaware of the influence the color red had on their performance, what would happen if participants were forewarned about the influence of color on performance? Would participants given instructions in red ink perform much worse while participants given black ink instructions perform much better in the anagram task? Would there be no change in performance? Will we see other changes? We will explore the influence of forewarning on our second study.

Study Two

As social creatures, humans are constantly influencing and being influenced by the environment. For example, color has the ability to affect people's behavioral responses. However, people may be unaware of these influences on their opinions, behaviors, and actions. Would forewarning of these influences change the ways in which people otherwise react in a particular situation? The central aim of our second study is to examine the impact that forewarning has on performance. Specifically, we want to examine the impact that forewarning on the negative effects of the color red has on anagram performance.

A study conducted by Petty and Cacioppo (1977), examined the effects that forewarning about the content of a message had on resisting persuasion. In one if their experiments, researchers wanted to see if participants who were forewarned about the content of a message produced counterarguments because they were motivated to do so. Sixty introduction to psychology students were randomly assigned to the study conditions: warning and instructed to write topic thoughts, no warning and instructed to write topic thoughts, warning and instructed to

write actual thoughts, no warning and instructed to write actual thoughts. Students were told that a psychologist from the counseling center was going to speak to them. Before the psychologist gave his speech, they were given a questionnaire to complete. Participants in the warning condition read that the psychologist will be talking about why all freshmen and sophomores should be required to live on campus (a topic in which the students' opinions differed from those of the speaker). Participants in the no warning condition read that the psychologist will be talking about conclusions he generated in his time working at the counseling center. After a silent three minutes, participants were asked to move on to the next part of the questionnaire. The next part asked participants in the actual thoughts condition to record all the thoughts they had during the last three minutes. Participants in the topic thought condition were asked to record their thoughts on the matter of freshmen and sophomores being required to live on campus. Afterwards, the psychologist gave his speech on why freshmen and sophomores should be required to live on campus. Results showed that participants in the warned condition and the no warning but instructed to write topic thoughts condition had more resistance to persuasion because thinking about the topic allowed them to come up with counterarguments.

Leon, Rotunda, Sutton, and Schlossman (2003), studied the influence of online forewarning on ratings of attraction. Participants were randomly assigned to the forewarning group or the no forewarning group. All of the participants used a computer to go to the web page that contained a general statement about the Internet. Participants in the forewarning condition additionally received information about the use of deception in the Internet. The next part of the study consisted of navigating through four web pages that contained photographs of a person of the opposite sex. The participant then rated the attractiveness of each photo and answered questions about the likeliness of interacting with the person whose photo they saw. Results

showed that participants forewarned about the use of deception on the Internet perceived the photo shown as less attractive than those who were not forewarned about the use of deception. They were also less likely to express the desire of further interaction with the person through engaging in online chats. These results were consistent with those of Petty and Cacioppo (1977) in the idea that when forewarned of persuasiveness, people will become more resistant to that persuasion. In this case, participants became more resistant to deception. In the case of our second study, we predict that participants forewarned about the influence of red on anagram performance will perform better than those who were not forewarned due to participants developing resistance.

Weber and Bizer (2006), studied the effects that forewarning about exam difficulty had on test performance. The researchers hypothesized that forewarning of test difficulty would boost performance in students with low anxiety but decrease performance in students with high anxiety. Before random assignment into one of the three experimental conditions, researchers measured the level of dispositional anxiety each participant had by having them complete a trait-anxiety questionnaire. Participants were randomly assigned to: the forewarned condition in which they were told that the test was difficult, the forewarned condition in which they were told that the test would be easy, or the no forewarning condition. Then participants were told that they would be completing a version of a previous GRE and that this test should be taken seriously. Results showed that students with low trait anxiety performed better when forewarned about the test being difficult as opposed to easy. Students with high trait anxiety performed worse when forewarned that the test would be difficult as opposed to easy.

To expand further research on the topic of forewarning, we have devised a study that looks at the effect that forewarning of the color red has on anagram performance. Participants

were randomly assigned to a forewarning or a no forewarning condition. In the no forewarning condition participants were given an anagram task with instructions written in either red or black ink. In the forewarning condition participants were informed about the effect that the color red has on performance before given an anagram task with instruction written in either red or black ink.

In accordance with study one, we predicted that participants who were given red ink instructions will solve fewer anagrams than those given black ink. We also predicted that those given a warning about ink color and anagram performance will perform better on the anagram task as compared to those who were not forewarned. We predicted that frustration will impact participants' performance. Specifically, we predicted that those in the black ink condition regardless of warning will find the anagram task less frustrating than those in the red ink condition. Those in the red ink condition who were forewarned will find the task less frustrating than those who were not forewarned. We expected no difference in the level of frustration of those in the black ink condition who received a warning. We predicted that when asked how frustrating they thought other participants found the task, there will be no difference in the red ink and black ink conditions. We also predicted that those in the red ink condition would feel they would have performed better if they were not forewarned vs. those in the black ink condition who would feel forewarning would not have made a difference in their performance.

Methods

Participants

There were 227 participants in study two. Of these, 82 were male (37.1%) and 139 were female (62.9%). The age of the sample ranged from 15 to 63 ($M = 23.51$, $SD = 7.58$). This

included 14.4% Caucasian ($N = 32$), 68.5% Hispanic ($N = 152$), 9.0% African American ($N = 20$), 1.4% Asian ($N = 3$), and 6.8% of participants reporting "other" ($N = 15$).

Materials and Procedure

Potential participants were asked to partake in an online study with the benefit of aiding the completion of our research. If the potential participant agreed to take part in the study, he or she was given the link of the online survey created through Qualtrics, a survey software. Before starting the survey, the participants were presented with an online consent form that informed them of the possible risks and benefits of participating in the study, and had to indicate their agreement by clicking the "I choose to participate" button in order to continue with the study. Our study two was composed of four parts and used the same color manipulation as in study one, but instead of three conditions we used two conditions (red ink and black ink).

In the first part of the study, participants were randomly assigned to one of four conditions: forewarning red, forewarning black, no forewarning red, no forewarning black. In the forewarning red condition, participants were forewarned about the color red and then given instructions written in red ink. In the forewarning black condition, participants were forewarned about the color red and then given instructions written in black ink. In the no forewarning red condition, participants were not forewarned about the color red and received instructions written in red ink. In the no forewarning black condition, participants were not forewarned about the color red and received instructions written in black ink. Participants in the forewarning condition were given a statement that read "The color red may carry the meaning of failure and avoidance in achievement contexts. It may unconsciously affect levels of frustration and anxiety, which in turn leads to poor performance levels. Prior research suggests that participants whom are given instructions in red may experience higher levels of frustration and solve fewer anagrams than

participants given instructions in black". All participants received anagram tests with identical

parts and only differentiated in the color of the instructions (red ink or black ink).

Resembling study one, the second part of the study exposed participants to the

instructions of the anagram test which were written in either red ink or black ink. Once the

participants read the instructions they had to click the "continue" button to begin the anagram

test. The test used different anagrams from those of study one. The anagram test consisted of 20

scrambled words and the participant had to unscramble as many as they could in three minutes.

A timer on the computer screen indicated when the three minutes had passed. After the three

minutes, participants were able to view the answers to the anagram test and calculate their score.

One point was given for each right answer.

In the third part of the study, participants were presented with seven questions about the

anagram task they completed. These seven questions were part of our dependent variables. The

first question asked the participants to record how many anagrams they correctly solved. The

second question gave us insight as to whether the participants were attentive to the color

manipulation. This second question asked the participants to recall the color of the ink used for

the instructions (black, red, green, or blue). On the last five questions the participants recorded

their responses on a scale of one to nine. In these questions participants recorded how

challenging the task was for them (1 = not at all challenging, 9 = very challenging), how

frustrating they found the task (1 = not at all frustrating, 9 = very frustrating), if they thought

forewarning of the effects of the color red on performance would cause someone to perform

better or worse than someone not warned (1 = worse than someone not warned, 9 = better than

someone not warned), to what extent the color ink on the instructions influenced their

performance (1 = decreased my number correct, 9 = increased my number correct), and to what

extent did being forewarned influence their performance (1 = decreased my number correct, 9 =

increased my number correct).

The fourth part of our study asked for the participants' demographic information. These

questions asked for their gender, age, ethnicity, if English was their first language, if they were a

student at Florida International University, and if they were colorblind. After completing the

study, the participants were debriefed on the study conditions and hypothesis.

Our study two consisted of seven dependent variables; however, our main interest was

the number of anagrams participants correctly solved. Another dependent variable we analyzed

was the extent participants thought that being forewarned influenced their performance. We also

analyzed the interaction between ink color and forewarning.

Results

A manipulation check using color manipulation (red or black ink) as the independent

variable and the color ink participants recalled seeing as the dependent variable was significant,

χ^2 (1) = 31.62, $p < .001$. Most participants in the red ink condition correctly recalled that the

instructions were written in red (65%) while most participants in the black in condition correctly

recalled that the instructions were written in black (67.7%). Phi showed a medium effect. This

indicated that participants were cognizant of the ink color in the instructions (*See Appendix A*).

To evaluate our main dependent variable, we ran a 2 X 2 factorial ANOVA with color

condition (red v. black) and forewarning condition (forewarning v. no forewarning) as our

independent variables and the number of anagrams participants correctly solved as our dependent

variable. There was no main effect for forewarning, $F(1, 223) = 2.68$, $p > .05$. This indicated that

there was no difference in the number of anagrams correctly solved in the no forewarning ($M =$

8.31, $SD = 4.49$) versus forewarning ($M = 9.13$, $SD = 4.83$) conditions. We found a significant

condition effect for the color condition, $F(1, 223) = 8.70$, $p < .05$. Participants solved more

anagrams in the black condition ($M = 9.53$, $SD = 4.87$) than the red condition ($M = 7.74$, $SD =$

4.24). We also analyzed the interaction between the independent variables (color condition and

forewarning condition) and the dependent variable (number of anagrams correct). We found a

significant interaction effect between color condition and forewarning condition, $F(1, 223) =$

8.07, $p < .05$. First, in the red condition, simple effects showed that participants solved more

anagrams in the forewarning condition ($M = 9.10$, $SD = 4.40$) than the no forewarning condition

($M = 6.40$, $SD = 3.64$), $F(1, 101) = 11.48$, $p < .05$. Second, in the black condition, simple effects

showed that participants solved a similar number of anagrams in the forewarning ($M = 9.16$, SD

$= 5.19$) and no forewarning ($M = 9.89$, $SD = 4.54$) conditions, $F(1, 122) = 0.69$, $p > .05$. Third,

for participants in the no forewarning condition, simple effects tests showed they solved more

anagrams in the black condition ($M = 9.89$, $SD = 4.54$) than the red condition ($M = 6.40$, $SD =$

3.64), $F(1, 113) = 19.98$, $p < .05$. Fourth, for participants who were forewarned, simple effect

tests showed that they solved a similar number of anagrams in the red ($M = 9.10$, $SD = 4.40$) and

black ($M = 9.16$, $SD = 5.19$) conditions, $F(1, 110) = .005$, $p > .05$ (*See Appendix B*).

  Another dependent variable we were interested in was the extent participants thought that

being forewarned influenced the number of anagrams they correctly solved. To evaluate this, we

ran another 2 X 2 ANOVA with color condition (red v. black) and forewarning condition

(forewarning v. no forewarning) as our independent variables and participant belief of

forewarning influence as our dependent variable. There was no main effect for forewarning, $F(1,$

$220) = 0.03$, $p > .05$. This meant that participants did not think being forewarned influenced the

number of anagrams they correctly solved. Participants in the forewarning condition ($M = 5.05$,

$SD = 1.59$) did not differ from those in the no forewarning condition ($M = 5.04$, $SD = 1.45$).

Likewise, there was no main effect for the color condition, $F(1, 220) = 0.23$, $p > .05$. Participants in the red condition ($M = 5.10$, $SD = 1.62$) and participants in the black condition ($M = 5.00$, $SD = 1.44$) did not think forewarning influenced the number of anagrams they correctly solved. Additionally, there was no significant interaction effect of forewarning and color condition $F(1, 220) = 0.94$, $p > .05$. Participants in the forewarning red condition ($M = 5.22$, $SD = 1.53$), forewarning black condition ($M = 4.92$, $SD = 1.65$), no forewarning red condition ($M = 4.98$, $SD = 1.73$), or no forewarning black condition ($M = 5.08$, $SD = 1.21$) did not think that being forewarned influenced the number of anagrams they correctly solved (*See Appendix C*).

Discussion

In accordance with study one, we predicted a main effect for the color condition, with participants given red ink performing worse on the anagram task than those given black ink. We also predicted that those given a warning about ink color and anagram performance would perform better on the anagram task compared to those who were not forewarned. Additionally, we predicted that those in the red ink condition would feel they would have performed better if they were not forewarned vs. those in the black ink condition who would feel forewarning would not have made a difference in their performance. Results supported only our first hypothesis. Consistent with study one, participants given instructions in red ink solved fewer anagrams than those who were given instructions in black ink. Results did not support our hypothesis that forewarning alone would increase performance on the anagram task. There was actually no difference in the number of anagrams correctly solved in the forewarning and no forewarning condition; however, there was an interaction between the forewarning condition and the color condition. Participants who were given instructions in red ink and had no forewarning solved fewer anagrams than all the other participants. Participants in the black ink and red ink

conditions who were forewarned solved a similar number of anagrams. This result may be due to participants in the forewarning condition being able to ignore the red ink color. Results did not support our last hypothesis that participants in the red ink condition who were forewarned would feel they would have performed better if they were not forewarned. All participants, regardless of condition, believed that forewarning did not influence the number of anagrams they correctly solved.

General Discussion

In assessing the effect of color priming on anagram performance, we predicted that instructions written in red ink would impair performance. This hypothesis was supported in both study one and study two. In both studies participants given instructions written in red ink performed much worse than those given instructions in either green or black ink. These findings reinforce the conclusion of Elliot et al. (2007) that red impairs performance on achievement tasks because it activates avoidance motivation and is associated with the danger of failure. The results of study one also revealed that participants were unaware of the effect ink color had on their performance. Such findings suggest that when administering or taking part in an achievement task one should be cautious as to priming the color red. For example, teachers often administer different versions of an exam in an effort to reduce cheating. Such versions of the exam are usually color coded. As a result, teachers must take care not to use the color red on such versions otherwise students given a version with the color red may perform worse than other students.

Regarding the effect that forewarning about the negative influence that the color red has on performance, we predicted that participants who were forewarned would perform better on the anagrams task than those who were not forewarned. By itself, forewarning did not produce any effect in the number of anagrams solved in the forewarning and no forewarning conditions.

However, participants who were not forewarned and were given instructions in red ink performed worse than all other participants, whereas those who were forewarned and received instructions in red ink performed equally well as participants who were given instructions in black ink. These findings are similar to those of Petty and Cacioppo (1977) and those of Leon, Rotunda, Sutton, and Schlossman (2003) in that forewarning of a particular influence may lead to resisting that influence. In the case of study two, forewarning of the negative effect of the color red may have led participants to ignore the color red while completing the anagram task. This resulted in counteracting the negative effect that instructions written in red ink had. Going back to the example of administering a test, it may be helpful to inform students of a possible effect that color in the test versions may have on their performance and to ask them to ignore the color.

There were several possible limitations to our study. Our study used a small number of participants which may have affected the results. Also most of our participants were college students. The level of interest and attention that each participant paid to the anagram task as well as the honesty of their answers were also possible limitations. Possible problems with the online survey may have surfaced, such as answers being marked wrong when they were right. Future studies may recruit a larger and more diverse pool of participants. If specifically looking at how the color red may impact test performance, it would be wise to use a classroom setting as most tests are administered in a classroom full of people. In addition, just as tests are administered to people at a certain level of knowledge it may be useful to use anagrams that match the cognitive level of the individual. Administering an anagram to a twelve-year-old could have different results than administering the same anagram task to a thirty-year-old. Future research may also

measure individuals' anxiety levels before and after the test to see how the color red directly

influences anxiety and to what extent that influences performance.

      Colors are an essential part of life and may have the potential to influence our thoughts,

behaviors, and actions in more ways than we think. The present study found that the color red

unconsciously impaired performance on an anagram test. This is an important finding that

schools and test administrators should find useful. Students spend the majority of their time in

school and being administered different tests, it is important to know that the use of red in any

part of examinations should be avoided as to prevent students performing lower than their

potential.

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Appendix A – Manipulation Check – Recall the color ink used in the instructions

IV_Ink_Color * Recall the instructions right above the analogy task. Without looking back, what color was the in... Crosstabulation

			Recall the instructions right above the analogy task. Without looking back, what color was the in...				Total
			Black	Red	Green	Blue	
IV_Ink_Color	Red Instructions	Count	32	65	3	0	100
		% within IV_Ink_Color	32.0%	65.0%	3.0%	0.0%	100.0%
		% within Recall the instructions right above the analogy task. Without looking back, what color was the in...	27.6%	64.4%	60.0%	0.0%	44.6%
		% of Total	14.3%	29.0%	1.3%	0.0%	44.6%
	Black Instructions	Count	84	36	2	2	124
		% within IV_Ink_Color	67.7%	29.0%	1.6%	1.6%	100.0%
		% within Recall the instructions right above the analogy task. Without looking back, what color was the in...	72.4%	35.6%	40.0%	100.0%	55.4%
		% of Total	37.5%	16.1%	0.9%	0.9%	55.4%
Total		Count	116	101	5	2	224
		% within IV_Ink_Color	51.8%	45.1%	2.2%	0.9%	100.0%
		% within Recall the instructions right above the analogy task. Without looking back, what color was the in...	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	51.8%	45.1%	2.2%	0.9%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	31.629[a]	3	.000
Likelihood Ratio	33.004	3	.000
Linear-by-Linear Association	18.217	1	.000
N of Valid Cases	224		

a. 4 cells (50.0%) have expected count less than 5. The minimum expected count is .89.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.376	.000
	Cramer's V	.376	.000
N of Valid Cases		224	

Appendix B –Ink color * Forewarning – Number of anagrams correct

Descriptive Statistics

Dependent Variable: Number of anagrams correct

IV_Ink_Color	WARNING: The color red may carry the meaning of failure and avoidance in achievement contexts. It may unconsciously affect levels of frustration and anxiety, which in turn leads to poor performance levels. Prior research suggests that participants whom ar	Mean	Std. Deviation	N
Red Instructions	No warning	6.4038	3.64213	52
	Warning	9.0980	4.40116	51
	Total	7.7379	4.23793	103
Black Instructions	No warning	9.8889	4.54409	63
	Warning	9.1639	5.19352	61
	Total	9.5323	4.86807	124
Total	No warning	8.3130	4.49437	115
	Warning	9.1339	4.82765	112
	Total	8.7181	4.66959	227

Tests of Between-Subjects Effects

Dependent Variable: Number of anagrams correct

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	384.344[a]	3	128.115	6.288	.000
Intercept	16792.444	1	16792.444	824.171	.000
IV_Ink_Color	177.331	1	177.331	8.703	.004
Warning	54.538	1	54.538	2.677	.103
IV_Ink_Color * Warning	164.413	1	164.413	8.069	.005
Error	4543.612	223	20.375		
Total	22181.000	227			
Corrected Total	4927.956	226			

a. R Squared = .078 (Adjusted R Squared = .066)

Appendix C – Ink color * Forewarning – Belief that forewarning influenced performance

Descriptive Statistics

Dependent Variable: To what extent do you think being forewarned in the instructions influenced the number of anagrams you got correct on the anagram task?

WARNING: The color red may carry the meaning of failure and avoidance in achievement contexts. It may unconsciously affect levels of frustration and anxiety, which in turn leads to poor performance levels. Prior research suggests that participants whom ar	IV_Ink_Color	Mean	Std. Deviation	N
No warning	Red Instructions	4.98	1.726	49
	Black Instructions	5.08	1.209	63
	Total	5.04	1.451	112
Warning	Red Instructions	5.22	1.527	51
	Black Instructions	4.92	1.646	61
	Total	5.05	1.593	112
Total	Red Instructions	5.10	1.624	100
	Black Instructions	5.00	1.437	124
	Total	5.04	1.520	224

Tests of Between-Subjects Effects

Dependent Variable: To what extent do you think being forewarned in the instructions influenced the number of anagrams you got correct on the anagram task?

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2.753[a]	3	.918	.394	.758
Intercept	5640.983	1	5640.983	2420.077	.000
Warning	.077	1	.077	.033	.856
IV_Ink_Color	.542	1	.542	.232	.630
Warning * IV_Ink_Color	2.185	1	2.185	.937	.334
Error	512.800	220	2.331		
Total	6216.000	224			
Corrected Total	515.554	223			

a. R Squared = .005 (Adjusted R Squared = -.008)