



# Can a Stroop Procedure Induce the Mehta and Zhu (2009) Color Effect?

# 3006

Kenneth M. Steele, Melissa Baker, Natsumi Kimura,  
Jennifer Gray, Elizabeth Strickland, & Player Barrett

Appalachian State University  
Boone, NC



## Introduction

Mehta and Zhu (2009) reported several experiments on the influence of the colors red and blue on a series of cognitive tasks. Red was hypothesized to induce a state of avoidance motivation that was predicted to make people more vigilant and risk averse in a task. Blue was hypothesized to induce a state of approach motivation that was predicted to increase the use of innovative, risky strategies in tasks.

Study 1a of Mehta and Zhu (2009) tested the effects of background color on solving anagrams. Words were categorized as being consistent with either an avoidance, neutral, or approach motivation. The anagrams were solved on either a red, white, or blue background. Mehta and Zhu reported a significant color by word-type interaction. Anagrams were solved more quickly when the word and the screen color invoked matching motivational states.

Steele et al. (2010, 2011) replicated the method of Mehta and Zhu (2009) but did not obtain their results. Avoidance words were not solved faster on red backgrounds and approach words were not solved faster on blue backgrounds.

The previous studies presented words in black letters on a neutral or colored background. Here we attempted to make the connection between color and word-type clearer by presenting anagrams in either red, gray, or blue letters on a white background. The original Stroop result focuses on interference effects produced by incongruent stimulus components (MacLeod, 1991). Mehta and Zhu (2009) make no clear predictions about incongruence. Instead their prediction is about facilitation when stimulus components induce congruent motivations.

The Mehta and Zhu prediction is that avoidance-word anagrams should be solved more quickly when they appear in red letters and approach-word anagrams should be solved more quickly when they appear in blue letters.

## Method

### Participants

202 college students (149 women and 53 men) participated for class credit.

### Apparatus

Sessions were computer-controlled using E-Prime software. Monitors were calibrated with a Spyder4Pro colorimeter.

### Procedure

Participants were asked to solve 15 anagrams (5 = Avoidance, 5 = Neutral, 5 = Approach). The anagrams were taken from Gilhooly & Hay (1977) and had been pretested to ensure they were consistent with the Mehta and Zhu motivation definitions. The words are listed in Table 1.

Each person was exposed to one color condition. The letters (1 cm high) appeared in either Red (RGB = 255, 0, 0), Gray (RGB = 85, 85, 85), or Blue (RGB = 0, 0, 255) on a white background with a frame (4 – 5 cm wide) in the same color as the word.

The session began with 6 practice anagrams. Participants initiated each anagram and typed in the solution underneath the anagram. The 15 anagrams were presented next. Anagrams were presented in random order. Word solution, solution time, and solution accuracy were recorded for each anagram.

Participants were then asked 3 questions about their speed-accuracy strategy on a 7-point bipolar (Disagree/Agree) scale.

Finally, participants were tested for color blindness on a short version of the Ishihara color deficiency test. A participant's data was excluded if the color deficiency test was not passed.

## References

Gilhooly, K. J., & Hay, D. (1977). Imagery, concreteness, age-of-acquisition, familiarity, and meaningfulness values for 205 five-letter words having single-solution anagrams. *Behavior Research Methods & Instrumentation*, 9, 12-17.

Mehta, R., & Zhu, R. J. (2009). Blue or red? Exploring the effect of color on cognitive performances. *Science*, 323, 1226-1229.

MacLeod, C. M. (1991). Half a century of research on the Stroop effect: An integrative review. *Psychological Bulletin*, 109, 163-203.

Steele, K. M., Putnam, E., Ayers, A., Tracy, S., & Antolic, E. (2010, November). *Does color influence anagram-solution speed?* Poster presented at the 51st annual meeting of The Psychonomic Society, St. Louis, MO.

Steele, K. M., Thorstenson, C., Sugg, K., Gurgainous, E., Stecher, A., & Putnam, E. (2011, November). *Red, white, and blue: Does background color affect solving anagrams?* Poster presented at the 52nd annual meeting of The Psychonomic Society, Seattle, WA.

Email Correspondence: steelekm@appstate.edu

## Results

### Solution Times

Table 2 shows mean solution times in seconds as a function of type of word and color of letters.

A Repeated Measures ANOVA was performed with Color as the Between-Subjects factor and Word-Type as the Within-Subjects factor. There was no significant effect of Color,  $F(2, 198) = 0.91, p = .40$ . There was a significant effect of Word-Type,  $F(2, 396) = 16.53, p < .001$ . Post hoc comparisons confirmed that Approach words were solved significantly more quickly than Neutral or Avoidance words.

There was a significant Color by Word-Type interaction,  $F(4, 396) = 3.79, p = .005$ . However, the pattern of results did not match the predicted pattern. Approach words were solved most quickly whether they appeared in either red or blue letters.. Avoidance words were solved most slowly when they appeared in red letters.

The entire analysis was repeated on the *log* transform of the solution times to see if the results could be explained by some combination of extreme scores. The pattern of results was the same as reported for the untransformed solution times.

### Accuracy

Table 3 shows mean accuracy percentages as a function of type of word and color of letters.

A Repeated Measures ANOVA was performed with Color as the Between-Subjects factor and Word-Type as the Within-Subjects factor. There was a significant effect of Color,  $F(2, 199) = 4.02, p = .019$ . Post hoc comparisons confirmed that accuracy rates were significantly lower when the words appeared in gray letters.

There was a significant effect of Word-Type,  $F(2, 398) = 12.5, p < .001$ . Post hoc comparisons confirmed that Approach words were solved significantly more often than Neutral or Avoidance words.

There was no significant Color by Word-Type interaction,  $F(4, 398) = 0.1, p = .98$ .

## Conclusions

Mehta and Zhu (2009) reported a facilitation effect on anagram solution times when the hypothesized approach/avoidance meaning of the word was congruent with the hypothesized approach/avoidance meaning of the color.

The purpose of this experiment was to make color a property of the words by using colored letters to see if this procedure would induce the Mehta and Zhu color effect.

The results did not show the pattern predicted by Mehta and Zhu. Approach words were solved most quickly whether they appeared in red or blue letters. Avoidance words were solved more slowly whether they appeared in red or blue letters.

Our results cast additional doubt on the existence of the Mehta and Zhu (2009) color effect.

Table 1

Anagrams from Gilhooly & Hay (1977)

<u>Approach</u>	<u>Neutral</u>	<u>Avoidance</u>
lover	album	agony
youth	month	panic
child	batch	virus
world	thumb	guilt
prize	index	wreck

Table 2

<u>Correct Solution Time (sec)</u>				
<u>Color</u>		<u>Approach</u>	<u>Neutral</u>	<u>Avoidance</u>
Red	<i>M</i>	9.6	13.1	16.4
	<i>SD</i>	(7.4)	(10.0)	(14.9)
Gray	<i>M</i>	10.9	11.3	14.3
	<i>SD</i>	(6.0)	(8.4)	(12.6)
Blue	<i>M</i>	10.9	16.7	14.3
	<i>SD</i>	(8.2)	(12.9)	(9.7)
All	<i>M</i>	10.5	13.7	15.1
	<i>SD</i>	(7.3)	(10.8)	(12.6)

Table 3

<u>Solution Accuracy (%)</u>				
<u>Color</u>		<u>Approach</u>	<u>Neutral</u>	<u>Avoidance</u>
Red	<i>M</i>	83.4	75.7	76.9
	<i>SD</i>	(18.6)	(18.0)	(20.6)
Gray	<i>M</i>	76.6	70.3	69.1
	<i>SD</i>	(21.2)	(20.5)	(20.4)
Blue	<i>M</i>	83.2	75.9	75.3
	<i>SD</i>	(18.8)	(20.9)	(23.5)
All	<i>M</i>	81.2	74.1	73.9
	<i>SD</i>	(19.7)	(19.9)	(21.7)

## Reprints

Steele et al. (2012).....



Steele et al. (2011).....



Steele et al. (2010).....

