

Does Color Influence Anagram Solution Speed?

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Introduction

"Color Psychology" is defined as the influence of color on psychological functioning, including cognitive, emotional, motivational, and behavioral effects (Valdez & Mehrabian, 1994). The results of investigations of color on psychological functioning have been weak, contradictory, and beset with methodological problems (Whitfield & Whiltshire, 1990.)

Mehta and Zhu (2009) reported several studies that demonstrated effects of red and blue on a series of cognitive tasks. Red was hypothesized to induce a state of avoidance motivation which was predicted to enhance performance on a detail-oriented task. Blue was hypothesized to induce a state of approach motivation which was predicted to increase use of innovative, risky strategies in problem-solving tasks.

Study 1a of Mehta and Zhu (2009) tested the effects of red on anagram solutions. Participants solved anagrams on red, white, or blue backgrounds. Words were chosen and hypothesized to be consistent with either an avoidance, neutral, or approach motivational state. Mehta and Zhu reported a significant color by word-type interaction. Anagrams were solved more quickly when the word and screen color invoked matching motivational states.

The purpose of this study was to replicate the procedure of Mehta and Zhu (2009) to determine whether the same results would be obtained.

References

- Mehta, R., & Zhu, R. J. (2009). Blue or red? Exploring the effect of color on cognitive performances. *Science*, 323, 1226-1229.
- Valdez, P., & Mehrabian, A. (1994). Effects of color on emotions. *J. of Experimental Psychology: General*, 123, 394-409.
- Whitfield, T. W., & Whiltshire, T. J. (1990). Color psychology: A critical review. *Genetic, Social, & General Psychology Monographs*, 116, 385-411.

Method

Participants

172 ASU undergraduate students participated in the study for course credit.

Apparatus

Sessions were computer-based and programmed using E-Prime software.

Procedure

Participants were asked to solve 12 anagrams (3 = Avoidance motivation, 3 = Approach motivation, 6 = Neutral motivation). The anagrams were taken from Mehta and Zhu (2009) and are grouped in Table 1 according to their hypothesized motivational influence.

Table 1 lists the word length in letters and the mean word length for each word-type group. Note that Neutral words were systematically shorter than the Avoidance or Approach words.

Each person was exposed to the anagrams on one color background. The screen color, Red, was programmed to have the values of H[ue] S[aturation] L[ightness] = 0, 240, 120 and the screen color, Blue, was programmed to be HSL = 160, 240, 120, consistent with Mehta and Zhu specifications. Mehta and Zhu did not provide HSL values for the White background.

Participants initiated each anagram problem. Anagrams were presented in randomized order. Word solution, solution time, and accuracy of the solution were recorded on each trial.

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

Finally, participants were tested for color blindness on a brief version of the Ishihara color deficiency test. Participants were excluded from analysis if the color deficiency test was not passed.

Only correct solutions were included in the analysis.

Results

No Color by Word-Type Interaction

Table 2 shows mean solution times in seconds for anagrams as a function of screen color and word type. The *SD* values in Table 2 indicate a wide range of solution times among the word groups. We excluded the longest 10%, 15%, and 20% of upper values in reanalyses and the pattern of differences did not change. Neutral words were solved about twice as quickly as the other word types.

A Repeated Measures ANOVA was performed with Color as the Between-Subject factor and Word-Type as the Within-Subject factor. There was a small Color effect, $F(2, 70) = 2.77, p = .07$, a clear effect of Word-Type, $F(2, 140) = 22.8, p < .001$, and no significant Color by Word-Type interaction, $F(4, 140) = 1.38, p = .24$.

The Repeated Measures ANOVA was repeated twice after excluding the upper 10% and the upper 15% of scores. The same pattern of results was produced. The effect of Word Type remained significant. The effects of Color and the Color by Word-Type interaction remained insignificant.

The lack of a significant Color by Word-Type interaction is not explained by the presence of extreme scores.

Word Type is confounded with Word Length

Neutral words were significantly shorter than Avoidance words, $t(7) = 3.2, p = .01$, and Approach words, $t(7) = 2.88, p = .02$.

Solution times for Neutral words were faster than Avoidance words, $t(128) = 5.1, p < .001$, and Approach words, $t(79) = 5.9, p < .001$.

Accuracy rates for Neutral words ($M = 72%$) were higher than Avoidance words ($M = 34%$), $t(171) = 19.2, p < .001$ and Approach words ($M = 24%$), $t(171) = 21.2, p < .001$.

Table 1

Anagrams from Mehta & Zhu (2009)

Avoidance	Approach	Neutral
Prevent [7]	Adventure [9]	Violin [6]
Guarantee [9]	Advance [7]	Drink [5]
Obligation [10]	Olympics [8]	Phone [5]
		Count [5]
		Computer [8]
		Ranch [5]

[*] = Word Length

<i>M</i> = 8.67	<i>M</i> = 8.00	<i>M</i> = 5.67
<i>SD</i> = 1.53	<i>SD</i> = 1.00	<i>SD</i> = 1.21

Table 2

Correct Solution Time (sec)

Color	Avoidance	Approach	Neutral
Red	<i>M</i> 50.8 <i>SD</i> (46.7)	66.1 (76.3)	29.4 (23.1)
White	<i>M</i> 70.5 <i>SD</i> (81.2)	122.0 (115.5)	37.8 43.6
Blue	<i>M</i> 59.1 <i>SD</i> (72.8)	86.8 (112.2)	25.7 (23.9)

Conclusions

The procedure of Study 1a of Mehta and Zhu (2009) was replicated, using the same independent and dependent variables. Their result was not replicated. Anagrams were not solved more quickly when the word and screen color invoked matching motivational states.

A methodological deficiency was discovered in the Mehta and Zhu (2009) procedure. Word length was not equated across the three groups and mean word length was confounded with the hypothesized motivational status of the words. A next step would be to determine if the Mehta and Zhu results are replicated if this methodological deficiency is eliminated.