

A Study of Color Memory and Preference

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ABSTRACT

Short-term color memory of 30 university students who had identified red, green, or blue as their favorite color, was evaluated in four hue categories: red, green, blue, and yellow. Munsell dimensions of hue, value, and chroma were used to select four target colors and 11 distractor colors for each of the targets. The distractors differed from the target in hue, value, or chroma, or a combination of both value and chroma. The subject looked at the target color chip for 5 seconds, with the intent of remembering it. After removal of the target color, and an additional period of 5 seconds during which the subject focused on a white card, the subject was given a stack of 12 randomly arranged color chips, including the target and the 11 distractors, and asked to choose the target color. There was no overriding relationship between preferred color and short-term memory for that color. Only subjects whose favorite color was red, overall, showed more accurate memory for red than for the other three colors. However, subjects whose favorite color was red also demonstrated better overall color memory than did subjects whose favorite colors were green or blue. Differences in hue, value, and chroma between the targets and the most frequently selected distractors were identified. For each case in which there were differences in value or chroma between targets and the most frequently selected distractors, the colors were remembered as being lighter and more chromatic than they actually were.

1. INTRODUCTION

Color memory has been described as “successive color matching,” a category of color matching in which time elapses between the presentation of a color stimulus and the attempt to recall and match the remembered color.^{1,2} Previous research has shown that some colors are more easily remembered than others, although there is some disagreement among these studies as to which colors are most easily remembered.^{3,4,5,6,7,8}

Noting that certain colors have inherent differences that make them more difficult to remember than others, Collins³ conducted experiments in which subjects were asked to reproduce a previously seen color, and found that particular wavelengths of green and red were hard for the subjects to reproduce and also difficult to recognize again. This finding was confirmed by others in a later study⁴ that showed that in addition to hue, ability to remember a color is also influenced by its lightness or darkness. Later, Nilsson and Nelson⁵ found that the most accurately remembered colors were violets, green-blues, and yellow-oranges. However, Jin and Shevell⁶ demonstrated that long and medium wavelengths were remembered more accurately than shorter wavelengths.

A 1998 study revealed that women remembered color more easily and more accurately than did men. Among ten colors included in this particular study, orange was the easiest color to remember, whereas yellow, light green, blue and pink were the most difficult to remember. Comparing color memory by gender, male subjects most easily remembered orange, dark blue, green, and red, while women showed better memory for orange, red, chamois, and violet. Furthermore, light colors were remembered as being lighter than they actually were, while dark colors were incorrectly remembered as being darker.²

Time between stimulus and recall was also found to have a significant effect on memory, with the accuracy of color memory diminishing rapidly as the elapsed time increased between intervals of zero, 15 seconds, 5 minutes and 24 hours.² However, other research found no significant difference for delays between 0.1 and 24.3 seconds.⁵ Yet another group of researchers who studied longer delays of 15 minutes, 24 hours, and 64 hours also found no relationship between time delay and color memory.⁴

Studies that addressed effects of subject's prior training or experience with color on their accuracy in color memory have also shown contradictory results. Using 43 chips from the Farnsworth-Munsell color test, Burnham and Clark⁸ did not find prior color experience or training to have a significant effect on color memory. However, earlier work³ with a questionably small sample of only six subjects had shown that trained subjects had more accurate color memory.

Our earlier study of short term color memory⁷ of forty female university students compared design majors having prior training or professional color experience with non-design majors who had no prior color training. Using color chips in four Munsell hue categories (yellow, yellow-red, green and purple), each category having a target and nine distractors, we found that yellow was the most accurately remembered color, and green was least accurately remembered by both design and non-design students. However, for the design majors, orange ranked second in accuracy of being remembered, while purple was the second most accurately matched color for the non-design majors. These findings confirmed those of previous studies^{2,3} that showed that green was the least correctly remembered color. The finding that yellow was the most correctly remembered color contradicted the findings of one previous study² but confirmed the findings of another.³ Our earlier study also investigated the use of cues. Most of the subjects reported the use of visual or verbal cues in remembering colors. Visual cues were used in the majority of the accurately remembered colors.

A subject's past color experience may be related to color preference, in that the subject might be expected to have had more experience with a preferred, or favorite color than with a non-preferred color. This study addresses the relationship between color preference and short-term color memory. This link between color preference and color memory is a new area of research that has not been presented or published previously. The primary purpose of our study was to examine the influence of color preference on short-term memory of the preferred color. A secondary objective was to investigate the relationship between the subject's favorite color and their overall short-term color memory. A third objective was to examine incorrectly remembered colors to determine whether there is a consistent direction of Munsell hue, value or chroma difference between the target and the incorrectly remembered color, and what relationship this difference might have with the subject's preferred color. After the study was underway, a fourth objective was added, to examine the results of the color matches in relation to CIELAB color differences between each distractor and its corresponding target.

2. METHOD

Prospective participants were undergraduate students who were initially randomly selected from among students in classes in a particular building on the university campus. Prospective participants were first asked what was their favorite color. The initial plan was to include only those students who indicated red, green, yellow, or blue as their favorite color. Approximately 60 prospective participants were questioned. Among this group, for each of the color categories, the first 10 who said that the color was their favorite, was invited to participate in the study. All who were invited agreed to participate. Only one of the 60 respondents identified yellow as their favorite color, therefore, that color category was eliminated, and only those who preferred red, green or blue were asked to participate. These 30 individuals were administered the Farnsworth-Munsell 100 Hue test. All were found to have normal color vision and at least average color discrimination ability as determined by their scores on the test.

Munsell color dimensions of hue, value, and chroma were used to select colors for the study. Color chips in four hue categories (red, green, yellow and blue) were selected from the Munsell Book of Color (matte finish). Each set included a target color and a series of 11 distractor colors, which are listed in Table 1. The Munsell locations of the distractor colors with respect to the target colors were similar for each of the four sets. Each distractor was within two Munsell hue, value, and chroma units of the target. Each of the distractors appeared closely related to, but visibly different from the corresponding target. In each color category, two of the distractors differed from the corresponding target in hue only, two differed from the target in value only, three differed from the target in chroma only, and four differed from the target in both value and chroma. Each of the color chips measured 17 x 20 mm.

Table 1: Munsell Designations of Target and Distractor Colors in Four Hue Categories

	Red	Green	Blue	Yellow
Target:	5 R 5/12	10 G 6/6	7.5 B 5/6	2.5 Y 8/8
Distractors:	5 R 6/10	10 G 7/4	7.5 B 6/8	2.5 Y 8.5/10
	5 R 6/14	10 G 7/8	7.5 B 6/4	2.5 Y 8.5/6
	5 R 4/10	10 G 5/4	7.5 B 4/8	2.5 Y 7/10
	5 R 4/14	10 G 5/8	7.5 B 4/4	2.5 Y 7/6
	5 R 5/8	10 G 6/2	7.5 B 5/2	2.5 Y 8/4
	5 R 6/12	10 G 7/6	7.5 B 6/6	2.5 Y 8.5/8
	5 R 5/10	10 G 6/4	7.5 B 5/8	2.5 Y 8/6
	5 R 4/12	10 G 5/6	7.5 B 4/6	2.5 Y 7/8
	5 R 5/14	10 G 6/8	7.5 B 5/4	2.5 Y 8/10
	2.5 R 5/12	7.5 BG 6/6	5 B 5/6	5 Y 8/8
	7.5 R 5/12	7.5 G 6/6	10 B 5/6	10 YR 8/8

Tests were conducted in a standard light box using illuminant D65. Using the experimental method for color memory evaluation that was established in our earlier research⁷, the subject was handed the target color chip and asked to look at it with the intent of remembering it. After 5 seconds, the target was removed. On removal of the target, the subject was asked to focus on a white card for 5 seconds. Finally, the subject was handed the randomly arranged set of color chips that included the target and distractors, and was asked to recall the target and select it from the set. The order of presentation of the four sets of colors was randomized.

3. RESULTS

Eight of the ten subjects who had chosen red as their favorite color correctly selected the red target. Five of the 10 subjects whose favorite color was green correctly remembered the green target, and only three of those whose favorite color was blue selected the blue target. Table 2 summarizes the correct selections of the target colors by the three groups of subjects. Overall, subjects whose favorite color was red more accurately remembered the red target than the other three targets, while subjects whose favorite color was green or blue were less able to remember their favorite color than at least one of the other colors. However, when the subjects whose favorite color was red were considered individually, the results showed that on average, red was not more accurately remembered than the other colors. The individual data showed that there were three subjects who correctly selected only the red target, one who correctly identified only the blue target, and one who correctly identified both yellow and blue, but not red. The five other subjects correctly remembered red and at least one of the other colors. One of these subjects correctly identified each of the four target colors.

Table 2 shows that, independent of color preference, red was the most remembered color. Individual data showed that nine of the 30 subjects correctly remembered only the red target, one remembered only the blue target, one remembered only the green target, and there were none who remembered only the yellow target.

Table 2: Correctly Remembered Colors in Each Hue Category According to Favorite Color

Favorite Color	Number of Correct Selections			
	Red	Green	Blue	Yellow
Red (n=10)	8	1	5	4
Green (n=10)	5	1	1	1
Blue (n=10)	3	3	1	1

Data also showed that subjects who favored the color red showed the best color memory overall. Each of the 10 subjects in this category correctly identified at least one of the targets, and one identified all targets. In comparison, only five of the subjects who preferred green, and only six of the subjects who preferred blue, were able to correctly identify at least one of the target colors.

Of the total 44 distractor colors (11 for each color category), 19 were selected by at least one participant. Table 3 lists the distractors that were selected at least five times. Differences between these distractors and the corresponding target colors included differences in hue, chroma, and value. In the five cases in which there were differences in chroma, the colors were incorrectly remembered as being brighter (higher chroma) than they actually were. This occurred in each of the four color categories. In the single case in which there was a difference in value between the target and distractor, the yellow color was remembered as being lighter than it actually was.

Table 3: Munsell Designations of Major Selected Distractors and Quality of Difference from Target

Color	Distractor	Number of Times Selected	Difference from Target
Red	5 R 5/14	8	higher chroma
	7.5 R 5/12	5	hue
Green	7.5 G 6/6	8	hue
	10 G 6/8	6	higher chroma
Blue	10 B 5/6	9	hue
	5 B 5/6	9	hue
	7.5 B 5/8	5	higher chroma
Yellow	2.5 Y 8/10	14	higher chroma
	2.5 Y 8.5/10	7	hue, lighter value, higher chroma

Realizing that Munsell steps are not all equal, after analyzing the responses, CIELAB color measurements were taken of the targets and distractors. This showed that the differences between target and distractors were not uniform across the four sets of colors. This finding limits the validity of making comparisons across the four color categories, and will be a focus of further investigation.

4. CONCLUSIONS

This study has implications for future work, in both fundamental research into the mechanisms of color memory, as well as applications in consumer product development and marketing. Unequal color differences among adjacent color steps in the Munsell system indicate the need to select distractor colors based on color measurement, rather than Munsell designations. Particularly because of contradictory findings among previous studies, further investigation is needed on this subject.

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