Investigation of eye-catching colors using eye tracking

Mokryun Baik, Hyeon-Jeong Suk, Jeongmin Lee, Kyung-Ah Choi
**color variation**
most effective and intuitive ways to visually prioritize information

*but still subjective*
to the eye of the designer
can be harmful
to perceiving visual information accurately
without an objective guideline
various types of content on a more small-sized display
our objective
is to provide empirical grounds for strengthening mobile visual information structure
empirically investigate
which colors are most eye-catching in a mobile communication context
divided into 3 parts to investigate whether hue, tone and color combination has effects on color saliency
<table>
<thead>
<tr>
<th>Part 1</th>
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<tbody>
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<td>Part 2</td>
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<td>Part 3</td>
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</table>
part 1.

to determine which color **hue** catches the attentions of the eyes first

- The hue circle was divided by 15° in HSB color system from Photoshop software to extract 24 different hues
- Gray has no hue, but was added because it is usually recognized as color
- Total of 25 hues were made up

25 Hues in Vivid Tone
part 1.

to determine which color **hue** catches the attentions of the eyes first

- Three more stimulus sets were produced with variations in tone - light, dark, and moderate - by controlling the saturation as well as brightness
part 1.

to determine which color **hue** catches the attentions of the eyes first

- Each hue set was randomly arranged in a 5 by 5 matrix (an icon array structure) in 3 different ways to avoid position bias
- The stimuli were placed over a black and white background
- Total of 24 sets (4 tones * 3 positions * 2 backgrounds)
part 2.

To examine whether certain *tones* attract the eyes more

- 25 tones for red hue were extracted by dividing the saturation (100%) and brightness (100%) levels by 5.
- The process was repeated for green and blue.
part 2.

to examine whether certain *tones* attract the eyes more

- Each tone set was randomly arranged in a 5 by 5 matrix in 3 different ways to avoid position bias
- The stimuli were placed over a black and white background
- Total of 18 sets (3 tones * 3 positions * 2 backgrounds)
part 3.

to test whether *color contrast* has an effect on saliency

background: 25 hues of Vivid Tone (part I)

+ Red Icons

+ Green Icons

+ Blue Icons
part 3.

To test whether **color contrast** has an effect on saliency:

- Each color combination set was randomly arranged in a 5 by 5 matrix in 3 different ways.
- The stimuli were placed over a black and white background.
- Total of 18 sets (3 icon colors * 3 positions * 2 backgrounds).
Part I. Hue (24 sets)

1-1. 25 Hues of Vivid Tone
2 Background x 3 set

1-2. 25 Hues of Light Tone
2 Background x 3 set

1-3. 25 Hues of Dark Tone
2 Background x 3 set

1-4. 25 Hues of Moderate Tone
2 Background x 3 set

Part II. Tone (18 sets)

2-1. 25 Tones of Red Hue
2 Background x 3 set

2-2. 25 Tones of Green Hue
2 Background x 3 set

2-3. 25 Tones of Blue Hue
2 Background x 3 set

Part III. Color Combo (18 sets)

3-1. Vivid Tone BG. + Red Icon
2 Background x 3 set

3-2. Vivid Tone BG. + Green Icon
2 Background x 3 set

3-3. Vivid Tone BG. + Blue Icon
2 Background x 3 set
the subjects were asked to select their preferred color while viewing each stimulus.

60 sets

- 7-second task
- 2-second break

approx. total of 9 min.
to prevent an afterimage effect
**Eye gaze Analysis System**
a table-mounted eye-tracking system developed by LC Technologies Inc.

15 college students made up of 8 males and 7 females were recruited with an average age of 25.00 years and a standard deviation of 3.64 years. All participated in all three parts.
method

Eye gaze Analysis System

a table-mounted eye-tracking system developed by LC Technologies Inc.

The lighting of the experimental room was lit in 100 lx.

seated at an average of 60 cm

from the 17-inch monitor, creating

*approx. 2° of viewing angle*
EMT Tracker
an eye-tracking analysis software

- The fixated positions within the first 3 seconds were taken into consideration.
- The initial fixation was removed from analysis as it was assumed that the initial fixation would generally be at the center of the screen or at a random point.
- Positions were recognized as fixations only when the duration exceeded 0.25 seconds.
**part 1.**

*warm group* grabs attention most effectively

- **warm group (6 hues)**: hues ranging from red (0 degree) to yellow (90°)
- **cool group (6 hues)**: blue-green (225°) to purple-blue (315°)
- **neutral hue group**: rest of the hues

The fixation counts of the warm group were higher than the other two groups (Chi-square test, p<.05)
part 1. and, a position effect

The color patches placed on the horizontal or vertical axes caught the eyes’ attention more easily
and, a position effect

The participants fixated very little on color patches that were located on the right side of the screen.
part 2.

no tendencies…
with regards to the tone difference

but, still a position effect
part 3.

**high contrast group** grabs attention most effectively

- **low contrast**: $|\text{background hue} - \text{foreground hue}| \leq 60^\circ$
- **medium contrast**: $60^\circ < |\text{background hue} - \text{foreground hue}| \leq 120^\circ + \text{gray}$
- **high contrast**: $120^\circ < |\text{background hue} - \text{foreground hue}| \leq 180^\circ$

![Color wheel with low contrast, medium contrast, and high contrast sectors]
**part 3.**

**high contrast group** grabs attention most effectively

<table>
<thead>
<tr>
<th>Contrast Level</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>low contrast</td>
<td>$</td>
</tr>
<tr>
<td>medium contrast</td>
<td>$60^\circ &lt;</td>
</tr>
<tr>
<td>high contrast</td>
<td>$120^\circ &lt;</td>
</tr>
</tbody>
</table>

The frequency of fixation counts was greatest for the high contrast group and lowest for the low contrast group (Chi-square test, $p<.05$)

![Contrast Examples](image-url)
The major findings are summarized into four aspects:

First, warm colors grab the eyes’ attention; Second, tone difference within the same hue has no effect on attention; Third, for hue contrast, complimentary pairs are particularly more dominant; Fourth, color patches located on axes have benefit.

In addition, it was revealed that the foreground-background color contrast does not play a decisive role.
appropriate use of color can help prioritize visual information in each UI context to communicate effectively.

these empirical findings are expected to be applied in practice straightforwardly.
Color and Emotion for Design Lab.
Department of Industrial Design, KAIST