

# The Relationship between Text Color and Reading Speed

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## **Abstract**

It is known that features of letters have effects on reading/scanning performance. A previous study reported that warm background colors (red, yellow, orange, etc.) with black letters made people read faster. However, it is not clear whether text color affects reading speed, and the aim of this study was to see the relationship between text color and reading speed. Each participant was given three passages, each of which was printed in black and other two colors among red, blue, yellow, green, and purple, and was asked to read them in turn, recording the time taken to read each one. There was no evidence that showed text color had an influence on reading speed, but it was shown that those who read passages printed in black extremely fast/slow read colored passages slower/faster than those printed in black. These results might have indicated that reading speed did not have a correlation with text color, but that human

beings could originally read colored passages faster than those printed in black.

**Keywords:** human study; reading speed; text color

### **Introduction**

Features of letters (color, font, size, luminance, etc.) are known to have effects on reading/scanning performance. It was reported that luminance of letters on a computer monitor and the type of font influenced reading speed (Yager, Aquilante, & Plass, 1998). It was also shown that speed and accuracy in scanning depended on combinations of text and background colors (Ohlsson, Nilsson, & Rönnerberg, 1981).

However, it remains unclear whether text color affects reading speed, let alone what color picks up the speed. Rello and Bigham (2017) concluded that warm background colors with black letters made people read faster, but they did not research the relationship between text color and reading speed, and a gap in our understanding of the sense of sight exists here. If it becomes clear whether this relationship exists or not, the knowledge will help the area of research on human visual sensation to develop.

This experiment was conducted to see whether there was the relationship between text color and reading speed. Participants were asked to read three passages that were printed in three different colors and to record the time it took for them to read each one. Their times were analyzed, and it was determined whether text color influenced reading performance.

The hypothesis was that passages printed in warm colors would be read faster than those printed in cool colors, because Rello and Bigham (2017) reported that warm background colors with black letters led to high reading speed. If this hypothesis was supported, combined with the study mentioned above (Rello & Bigham, 2017), it could be concluded that warm colors themselves had strong influences on reading speed.

## **Method**

### **Participants**

Twenty- five students in the University of Tokyo (twenty- one men and four women) participated in this experiment. Their ages ranged from 18 to 20.

### **Design**

The independent variable was text color, and the dependent variable was the time taken

to read each passage. The control variables were the type of font, the number of letters, and the background color (white). The type of font was controlled because Yager et al. (1998) reported that it influenced reading speed, and the number of letters was controlled because it was almost obvious that the time taken to read each passage was dependent on it. The background color was white because Ohlsson et al. (1981) concluded that speed in scanning depended on combinations of text and background colors and our experiment aim was to investigate the influence of text color on reading speed on white paper.

## **Materials**

Each passage contained 1,200 letters and was printed in one color among black (RGB(0, 0, 0)), red (RGB(255, 0, 0)), blue (RGB(0, 112, 192)), yellow (RGB(255, 255, 0)), green (RGB(0, 176, 80)), and purple (RGB(112, 48, 160)). It was printed on one white A4 size paper (font type: MS *mincho* [MS 明朝], font size: 12). Three different passages were used, because if one participant read the same passage over and over again, they would memorize the content and read it faster. In order to ensure a similar difficult level, all passages were from one book (*Sapiens zenshi jou bunmei no kouzou to jinrui no koufuku* [サピエンス全史 (上) : 文明の構造と人類の幸福. Sapiens : a brief history of humankind]). Table 1 shows the text color and sections in this book from which passages used in the experiment were quoted. The

participants' smartphones were also used to record the time it took for them to read each passage.

**Table 1.** The text color and sections in the book mentioned above from which passages used in the experiment were quoted.

Black	Red	Blue	Yellow	Green	Purple
p.14 1.1 –	p.34 1.1 –	p.59 1.1 –	p.104 1.1 –	p.128 1.1 –	p.86 1.1 –
p.15 1.17	p.35 1.14	p.60 1.14	p.105 1.17	p.129 1.16	p.87 1.16

## Procedure

Each participant was given three passages. They were printed in black and other two colors among red, blue, yellow, green, and purple. Participants were asked to read them in turn and to record the time taken to read each one in their homes. Passages printed in red or green were read by eleven people, and ones printed in blue, yellow, or purple were read by nine people, respectively.

## Data analysis

The times taken to read passages and the ratios of certain color to black (Equation 1) were averaged for each text color. The correlation coefficients between the ratio of each color to black and the time taken to read a passage printed in black were also calculated.

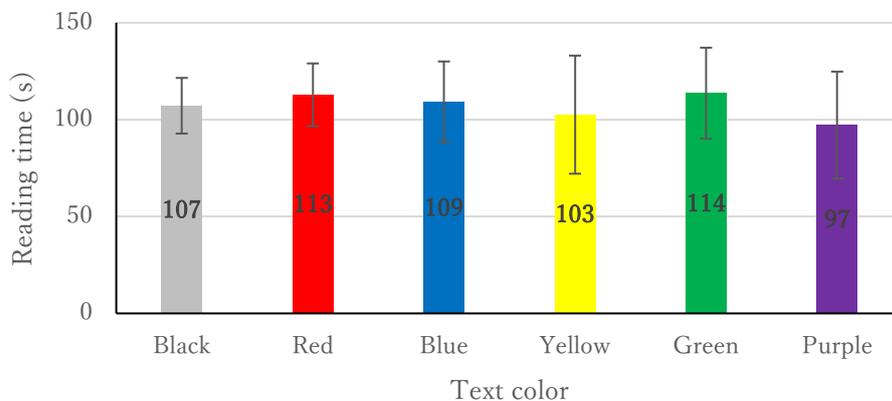
$$\text{the ratio of } X \text{ to black [\%]} = \frac{a - b}{b} \times 100 \quad (1)$$

a = the time that a participant took to read one passage printed in  $X$  [s]

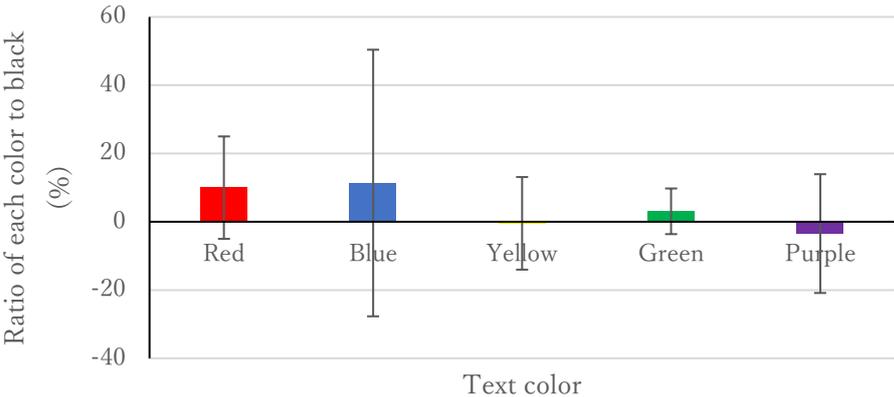
b = the time that the participant took to read one passage printed in black [s]

## Result

The aim of this experiment was to investigate the relationship between text color and reading speed. The times taken to read passages and the ratios of each color to black were averaged for each text color. Figure 1 shows the average times and Figure 2 shows the average ratios. Participants read a passage printed in yellow or purple faster and one printed in red, blue, or green slower than one printed in black (Figure 1 and Figure 2). However, there were not significant differences for the different text colors, and the 95% confidence intervals were wide.

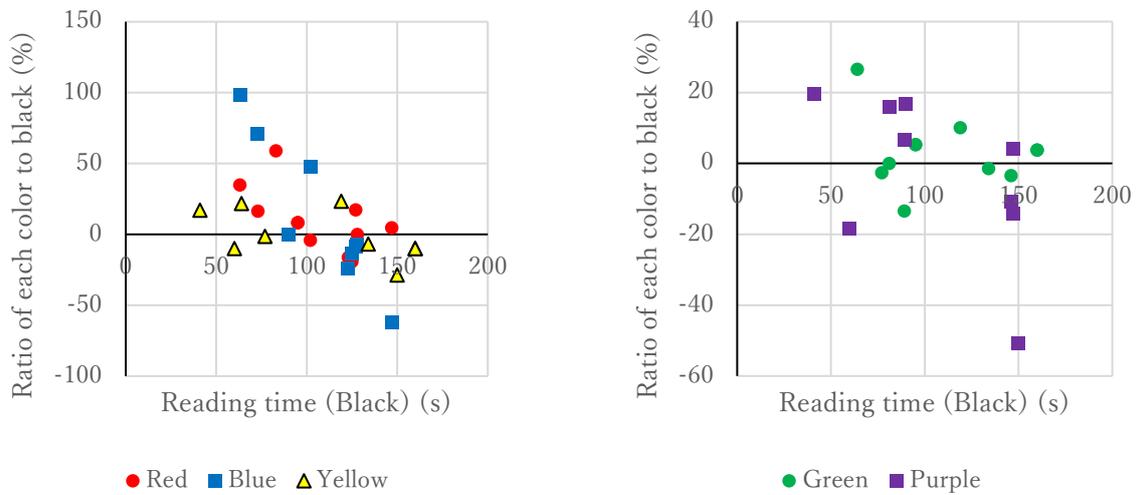


**Figure 1.** The average time taken to read passages printed in different colors. The error bars show the 95% confidence intervals.



**Figure 2.** The average of the ratio of each color to black. The error bars show the 95% confidence intervals.

Figure 3 shows the distribution of the ratios of each color to black according to times taken to read passages printed in black (the reading time (Black)). There were negative correlations between the ratio of each color to black and the reading time (Black);  $r(x)$  indicating the correlation coefficients between  $x$  and the reading time (Black),  $r(\text{the ratio of red to black}) = -0.61$ ,  $r(\text{the ratio of blue to black}) = -0.92$ ,  $r(\text{the ratio of yellow to black}) = -0.57$ ,  $r(\text{the ratio of green to black}) = -0.21$ , and  $r(\text{the ratio of purple to black}) = -0.56$ .



**Figure 3.** The distribution of the ratios of each color to black according to the reading time (Black).

### Discussion

As Figure 1 shows, it does not seem likely that there is a direct relationship between text color and reading speed. This does not support the hypothesis that passages printed in warm colors would be read faster than those printed in cool colors. This hypothesis was based on two previous studies. One of them reported that warm background colors with black letters led to high reading speed (Rello & Bigham, 2017), and the other reported that people were stimulated when seeing warm colors (Stone & English, 1998). Although warm text color with a white background is different from warm background color with black letters, if the reason why warm background colors lead high reading speed is that readers are stimulated when seeing warm

colors, it is likely that they read passages printed in warm colors as well. One possible reason why the data in this present study do not support the hypothesis is that letters printed in warm colors, whose colored areas are too small, cannot stimulate readers. If this presumption is correct, reading speed depends on how the reader is stimulated, rather than on text color or background color. Further research is needed to establish the influence of readers' moods on their reading speeds.

One may think that the 95% confidence intervals shown in Figure 1 and Figure 2 are too wide to draw any conclusions from these data. That is correct to a certain degree. The problems with our experiment were that the number of participants was small, that the conditions where participants read passages were different, and that whether or not participants understood the contents of the passages was not taken into account. However, the wide 95% confidence intervals resulted not only from these limitations. They resulted also from the fact that the time it took for a participant to read each passage was dependent on how fast he/she read a passage printed in black, as shown in Figure 3. From this point of view, too, it can be concluded that there is not a direct relationship between text color and reading speed

Figure 3 tells that the slower someone reads a passage printed in black, the lower the

ratios of each color to black he/she has. This means that participants who read passages printed in black extremely fast/slow read colored passages slower/faster than those printed in black. It is likely that participants who read passages printed in black extremely fast were simply accustomed to reading printed matter, therefore this result may indicate that human beings can originally – in a state of being less accustomed to reading – read colored passages faster than those printed in black. Further studies are necessary to investigate how often participants read printed matter, such as books, magazines, and newspapers.

Overall this study showed that text color does not have a correlation with reading speed but those who read passages printed in black extremely slow read colored passages faster than those printed in black. This conclusion may fill the gap in our understanding of human visual sensation and be useful to the design of printed matter that is easy for everyone to see.

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