Package design color preference using eye-tracking technology: Does gender make a difference?

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ABSTRACT: Studies focusing on gender differences regarding color preferences in the application of package design seems to be scarce. This study aims to reveal the gender differences in color package design preference and to recommend what color factor to best to apply for package design using eye-tracking technology. A study of eye-tracking was conducted. T-test and one-way Anova followed by the Tukey Post Hoc test were used to test if there is a difference in fixation count based on the colors presented. The study found no difference in color preference between male and female participants. It revealed that brown, as well as yellow, has no significant difference in color preferences.

Keywords: Color, Eye-tracking, Gender, Packaging, Preference

1 INTRODUCTION

Most researchers in color used a questionnaire survey (both online and offline) as a method of investigating color preference (Wei et al. 2008; Ou et al. 2012; Seher et al. 2012; Bakker et al. 2013; Westland and Shin 2015; Yu et al. 2018). However, a study by Bakker et al. (2013) argues that it is hard to draw valid and reliable conclusions on color responses using questionnaires in color research. An eye-tracking observation method was used to objectively identify the color preference of study participants to investigate the feasibility of deriving color preferences by defining fixations and relevant details (Lee et al. 2005). Other researchers in color used eye-tracking as an investigation method on color preference (Cho & Suh 2020).

Swasty et al. (2019) used two different methods (questionnaire and eye-tracking) and suggested that the visual data from the eye-tracking method is more accurate than data from the questionnaire as a sense of vision is unconscious (Apsari 2012). The main purpose is to find out which areas attract the most attention (number of fixations) and identify the color and image combination factors on the packaging that more people preferred. The study revealed that the brown color used in monster illustrations is the most preferable combination of color and image for the chocolate-flavored banana chip package design. However, the study results obtained are still general, and did not show any differences in color preference between male and female respondents.

Eye-tracking is a tool for analyzing the visual attention related to consumers' emotional and cognitive responses from the neuro-marketing perspective (dos Santos et al. 2015). Eye-tracking technology can be an effective eye movement measurement tool for saccades (scan paths) and fixations (pause of the eye movements). It provides objective data on the cognitive processes and emotion as well as identifies where and how long a viewer looks in the Area of Interest (AOI). It also identifies the eye movement time-based sequence to describe the correlation between the tendency of viewers to gaze at certain stimulus and their preferences (Cho & Suh 2020).

Another study by Husić-Mehmedović et al. (2017) using eye-tracking technology contributes to packaging design studies to explore which package features in the beer category (cans) influence consumer attention and subsequent evaluation packages. The study shows that color might determine—in the category of products that have a standard form (cans)—when color plays an important role.

The relationship between color preference, gender identity, and personality traits was investigated by Bonnardel and Lamming (2010). Making use of 16 stimuli of the D15 color vision panel test displayed in triads on 4x4 cm cards, they argue that gender color preferences deliver the meaning of distinguishing nature. Bonnardel et al. (2018) investigated the gender difference in color preference among British and Indians young adults. Using 16 stimuli based on the Farnsworth D15 test in triads on 4-cm squared cards, they confirmed a gender difference in both cultures. Zhang et al. (2019) investigated the association between age, gender difference, and color preference in Chinese adults by evaluating how much they prefer each of the 31 colors on a 9-point scale to provide color perception in culture-specific characteristics.

The study by Krosse (2018) aims to explore which complementary warm and cold colors males and females prefer the most in a color wheel. Then he investigates whether males and females will give a higher rating for the colors taken from the first study related to their gender than the colors that belonged to the other gender. The results found that both males and females gave higher ratings to the two female colors (derived from the first study). In other words, the result indicates no difference in color preference between males and females.

A pilot study was conducted to reveal the most important color factor to apply for package design. From a questionnaire of 110 respondents, it was revealed that 41% of them mostly agree that color should inform the flavor/variant of the product, followed by brand identity factor (31%), and product category factor (26%), respectively.

Studies focusing on gender differences regarding color preferences for the application in package design seems to be scarce. Most studies focus on gender differences in color preferences in general. Therefore, this study will only focus on color as the extant study pointed out that the most important and attractive factor in packaging is the color element (Babolhavaeji et al. 2015). The objective of this study is to reveal the gender differences in package design color preferences using eye-tracking technology, as the extant study suggests gender differences were discovered and interpreted in terms of visual attention (Cuesta et al. 2018). Another objective is to recommend what color factor best to apply for package design (should it inform the product category or inform flavor/variant).

2 METHOD

2.1 *Stimuli*

The object of this study is a chocolate-flavored banana chips package design that only focuses on color as a design element. There are four objects with different colors: yellow, brown, white, and purple. The yellow color is associated with the banana product, brown is associated with coco flavor, the white as a neutral color is associated with a private brand, and purple is the contrast color to yellow that is not associated with both product and flavor.

2.2 *Subjects*

This study was aimed at adolescents and young adults, ages 15–30 based on the classification of Yarlagadda et al. (2015). Forty people participated as respondents who were selected randomly. There were 20 male and 20 female participants. Respondents who participated were required to have normal color vision (as tested by the Ishihara Pseudo-isochromatic Plates) and minimum vision -3D (still clear without using glasses so that the data obtained is valid).

2.3 *Procedure*

First, participants were given instructions to assess the color of the packaging that was suitable for the packaging of chocolate-flavored banana chips based on their preference. The instructions were

delivered in Bahasa. Then they were shown four objects on each slide. Those four objects were displayed four times with the order of color displayed randomly to eliminate the tendency of looking at the central point or from left to right. The four slides were displayed to the respondents for 10 seconds. This is based on the information of Rowan (2010) in Apsari (2012) that buyers generally spend 10 seconds observing a product category in a supermarket display. Data collected were the fixation amounts. Before starting the eye-tracking recording, the calibration was performed on each respondent to detect the position of the user's eye view on the monitor. This is to ensure the data collected are valid.

This eye-tracking study was carried out in the Laboratory of Labor Design Analysis and Ergonomics of the Industrial Engineering Study Program at Parahyangan University, Bandung, Indonesia using hardware and software Tobii X2- 30 from Tobii Studio. The data collected were the fixation counts which were the number of times the eye gaze paused in a spot within the AOI (Bergstrom &Schall 2014) to investigate how often the areas were viewed. The data was then processed by displaying the AOI of each displayed image. The collected data were analyzed concerning the average duration of fixation.

2.4 Data analysis

To analyze data, this study used independent sample T-tests and ANOVA to determine if there were any differences in the color preference of a particular grouping variable, i.e., gender.

3 RESULT & DISCUSSION

3.1 Eye-tracking study

Figure 1. Heatmap results of four display slides based on fixation count.

Figure 1 illustrates that the heat map uses different colors to show the participant fixation count and the length of time they spent looking at the areas (Bergstrom &Schall 2014). The red color indicates the highest fixation count or the longest time, while green indicates the least. Zero fixation count means that the participant has not fixated on the AOI by the end of the recording (Tobii Technology AB 2012).

3.2 The analysis of gender differences in fixation count

A T-test was performed to confirm if the eye movements were influenced by color preference. On the average condition, there is no difference in fixation count between males and females on the four colors presented. Details of the difference analysis results are presented in Table 1.

One-way ANOVA followed by the Tukey Post Hoc test was used to test if there was a difference in fixation count based on the colors presented. In short, this test was performed to see which

Table 1. Comparison analysis results of the mean fixation based on gender.

No	Color	t	p	Mean		SEM	
				Male	Female	Male	Female
1	Brown	-0.500	0.621	5.050	5.513	0.455	0.805
2	Yellow	0.238	0.813	4.588	4.425	0.439	0.524
3	White	.031	0.975	3.975	2.153	0.482	0.648
4	Purple	.457	0.650	3.638	3.338	0.410	0.513

Table 2. Analysis results of the comparison of mean fixation by color.

No	Color	p
1	Brown*Yellow	.194
2	Brown*White	.047
3	Brown*Purple	.004
4	Yellow*White	.252
5	Yellow*Purple	.011
6	White*Purple	.313

Table 3. Mean value and standard deviation of the four colors presented.

No	Color	Mean	SD
1	Brown	5.28	2.89
2	Yellow	4.51	2.14
3	White	3.96	2.52
4	Purple	3.49	2.06

color of the four the participants most preferred. The results of the analysis showed there was a significant difference in the fixation count between the four given colors ($F_{(3,117)} = 4.23$, $p < 0.05$). The subjects tended to see brown and yellow more than other colors. A detailed analysis of the difference in fixation count on the colors displayed is presented in Table 2.

From the results of the signification test (Table 3), there was no significant difference between yellow and brown. The highest rating was given to the brown color (5.28), but it makes no difference from yellow. It can be concluded that these two colors can be alternative options in designing chocolate-flavored banana chips packaging.

4 CONCLUSION

This study utilized eye-tracking technology as color preference can be denoted by people's eye movements (Babolhavaeji et al. 2015). The objective of this study was to reveal the gender differences in color package design preference and to recommend what color factor best to apply for package design using eye-tracking technology. The results confirmed a study by Krosse (2018) that found no difference in color preference between male and female participants. From the study, it revealed that brown, as well as yellow, has no significant difference in color preference for chocolate-flavored banana chips package design. Thus, for practical implication, designers or brand owners can use color that informs the flavor/variant of the product (as suggested from the pilot study), as well as color that indicates the product category for alternative color.

Furthermore, the results would allow the brand owner to develop relationships with customers when packaging can be generated according to the expectations of each consumer gender group and thus make the visual elements of packaging more appealing to them. However, this study is limited

to the same age group (adolescents and young adults between 15 and 30 years-old) and country (Bandung-Indonesia). Further studies could also compare the gender contrast between different ages, cultures, and countries.

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