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UTILIZATION OF EYE TRACKING TECHNOLOGY IN DESIGN AND MARKETING DECISION MAKING

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Abstract

Manuscript type: *Original paper.*

Research Aims: *This study aims to reveal whether combination display affects fixation count and duration.*

Design/methodology/approach: *This study used eye tracking methods in data collection and packaging design testing from the results of previous study. Respondents who participate were 40 people from teenagers and young adults. The collected data were analyzed quantitatively by the amount of fixation and processed by the Multivariate Analysis of Variance (MANOVA) test.*

Research Findings: *From the statistical data on Baba Nana Brand, the average duration of the respondents did not show any difference in the study. However, the number of variables showed differences in the whole study. In other words, the respondent's gaze is quite a lot and often looks at the Baba Nana. It was revealed that the Baba Nana as a brand that is not yet on the market turned out to be quite attractive to respondents.*

Theoretical Contribution/Originality: *Utilization of eye tracking technology in design and marketing decision making.*

Practitioner/Policy Implication: *Marketers can utilize eye tracking technology in making design and marketing decisions, mainly when launch a new product to the market.*

Research limitation/Implications: *Further research can study whether the fixation count and duration variable duration affects the consumer's statement of product interest.*

Keywords: Display, Eye tracking, Fixation, MANOVA, Packaging

INTRODUCTION

The market is increasingly competitive. To be successful, products must meet the needs

of target markets better than their competitors (Hawkins, Mothersbaugh, and Best, 2009, as cited in Kumar et al., 2016). Packaging of a product also has a big effect

on impulse purchasing. The most important factor in this impulse purchase is the graphic design factor (Cahyorini & Rusfian, 2011). Ahmad et al. (2012) reveal that the role of color packaging of a product is the most influential factor in the perception of purchasing a product.

The previous research (Swasty et al., 2019) obtained the result that the most desirable combination of image and color in Primary Display Panel (PDP) packaging banana chips of chocolate flavor is brown color with a big monster's illustration. After conducting statistical testing through two different methods (questionnaire and eye tracking), it reveals that the visual data obtained using the eye tracking method is more reliable than the questionnaire results. This research is reinforced with prior study (Apsari, 2012) which reveals that the results gained with the eye tracking method are more accurate. This is because the method uses a sense of vision that is sometimes not realized by the respondent itself.

There are a wide variety of survey methods to learn color preference, but most studies use a subjective approach by adopting a questionnaire method. To get objective color preference data, a prior study uses experimental methods of eye tracking to explore the possibility of a relationship between color preference and scan path characteristics (Lee et al., 2005).

Study on eye tracking can contribute to the development of new products; from designing the best packaging in terms of functionality and usability to new product development and design attractiveness. This study is limited to Primary Display Panel (PDP) packaging of the home industry banana chips. As for the study is focused on the color elements and images of PDP packaging only, excluding detail

information (text) on the PDP. The research problems are (1) whether the combinations of display affect variable number of fixation (count) and duration of fixation, and (2) whether the packaging obtained from the previous study results (Baba Nana) can compete with the packaging of the existing brand. The main purpose of this study is to reveal whether the display combinations affect the variable of count and fixation duration.

Previous research by Zamani et al. (2016) revealed that buying decision and time spent in selecting packaging showed consumers prefer the generally recognized packaging that sold in the local market. In addition, Bialkova et al. (2020) argue that the stronger brand received more attention and choice than the weaker brand.

The eye tracking research to date have only focused on the evaluation of consumers' visual attention to packaging that already been existed in the market. However, only few studies, to the best to Authors' knowledge, have evaluated a new design to be compared to the design from the existing brand. This study aims to evaluate if the new packaging design obtained from the previous study results (Swasty et al., 2019) can compete with the packaging of the existing brands in the retail. This study provides contribution for new product development and product display in retailing.

LITERATURE REVIEW

Eye Tracking in Packaging Study

Eye tracking is a method that helps researchers understand visual attention (Kim & Kim, 2020; Schwebler et al., 2020), by detecting which point it sees, how long it is staring and the path that the eye sees (Bergstrom & Schall, 2014). Essentially, this method can provide data about the location

of fixation, duration, and eye movement (Button, 2019). Eye tracking can significantly contribute to this goal as it helps marketers to understand what attract the customers in the retail environment (Huddleston et al., 2015).

In addition, research on eye tracking can contribute to the development of new products; from designing the best packaging in terms of functionality and usability to new product development and design attractiveness (dos Santos et al., 2015). Eye tracking can help define industrial designs for products, packaging, and nutritional labels. The research related to the *eye tracking* method conducted by Zamani et al. (2016) reveals that products of larger sizes tend to be more likely to be preferred.

Some aspects of product packaging have important roles in establishing the perception and purchase behaviour of the product information aspect, how to use the product, packaging design, and material quality (Hussain et al., 2015). The study ~~done~~ conducted by Catlin et al. (2012) reveals that the packaging of a product can affect consumer attention.

Fixation Count and Duration

The eye tracking software produces gaze. There are two forms of gaze, i.e. fixation and saccade. Fixation is a condition in which the focus of attention is maintained on a single area for at least a tenth of a second. Saccade is the rapid eye movements between two fixations (Husić-Mehmedović et al., 2017). In other words, fixation is the pause of eye movement focusing on a specific area (Bergstrom & Schall, 2014). The eye tracking software enables the measurements of fixation count (number of fixation) and fixation duration. When conducting eye tracking research, longer fixations in the target (Area of Interest) are believed to

indicate greater interest and involvement with something (Cho & Suh, 2020). The fixation count indicated how frequently a participant viewed or refocused attention on that area/ object. The fixation duration is the amount of time spent on a particular area of interest (Huddleston et al., 2015).

Husić-Mehmedović et al. (2017) found that position interfered with packaging characteristics, and while the two collages with varying package positions mitigated this issue, they did not eliminate position's influence. The central position focus appears to be a common occurrence in studies conducted in virtual environments in which participants begin viewing in the center. Therefore, in eye tracking study, the researchers usually provide more than one display in which the position of stimuli is randomised to show to participants to test whether the randomised displays influence the fixation count and duration.

H1: Display combinations (as independent variables) have a significant effect on the fixation count and duration (dependent variables)

Prior study (Lee et al., 2005) demonstrates that fixation counts and duration are significantly different between the most and least preferred objects. In contrast, Kim and Kim (2020) examined the differences in visual exploration and fixation in response to different types of object. The average fixation values between Object 1 and Object 2 were not significantly different. They compared the relative mean values of fixation and count. Additionally, because fixation patterns diverse according to object type and participant, each factor had to be considered separately. Another recent study argues that the stronger brand received more attention and choice, so that it outperformed the weaker brand. The brand effect was

significant in both the laboratory and in-store environments and was related to the number of fixations, the duration of fixations, and the choice made. In comparison to the non-chosen brand, the chosen brand received significantly more fixation counts and longer durations (Bialkova et al., 2020).

H2: Respondents’ average fixation duration shows the difference in various displays

H3: Respondents’ average fixation count shows the difference in various displays

RESEARCH METHOD

There are three phases of this study as shown in Figure 1.

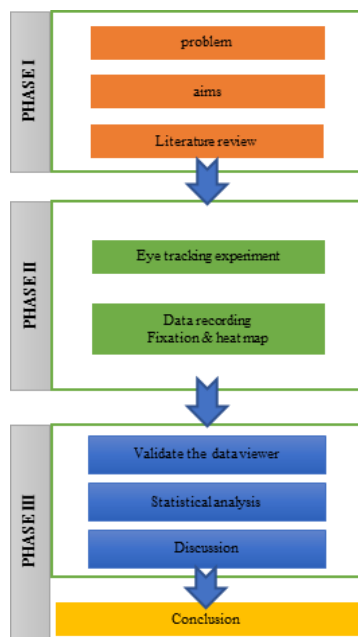


Figure 1. Research Framework

This research used the eye tracking method in data collection and test the effectiveness of packaging design from previous study results (Swasty et al., 2019). The research used Tobii X2-30 hardware and software from Tobii Studio. Participants were selected near the institution where the study was being held. Respondents were shown slides that contain images of the package PDP banana chips in the modern market

(Zanana, Bangnana Chips, V-Sang, Green Day, Aneka, Lumba-lumba, and Suseno), including the new PDP packaging obtained from the previous study (Baba Nana). This study used five levels (five treatments in one group) within-group experimental design, in which treatments are in the form of display scenarios. There were five displays where the new packaging (Baba Nana) placed randomly (middle, top left, top right, bottom left, and bottom right). The data about fixation and the duration in each scenario are compared using MANOVA. The use of this technic is purposed mainly to investigate the effect of independent variables (treatments) on multivariate combination of dependent variables (Hair et al., 2018; Malhotra, 2019).

Each display was shown to the respondent for 10 seconds. The duration was based on Rowan (2010, as cited in Apsari, 2012) that buyers generally spend 10 seconds to observe one product category. The data consist of fixation count (number of fixation) and fixation duration (Bojko et al., 2005; Huddleston et al., 2015) as well as heat map visualization.

The study were conducted in the Laboratory for Analysis of Work Planning and Ergonomics in Industrial Engineering Study Program, Parahyangan University Bandung. For that, respondents who participated should meet the criteria of the respondents’ profile with a minimum amount of 39 people (Tobii Technology AB, 2012). Another requirement is the participants must have a normal colour vision in order to obtain valid data.

Similar to previous study (Swasty et al, 2019), this follow up study took adolescent and young adults’ participants (15-30 years old based on classification by Yarlagadda et al. (2015) with a consideration that these age groups were potential buyers, love chips, and

adapt to something new. In Addition, by using the same age group of participants (within-group design), the results can be compared without worrying about the group differences.

The collected data was then analyzed quantitatively with regards to the amount of fixation and heat map. The data was then processed with a multivariate Analysis of variance (MANOVA) test which can show differences as a result of different treatments and interactions separately, which was not revealed by ANOVA (Sutrisno & Wulandari, 2018). For critical area, we set $\alpha = 0,05$. It means that H_0 will be declined when the value of statistical significance ≤ 0.05 .

The MANOVA was intended to reveal whether there was a significant difference in the new banana chips packaging object (Baba Nana) that attracted the attention of respondents when the object was adjacent to various existing brands of banana chips that have been in the modern retail. The MANOVA test flow is illustrated in Figure 2 as follows.

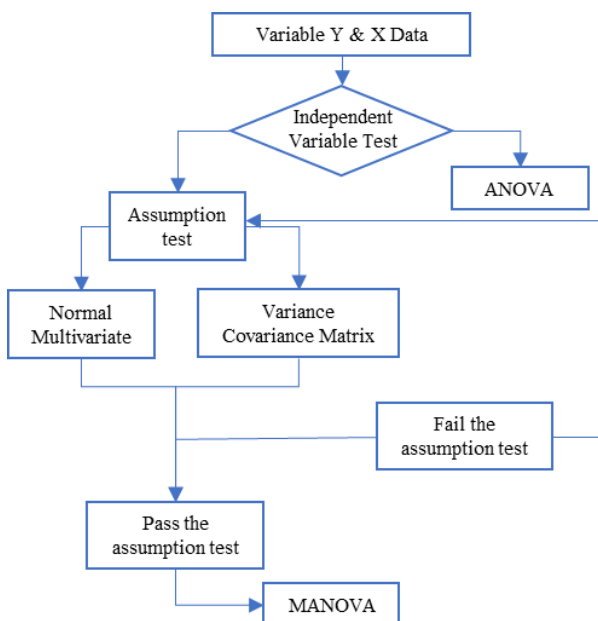


Figure 2. MANOVA Test Flow

RESULT AND DISCUSSION

The heat map data was obtained by eye tracking software, as shown in Appendix A. Baba Nana packaging design resulted from previous study is placed adjacent to other banana chip brands that already exist in the market. The study was executed by showing five randomly displays. This study is to uncover the answer to the research formula i.e. "does the combination of display affect the count and duration of fixation?" From the heat map (Figure 3), it appears that all display combinations are not significant in the fixation count and duration.

Then the data of statistics obtained from *data viewer* is processed using IBM SPSS 23 software with Multivariate Analysis of Variance (MANOVA) test to answer the issue "does the combination of display affect the count and duration of fixation." First of all, The MANOVA should pass assumption test, ie Box's M test and Levene's test to test the similarity of Variant-Covariant from the sample data (Figure 3).

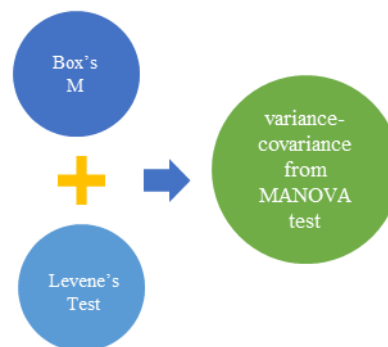


Figure 3. Phase I Analysis

From the MANOVA test to 9 objects of packaging, only Baba Nana object met the assumption test and the significance test, and the independent variable (display) affected only one dependent variable i.e. the count variable. The objects of ANEKA, Bangnana Tosca, Greenday, V-Sang, and Zanana did

not meet the assumption test. Therefore, they could not proceed to the next stage which was significance test. While Bangnana yellow, Lumba-lumba and Suseno met the assumption test but did not meet the significance test, in other words, the independent variable (display) had no significant effect on the dependent variables (Duration and Count). Thus, the discussion further focuses on the Baba Nana object alone.

Here are the steps and the MANOVA test results on the Baba Nana object. First, the Box's M Test had been done. From the result test (Table 1), the dependent variable had the same variant-covariant for independent variables.

Table 1. Box's M Test on Baba Nana object

Box's M	19.824
F	1.615
Df1	12
Df2	281832.353
Sig.	.080

Table 3. Multivariate significance test on Baba Nana Object

Description	value	F	Hypothesis df	Error df	Sig.	Partial eta squared
Pillai's trace	.118	3.069	8.000	390.000	.002	.059
Wilks' lambda	.882	3.129 ^a	8.000	388.000	.002	.061
Hotelling's trace	.132	3.189	8.000	386.000	.002	.062
Roy's largest root	.124	6.043 ^b	4.000	195.000	.000	.110

Based on MANOVA test with four methods, i.e. Pilla's Trace, Wilks' Lambda, Hotelling's Trace, dan Roy's Largest Root prove that the displays variable affect the variable count and duration. To know in detail which dependent variables is more influenced by independent variables, between subject effect tests were conducted.

From Table 4, it appears that the duration variable has an average value of 0.5857 and the count variable has an average value of

Afterwards, the Levene's test on Baba Nana object has been conducted. The result (Table 2) has significance values 0.533 and 0.366 which are greater than 0.05. The result shows the two dependent variables have the same individual variance-covariance matrix, and the participants are from the same population.

Table 2. Levene's Test on Baba Nana object

Description	F	Df ₁	Df ₂	Sig.
Duration	0.790	4	195	.533
Count	1.083	4	195	.366

Multivariate Significance Test

Since the assumption test is successfully fulfilled, the authors test the multivariate significance (Table 3). The result shows that the independent variables (displays) have a significant effect on the dependent variables (fixation count and duration).

2.75. Furthermore, the overall Between Subjects Effects tests are done with dependent variables of duration and count (Table 5). The results show that the average duration of a respondent does not show any difference in various displays (H2 is declined due to the significance value $0.068 > 0.05$). Additionally, the average count of a respondent shows the difference in various displays (H3 is accepted due to the significance value $0.000 \leq 0.05$).

Table 4. Descriptive Statistics on Baba Nana Object

Description	Display	Mean	Std Dev	N
Duration	D 1	0.7982	0.52785	40
	D 2	0.5628	0.55470	
	D 3	0.5203	0.49447	
	D 4	0.5800	0.53923	
	D 5	0.4765	0.43357	
	total	0.5857	0.51802	
Count	D 1	4.1000	2.13397	40
	D 2	2.7000	2.06559	
	D 3	2.1500	1.61006	
	D 4	2.4750	2.29813	
	D 5	2.3250	2.36846	
	total	2.7500	2.20495	

The duration is the same in all scenarios (five displays) or get no treatment effect to see any significant differences resulted from different scenarios. Furthermore, the determination of independent variable on the 'count' is also small as the independent variable is not a significant determinant. What determines whether it is significant or not are different scenarios.

From the test, it can be concluded that of the five displays, the Baba Nana object shows a difference in the various displays, and the variable with the average of the most indicated the difference is the count variable. In other words, many respondents often look

at the Baba Nana object although it is an unfamiliar brand. The possible explanation is because its primary display panel has attractive visual cues (colour and illustration) that attract the attention and differentiate from the existing brands. In this case, Baba Nana has a big monster illustration on its primary display panel. This is aligned with Zamani et al. (2016) who reveals that products of larger sizes tend to be more likely to be preferred. As an unfamiliar brand, Baba Nana can stand out from other existing brands. This finding is in contrast with recent study that argues the stronger brand outperformed the weaker brand (Bialkova et al., 2020).

Table 5. Between Subjects Effects Test on Baba Nana Object

Description	Dependent Variable	Sum of square	dF	Mean Square	F	Sig.	Partial eta squared
Corrected model	Duration	2.328 ^a	4	.582	2.222	.068	.044
	Count	97.650 ^b	4	24.412	5.473	.000	.101
Intercept	Duration	68.621	1	68.621	261.996	.000	.573
	Count	1512.500	1	1512.500	339.067	.000	.635
Display	Duration	2.328	4	.582	2.222	.068	.044
	Count	97.650	4	24.413	5.473	.000	.101
Error	Duration	51.073	195	.262			
	Count	869.850	195	4.461			
Total	Duration	122.022	200				
	Count	2480.000	200				
Corrected total	Duration	53.401	199				
	Count	967.500	199				

a. R Squared=.044 (adjusted R Squared= .024)

b. R Squared=.101 (adjusted R Squared= .082)

CONCLUSION

The study is aimed to know whether the combination of display affects the count and duration fixation. From the heat map, it appears that all combination of displays were not very significant in influencing count and duration. Therefore, the statistic data was carried out.

From the statistical data on Baba Nana object, the average duration of respondents does not show any difference in the five displays shown. However, the fixation count variable shows the difference in the five displays. In other words, many respondents often look at the Baba Nana object. It was revealed that the Baba Nana object as a brand that has not been exist yet in the market was able to attract respondents. It can be said if the packaging of new banana chips (Baba Nana) with a combination of brown color and a monster illustration attracted the attention of respondents when the packaging is adjacent

to various brands of banana chips that have been in the retail. In other words, the packaging design has a competitive advantage.

For practical implication, this study provides contribution for new product development and product display in retailing. Thus, marketers can utilize eye tracking technology in design and marketing decision making, especially when launching a new product to the market by testing packaging designs first. This in line with Wells et al. (2007) who suggest that packaging needs to create differentiation from competitors' products. From their research results, more than 73% of consumers stated that packaging has a major influence on the decision-making process for the product purchase.

It is reinforced by Singh (2018) which concludes that the buying intent and consumer perception have a direct impact on consumer buying behaviour. Beautiful

background, color, shape, appropriate labeling, can inspire consumers to the product. It is also recommended that marketers should pay close attention to packaging. If they use, launching or introducing a bad packaging will face the cause of product failures. Moreover, this study provides contribution to the scientific world. This study proposes new methodology to study the product attractiveness.

This study reveals that the combination of display can affect the variable of count fixation and duration fixation. However, this study has not explored about the consumer's statement of product interest. For further research, it can be researched whether the count fixation variable and duration fixation affect the consumer's statement of product interest.

The paper arrives only conclusion as to whether the independent variables influence each independent variable. The further study should use univariate test embedded in

MANOVA. In addition, beta coefficients of Independent Variable for the two Dependent Variables produced by MANOVA should be compared.

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APPENDIX

Appendix I. Heat Map Result from Five Displays





