Design of Effective Positioning and Form of Front-of-Pack Nutrition Labelling on Food Products Based on Eye-Tracking Method

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Abstract. Nowadays, Indonesian consumers are very lacking in attention to nutrition labels. This research focused on front-of-pack nutrition labelling. Based on a research conducted in US, Europe, Australia, and New Zealand, front-of-pack nutrition labels ease consumers to choose healthier food products. The objective of this research for the food manufacturers is as a recommendation of effective front-of-pack nutrition labelling, and for the consumers as a consideration to choose proper and healthier products. This research was begun with consumer preference questionnaire and was continued with eye-tracking. The results of questionnaire and eye-tracking were compared and were validated using eye-tracking. This research shows that the most effective front-of-pack nutrition label should be placed at upper left and using PDI (Percent Daily Intake) format.

1. Introduction

Based on Government Regulation no 69 on 1999 chapter 32 and 33, all of food products in the market have to add nutrition labels on its package. The purpose of this Government Regulation is as guidance for food manufacturers and consumers to know even understand nutrition labels. Qualitative research conducted in 2003 by the International Food Information Council (IFIC) Foundation indicated that consumers refer to food labels when deciding which foods to purchase or eat. More than 8 of 10 consumers (83%) looked at ingredients or nutrition information at least sometimes; 11% always looked; 32% almost always; and 40% sometimes looked [1]. Based on surveys held by The Food and Drug (FDA) on 2005, 60-80% had read food labels before buying a new food item, and 30-40% said that the label had influenced their choice in buying food products [2]. On the other hand, based on review of National Consumers in Indonesia, customer’s attention to nutrition labels still low, only 6,7% consumers pay attention to the full content of nutrition labels [3].

Nutrition labels are important as a consideration matter in food purchasing because these labels were used as food intake guidance, specifically for overweight and obesity patients, pre-op and post-op patients, and for autism children. Nutrition labels were designed to help customers to make healthier decision a research conducted in Europe, US and Australia/New Zealand suggests that the majority of consumers find back-of-pack nutrition labels confusing [4-6]. Result from a study by Vijwanthan and Hastak in 2002 suggested that adding some kind of benchmark, as a percentage of the recommended daily intake, can help consumers put nutritional information into context [7]. Simple
front-of-pack labels, which summarize nutrition profile and whole interpretation, hopefully could facilitate and increase the healthier food purchasing decision because the purpose of visible positioning could reduce the information asymmetry between consumers and food manufacturers. In Europe, front-of-pack nutrition labelling was used as an important policy tools to help consumers make a healthier decision in food purchasing [8].

Front-of-pack nutrition labels don’t provide detailed nutrition composition as in back-of-pack nutrition tables. These labels are more simple and provide information more comprehensively to the consumers. More simple symbols provide whole health value of a product comprehensively and decrease processing time [9]. There are some types of this front-of-pack nutrition label, such as Guideline Daily Amount (GDA), Multiple Traffic Light (MTL) and signpost logo (e.g. Health Tick and Choices Logo). Till now there are some debates about how this information should be presented [10-12]. The aim of this study was to achieve a recommendation of front-of-pack nutrition labelling for Indonesian consumers.

2. **Research Methodology**

This research used conjoint analysis and eye-tracking method. This methodology is not limited to the use of liquid milk packaging, but it can also be used for other product design research.

2.1. **Package Design and Product Combination Used**

Design of package which was used in this research was dummies. This dummy design was used because in the future the result of this research was expected to be used as a recommendation of front-of-pack nutrition labels positioning on every food product.

These dummy products were combined into four position attribute variations and two form attribute variations. Position attribute variations are upper left, upper right, lower left, and lower right. Form attribute variations are Multiple Traffic Light (MTL) form and Percent Daily Intake (PDI) form.

2.2. **Respondents**

Total respondents in this research were 210 respondents; consist of 110 questionnaire respondents and 100 eye-tracker respondents. The 100 eye-tracker respondents were divided into two groups, which are 80 respondents in the first phase and 20 respondents in the second phase (validation phase). Respondents were students of Engineering Faculty University of Indonesia.

2.3. **Materials**

This research was conducted using Eye Link II Head Fixed Eye Tracker tool, consist of Eye Link II Host PC, Eye Link II Display PC, Eye Link II PCI Card, dan Eye Link II Headband. This tool was combined by Experiment Builder as a command execution media. Eye Link II Display PC which was used in this research was Hans G monitor 29.5 × 46.4 cm and a CPU. Human’s sight range is limited to 30° [13], so the minimum range between the monitor and the eyes is 88.6 cm.

2.4. **Procedure**

This research was begun by consumer’s preferences questionnaires deployment. The questionnaire consists of 8 package combinations and the respondents were asked to sort those combinations based on their preference to the design. First order was the most preferred design and the last order was the least preferred design.

Eye-tracking data collection was conducted by giving stimulus to the respondents in form of a combination consists of one MTL picture and one PDI picture. One picture was presented in 10 seconds. This research was limited into the respondents’ attention and not into the purchase decision.

2.5. **Design Analysis**

Questionnaire data were processed using conjoint analysis. On the other hand, eye-tracker’s fixation duration data were processed in two analysis, which are fixation map and statistical analysis.
Statistical analysis was used to know the significance level of two factors and their interaction. The statistical analysis that was used in this research is Two-Way ANOVA. Validation data were processed using fixation map (for duration fixation data) and also considering first fixation variable.

3. Result and Analysis
The results were consisted of first phase result with preference questionnaire data and validation result from eye-tracker data.

3.1. First Phase Result
Consumers’ preference questionnaire data were processed using conjoint analysis and the result of the questionnaire was design with upper left position with MTL form was the most preferred. This result was drawn from the most positive value from each level’s attribute as can be seen in table 1. The most positive value in position attribute was in upper left level (0.4304), and the most positive value in form attribute was in MTL level (0.0117).

| Attribute | Level     | Part Worth | Importance Level |
|-----------|-----------|------------|------------------|
| Position  | Top Left  | 0.430368607| 97.81%           |
|           | Top Bottom| 0.396457057|                  |
|           | Bottom Left| -0.619226737|                |
|           | Bottom Right| -0.207598928|                 |
| Type      | MTL       | 0.011737416| 2.18%            |
|           | PDI       | -0.011737416|                  |

For eye-tracking method, the upper left PDI was the most preferred for the respondents. It was drawn from the longest fixation duration. In the duration-based fixation time, green color shows low interest and red color shows high interest. Respondents were noticed the label’s presence, but the upper left and the lower right were the most interested position, as can be seen in figure 1.

![Figure 1. Fixation map of stimulus](image-url)
Significance of the two factors and their interaction could be analyzed using linear statistic model in Two-Way ANOVA [14]:

\[ X_{ijk} = \mu + \tau_i + \beta_j + (\tau\beta)_{ij} + \epsilon_{ijk} \quad \begin{array}{c}
  i = 1,2,3,4 \\
  j = 1,2 \\
  k = 1,2,...,n
\end{array} \] (1)

where:
- \( \tau_i \) = position factor’s effect
- \( \beta_j \) = form factor’s effect
- \( (\tau\beta)_{ij} \) = two factors’ interaction effect
- \( k \) = number of respondents (one respondent represents one replication)

Hypothetical test that were used in this research:

- \( H_0 : \tau_1 = \tau_2 = \tau_3 = \tau_4 \)
  \( H_1 : \) there is at least one non-zero \( \tau_i \)
- \( H_0 : \beta_1 = \beta_2 \)
  \( H_1 : \) there is at least one non-zero \( \beta_j \)
- \( H_0 : (\tau\beta)_{ij} = 0 \)
  \( H_1 : \) there is at least one non-zero \( (\tau\beta)_{ij} \)

P-value of position factor was 0.058, p-value of form position factor was 0.605, and p-value of between factors was 0.788. 90% confidence level was used and there was enough evidence to reject \( H_0 \) (1) that form factor had significant effect to the duration fixation; there was enough evidence to receive \( H_0 \) (2 and 3) that position factor and two factors’ interaction were not significantly affect the duration fixation.

3.2. Second Phase (Validation)

Consumers preference questionnaire showed different result compared to eye-tracking. The questionnaire showed the most preferred was upper left MTL, on the other hand eye-tracking showed upper left PDI for the most preferred design. These designs were validated using eye-tracker. The stimulus that was presented was Ultra Milk Hi-Calcium Low Fat 1 liter. The presentation of the stimulus was the same with the first phase data collection, respondents were given a combination consists of one MTL picture and one PDI picture with 10 seconds each.

Validation phase result was analyzed using two variables, which were fixation duration and first fixation. The fixation maps in validation phase showed that respondents were more interested in PDI design that the MTL, as shown with the red marks in figure 2.
Fixation duration shows how long fixation stays in an interest area. As can be seen in figure 3, PDI was watched longer than MTL.

First fixation run index shows how many runs of fixation have occurred when a first fixation is made to an interest area. As can be seen in figure 4, respondents were focused in PDI as 27 runs than MTL that only has 24 runs.
First run fixation count shows number of all fixations in trial falling in the first run of the current interest area. As can be seen in figure 5, the number of fixations that went through PDI was 52 than MTL had 43 fixations.

**Figure 5.** First run fixation count graph of validation phase

**4. Conclusion**
Position factor affected respondents’ fixation duration significantly in the 90% confidence level. Form factor and the interaction between those two factors were not significantly affecting the fixation duration. The most interesting packaging design was the package with upper left label position and
PDI label form. Thus, it was recommended to put front-of-pack nutrition label on upper left and using PDI label form.

For the future research, we recommend to study more thoroughly to the purchase decision. We also recommend using real object and scene camera eye-tracker so the respondents could feel the more realistic condition and hopefully the result would represent the actual condition. Future research would be recommended to study more about color attribute and design aspect so there would be a better analysis.

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References
[1] Borra S 2006 The American Journal of Clinical Nutrition 83 (5) p 1235S
[2] Philipson T 2005 The American Journal of Clinical Nutrition 82 (1) pp 262S-264S
[3] Badan Perlindungan Konsumen Nasional 2007 Hasil Kajian BKPN di Bidangan Pangan Terkait Perlindungan Konsumen
[4] Byrd-Bredbenner C, Wong A and Cotte P 2000 British Food Journal 102 (1) pp 615-629
[5] Cowburn G and Stockley L 2005 Public Health Nutrition 8 (1) pp 21-28
[6] EUFIC 2005 Nutrition information & food labelling—Results of the EUFIC Consumer Research conducted in May-June 2004
[7] Vijwanathan M and Hastak M 2002 Journal of Public Policy & Marketing 21 (2) pp 305-318
[8] European Commission 2008 Proposal for a regulation of the European Parliament and of the Council on the provision of food information to consumers
[9] Scott V and Worsley A 1997 Australian Journal of Nutrition and Dietetics 54 (1) p 41426
[10] Drichoutis A C, Lazaridis P and Nayga R M 2006 Academy of Marketing Science Review 9 (9) pp 1-22
[11] Feunekes G I, Goertemaker I A, Willems A A, Lion R and Van Den Kommer M 2008 Appetite 50 (1) pp 57-70
[12] Grunert K G and Wills J M 2007 Journal of Public Health 15 (5) pp 385-399
[13] Lehto, Mark R and Buck J R 2008 Introduction to human factors and ergonomics for engineers (New York: Taylor & Francis Group)
[14] Montgomery D C 2017 Design an analysis of experiments (6th ed.) (Arizona: John Wiley & Sons Inc)