Utilization of facial expression analysis in the pricing strategy formulation

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Abstract. Value-based pricing is one of the pricing strategies to determine the appropriate price plan based on the product’s value. This article examines how the facial expression of the customer can be used to measure intention to buy for the price plan developed by value-based pricing. The results of this study indicate that participants’ positive emotions were significantly higher than negative emotions for all the products displayed formulated using value-based pricing, consistent with the self-reported questionnaire result. In conclusion, facial expression measured by FaceReader can be used to validate the price plan formulated using value-based pricing.

1. Introduction

Price is one of the marketing tools that have a significant impact on the profitability of business organizations [1]. Price has been an important factor that has historically influenced consumer preferences. Therefore, a business organization must carefully choose the right pricing strategy for its products. One of these pricing strategies is value-based pricing. Value-based pricing is a pricing strategy based on the value inherent in the product in the eyes of consumers [2]. Value-based pricing is done after analyzing consumer needs and perceived value. For customers, the perceived value is the ratio between the benefits obtained when consuming a product or service (perceived quality) and the costs incurred when using a product or service (perceived cost) [3]. High perceived value means that the customer is more willing to buy the product. The consumer prefers value-based pricing because it can help them satisfy their needs and wants [4].

Although value-based pricing theoretically can be used to determine the price plan for the products based on its value, there is still a need to test the validity of the price plan to the potential customer. The validity test is used to determine the customer’s intention to buy the product with the price plan prepared using value-based pricing. Then, based on the test result, the price plan can be further refined. One of the disciplines that can help the price validity test process is neuromarketing.

Neuromarketing is a discipline of economics that uses clinical information about nerve function and mechanisms to help explain consumer behavior [5]. Neuromarketing can help understand how unconscious mind processing influences the decision to purchase, providing a better understanding of the consumers’ thoughts, emotions, feelings, needs, and motivation [6]. Emotional signals especially have a contribution in the pre-decision phase [7]. Reference [7] proposed two approaches in neuromarketing, namely psychological and neurological. The psychological approach, also called biometrical, measures body reactions on specific marketing stimulus. While the neurological approach, or neuromeric, measures brain reactions on specific marketing stimulus. Each approach uses different types of signals so that each has weaknesses and strengths. Biometric measurement in neuromarketing includes measuring facial expressions, eye tracking, electrodermal activities, heartbeat and perspiration, and response time.

The biometric measurement used in this research to test the validity of price plan is facial expression. Facial expression is a series of muscle contractions that are semi-universal and associated with emotions [8]. Facial expressions are crucial for understanding humans. Emotions, pain, and intentions are among...
human feelings that can be deduced from the cues displayed on facial expressions [9]. In marketing, facial expression can help the marketer develop a marketing strategy. For example, [10] uses facial expressions of the visitors of an online or offline store to differentiate between window shoppers, potential customers, and buyers. The result is then used to determine customer handling strategies. Facial expression in this research will be used to measure customer’s intention to buy based on the price plan to develop using value-based pricing.

2. Research Methodology
Price plan validity test is done using the neuromarketing experimental method that is equipped with a self-reporting questionnaire. This test was conducted to determine the intention of respondents to buy products with a price plan that has been developed using a value-based pricing strategy. Reference [11] said that there is a strong correlation between emotions felt by customers and customer purchase intentions. Customers who display positive emotions are considered to have purchase intentions on the products offered [12].

The biometric measurement instrument used in the experiment is FaceReader developed by Noldus Information Technology. FaceReader is an online platform for face expression analysis through the web. FaceReader was chosen because FaceReader is a reliable indicator of financial expressions of basic emotions and does not need human correction [13].

To illustrate the testing framework clearly, this research uses Swifter (SF) product, a woman’s clothing brand, as the research object. The respondents are customers who have ever purchased an SF product and meets SF’s target market criteria. The criteria are women aged between 16-30 years. The sampling technique used in this study is a non-probability sampling technique, i.e., purposive sampling. The sample size required for simple experimental studies with strict experimental controls is between 10 and 20 [14]. Researchers contacted people who met the sample criteria and asked for their willingness to be the object of the experiment. If they agreed, then a link that will connect the participant with the FaceReader website is shared with prospective participants. Participants must meet several conditions when opening a link, as follows [15]:

a. Open the link using a handphone, a laptop, or a computer that has a camera or webcam.
b. In a room or location having enough lighting.
c. The position of the camera is right in front of the participant’s face.
d. Participants should focus on watching the video displayed and not doing other activities.

When the link was opened for the first time, the face of participants was scanned. After that, videos showing SF products were displayed. While the participants were watching the video, the camera will record the facial expressions of the participants.

Then, emotion analysis is carried out by detecting the micro expression of participants’ faces when they watch videos showing products at the proposed price. FaceReader classifies facial expressions into six basic emotions: happiness, sadness, anger, surprise, fear, and disgust.

Emotion is a good predictor of the intention to buy. Reference [16] states that customers tend to buy when their positive emotion is higher than negative emotion toward a product. Therefore, the t-test between positive and negative emotion is used as a predictor of intention to buy. According to [16], positive emotion that influences buying behavior is happiness, while sadness, anger, surprise, fear, and disgust show negative emotions.

The procedure of the experiment is as follows:
1. Participants are checked whether they meet the research criteria.
2. The researcher explained the research protocol to the participants.
3. Video exposure consists of:
   a. A product picture with the proposed price.
   b. A fixation cross image at every product transition, to let the brain enter a resting phase so the reactions to the following product image will not overlap and are easier to analyze [17].
4. Participants were asked to answer a self-reported questionnaire to measure intention to buy. The self-reported questionnaire contains several questions about the intention to buy and the opinion
about the appropriate prices. Intention to buy is measured using a Likert scale (1-5). Every time participants watch a product image along with its price tag, they were asked to answer two questions: a) I will buy the product or b) The product price is worthy.

If the price offered is not perceived as worthy, the respondent is asked to provide an appropriate price recommendation for the product. The combination of the self-reported questionnaire and the expression analysis is done to get a better understanding of consumer perception towards the product and its price. The questionnaire was used as a complement and comparison for the analysis of the facial expression.

### 3. Result

Tests were carried out on 16 respondents for all SF products in the 2019 SF’s product catalog. FaceReader analyzes respondents' expressions from videos that are exposed every 0.1 seconds. The emotions analyzed in this study are emotions of happiness, sadness, anger, and disgust. The four emotions were chosen because they are included in the category of positive emotions and negative emotions that can be used as predictors of purchase intentions [16]. Mean and standard deviation of data collected from FaceReader can be seen in Table 1.

| Product Name | Type of Emotion | Happiness | Sadness | Anger | Disgust |
|--------------|-----------------|-----------|---------|-------|---------|
|              | μ    | σ | μ    | σ | μ    | σ | μ    | σ |
| Kaleena      | 0.30 | 0.17 | 0.11 | 0.03 | 0.03 | 0.02 | 0.03 |
| Naima        | 0.32 | 0.12 | 0.06 | 0.04 | 0.04 | 0.05 | 0.05 |
| Calyta       | 0.31 | 0.17 | 0.06 | 0.06 | 0.06 | 0.05 | 0.05 |
| Malone       | 0.29 | 0.25 | 0.04 | 0.06 | 0.06 | 0.05 | 0.05 |
| Frila        | 0.27 | 0.23 | 0.04 | 0.06 | 0.06 | 0.05 | 0.05 |
| Lyah         | 0.18 | 0.12 | 0.06 | 0.06 | 0.06 | 0.05 | 0.05 |
| Adys         | 0.27 | 0.23 | 0.06 | 0.06 | 0.06 | 0.05 | 0.05 |

| Product Line Name | T-test          | T-test          | T-test          | T-test          | T-test          |
|-------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                   | Happiness vs Sadness | Happiness vs Disgust | Happiness vs Anger | Positive Emotion vs Negative Emotions | Difference Between Means |
| Kaleena           | 6.827           | 9.225           | 9.092           | 8.443           | Significant  |
| Naima             | 13.109          | 12.139          | 11.888          | 12.223          | Significant  |
| Calyta            | 7.192           | 8.865           | 9.736           | 8.921           | Significant  |
| Malone            | 5.633           | 5.067           | 5.813           | 5.494           | Significant  |
| Frila             | 6.021           | 5.897           | 6.093           | 6.859           | Significant  |
| Lyah              | 6.192           | 6.427           | 6.534           | 3.988           | Significant  |
| Adys              | 5.286           | 5.140           | 5.244           | 3.719           | Significant  |
A normality test was carried out to find out whether the data can be well-modelled with normal distributions. The result showed that each data set is having p-value of more than 0.05. Therefore, it can be concluded that the data were normally distributed.

Then, dependent samples t-tests were carried out to determine if there is a significant difference between the means of positive and negative emotions with $\alpha=5\%$ and degree of freedom 14 ($t_{\alpha}=1.761$). The result can be seen in Table 2.

Table 2 shows that all the positive emotions is statistically different from negative emotions for each product. Recapitulation of respondents' answers to the self-reported questionnaire is in Table 3:

| Product Line Name | Item of Question | Frequency $(n=16)$ | %   | Price Recommendation (IDR) |
|-------------------|------------------|-------------------|-----|-----------------------------|
| Kaleena (IDR 244,000) | Intention to buy | Willing           | 15  | 94%                         | NA                           |
|                    |                  | Unwilling         | 1   | 6%                          | 220,000-235,000              |
|                    |                  | Unworthy          | 2   | 12%                         | NA                           |
|                    | Price worthiness | Worthy            | 14  | 88%                         | NA                           |
|                    |                  | Willing           | 14  | 88%                         | NA                           |
| Naima (IDR 194,000) | Intention to buy | Unwilling         | 2   | 12%                         | 170,000                      |
|                    |                  | Unworthy          | 1   | 6%                          | NA                           |
|                    | Price worthiness | Worthy            | 15  | 94%                         | NA                           |
|                    |                  | Willing           | 12  | 75%                         | NA                           |
| Calyta (IDR 164,000) | Intention to buy | Unwilling         | 4   | 25%                         | 150,000                      |
|                    |                  | Unworthy          | 3   | 19%                         | NA                           |
|                    | Price worthiness | Worthy            | 13  | 81%                         | NA                           |
|                    |                  | Willing           | 13  | 81%                         | NA                           |
| Malone (IDR 204,000) | Intention to buy | Unwilling         | 3   | 19%                         | 200,000                      |
|                    |                  | Unworthy          | 2   | 12%                         | NA                           |
|                    | Price worthiness | Worthy            | 14  | 88%                         | NA                           |
|                    |                  | Willing           | 15  | 94%                         | NA                           |
| Frila (IDR 244,000)  | Intention to buy | Unwilling         | 1   | 6%                          | 195,000                      |
|                    |                  | Unworthy          | 1   | 6%                          | NA                           |
|                    | Price worthiness | Worthy            | 15  | 94%                         | NA                           |
|                    |                  | Willing           | 13  | 88%                         | NA                           |
| Lyah (IDR 144,000)   | Intention to buy | Unwilling         | 3   | 12%                         | 130,000-135,000              |
|                    |                  | Unworthy          | 3   | 19%                         | NA                           |
|                    | Price worthiness | Worthy            | 13  | 88%                         | NA                           |
|                    |                  | Willing           | 16  | 100%                        | NA                           |
| Adys (IDR 194,000)   | Intention to buy | Unwilling         | 0   | 0%                          | NA                           |
|                    |                  | Unworthy          | 1   | 6%                          | 170,000                      |
|                    | Price worthiness | Worthy            | 15  | 94%                         | NA                           |
Table 3 shows that all the price formulated using value-based pricing are acceptable for the respondent. Majority of the respondent willing to buy the product on the proposed pricing.

4. Discussion
Reference [18] stated that nonverbal messages were sometimes more important than verbal messages, one of them was facial expressions. Reference [9] argued that “The face is one of the most powerful channels of nonverbal communication.” Previous researches have investigated the relationship between facial expression with certain aspects of marketing [10][19][20], but none on pricing strategy.

The results of this study indicate that participants’ positive emotions were significantly higher than negative emotions for all the products displayed. Therefore, it can be concluded that all the prices formulated using value-based pricing method are acceptable. The results of a self-reported questionnaire to measure purchase intention also show a relatively high level of willingness to buy for all products, which are more than 75%. The same results were also found for price worthiness.

However, the result of this study should be taken carefully. According to [13] the accuracy of FaceReader is depend on the quality of the posed photograph used, which is difficult to achieve in the spontaneous (and more ecologically valid) facial expressions. Also, the lack of comparative measures, such as facial EMG, heartbeat, or skin conductance, make this research results limited.

5. Conclusion
This research uses the facial expression to measure the intention to buy for the customer based on the price plan developed using value-based pricing. The results of this study indicate that the significance of participants’ positive emotions measured by facial expression can be used to measure intention of buy. This is aligned with the self-reported questionnaire result. So, it can be concluded that all the prices formulated using a value-based pricing method are acceptable for the customer. However, the result should be taken carefully because of the limitations of FaceReader and the lack of comparative measures, such as Facial EMG, heartbeat, or skin conductance, to validate the FaceReader reported emotions.

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