A Study on a Method to Improve the Package Design of a Plastic Bottle Drink

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Abstract

Package designs that successfully unite labels and the physical form of a plastic bottle drink often provide a good indication of whether customers will purchase plastic bottle drinks. Therefore, enterprises strive to develop attractive package designs. To develop these designs, enterprises must first determine their underlying purpose for improving package designs. Then, they can determine the images they need to project to convey this purpose, and the enterprises can incorporate the company image into package designs. In this way, customers can get a sense of the image of the company through the package design. However, there is currently no methodology to identify company images and develop package designs that reflect these images. Package design usually proceeds by a process of trial and error, based on designers’ subjective perceptions and experiences. This study aims to propose a method to improve the package design of a plastic bottle drink. We determined the images that the company should project by setting a purpose. Also, we attempted to understand the images that customers perceive from the current package design of products. Then, we compare the company’s intended images with the customers’ perceived images to identify the images that should be reflected in the new package design. Furthermore, we discussed a method for incorporating these images into package design. We studied the relationship between images and design elements using a multivariate regression/quantification method of the first type. In so doing, we were guided toward improving the present package design. Finally, we proposed a concrete procedure to develop the package design, based on the regression equation.

Keywords: Image, Image terms, Design elements, Physical form

1. Introduction

Package design that successfully unites the label and the physical form of a plastic bottle drink increases the likelihood that customers will purchase plastic bottle drinks. Package design plays an important role in both attracting consumer attention in stores and conveying product information and value [1]. Kotler [2] states that well-designed packages enhance consumer convenience such as ease of purchase and ease of exploration. Moreover, examples where excellent product design has increased product evaluation and improved sales, have been reported [3][4][5][6].

A graphic design should intuitively convey an impression of the product, and for this reason, enterprises strive to develop attractive package designs. As one way to develop these designs, first, enterprises must decide on their purpose for improving package design, and then they must determine the images that they want to project, based on this purpose. Ultimately, the enterprise can incorporate these images into the package design. As a result, customers can perceive the company’s images from its package designs.

However, there is currently no methodology to identify the images that companies should convey and to develop package designs that reflect these images. Package design usually proceeds by a process of trial and error based on designers’ subjective perceptions and experiences. Therefore, it is not clear whether a developed package design fulfills the intended purpose.

Based on this background, this study aims to propose a method to improve the package design of a plastic bottle drink. This method includes how to determine the images that should be incorporated into the package design by comparing a company’s projected images with customers’ perceived images, with respect to the current package design. Moreover, this study discusses how to convey the chosen images in the package design of a plastic bottle drink. This study focuses on carbonated drink bottles as the example.

2. Previous Studies and Research Approach

2.1 Previous Studies

There are many previous studies on package design. Discussion around the communication effect that packaging has in store began in 1950s. Banks [7] discusses and measures the influence of new materials
used in packaging on product selection and sales. In the 1970s and 1980s, studies evaluating the large communication effect of packaging [8] and the relationship between packaging and perceived quality [9] were undertaken.

Since the 1990s, packaging has been positioned as one of the elements that make up brand equity [10], and studies have been conducted to discuss the relationship between packaging and brand equity. Underwood [11] revealed a conceptual model in which brand identity is formed by consumers' contact with packaging. At the same time, studies discussing the relationship between individual elements (such as photographs, colors, and shapes of packages) and consumer reactions have also increased in number [12][13].

Here, the asset value of the brand is called brand equity [14][15], and brand identity is the underlying concept. Brand identity gives the brand direction, purpose, and meaning [14]. Moreover, brand identity is a goal or the ideal image of how a strategy planner would like the brand to be perceived [16].

Previous studies on package design creation support include studies by Tashiro et al. [17] and Kaneko et al. [18]. Tashiro et al. [17] proposed a method to measure potential customers' image of a concept and to support the creation of designs that reflect this image by providing designers with a wide variety of information on a concept. This information is provided in a form that can be easily utilized by these designers. For example, designs related to the image of "cities" could be created using the proposed method, and the usefulness of such designs could be verified. This method enables the creation of designs that consider not only the designers' subjectivity but also the potential customers' viewpoint for the given concept.

Kaneko et al. [18] extracted design elements in consideration of consumers’ viewpoints. Design elements are aspects of the package design, such as colors and logos. These researchers then explored the relationship between design elements and images using a multivariate regression/quantification method of the first type.

2.2 Research Approach

As mentioned in Section 2.1, although many studies on packaging have been conducted, most discussed the impact of packaging on consumer purchasing behavior and product evaluation. In other words, there are few studies that derive concrete guidelines on how to improve packaging by changing design elements.

In this study, enterprises first decide on their purpose for improving package design and then determine the image that they want to project based on this purpose. This image can be regarded as part of brand identity. Various ways of communicating the brand identity can be considered, such as commercial advertisements, implementation of a campaign, as well as package design. In this study, we define the company image as an image that can be reflected in package design and be linked to the purpose of improving package design in brand identity.

Next, we investigate the image that consumers form when they view the present package design of a targeted product. We define these images as customer images. Finally, we compare company images with customer images to identify images that are not transmitted in the current package design. We define these images as those that can be reflected in future package design.

To express these three images in precise terms, first, this study collects image terms that express images that can be incorporated into package design, and creates a table of these image terms. By setting a purpose, we can begin to understand the images that companies should convey, referred to as company images, and we can understand customer images the images that customers perceive from the present package design through interview, referred to as customer images. Information on these images is recorded as language data, and respondents to the interviews answer with various expression. Therefore, we match the language data obtained through this interview with the image terms, we compare company images with customer images to determine the images that should be reflected in the future package design.

Next, this study explores a method to incorporate these images into package design. We refer to elements of package design, such as the entire color, form, etc., as “design elements.” We extract the design elements of the plastic carbonated drink bottles according to the customers’ viewpoints and relate the images to the design elements using a multivariate regression/quantification method of the first type. The regression equation can serve as a guide to improve package design. Based on the above, this study proposes a method to improve the package design of a plastic bottle drink.

3. Clarifying the Images to be Reflected in the Future Package Design

3.1 Extract Image Terms

This study aims to communicate company images to consumers by improving package design. If the images are expressed in terms that cannot be reflected in the package design, it is difficult to improve it. Therefore, it is necessary to clarify terms expressing images that can be reflected in package design. We define these terms as image terms. Image terms can be extracted by collecting information about the image received from the packaging of commercially available carbonated drinks.

We studied how to extract the image terms to be reflected in the package design of plastic carbonated drink bottles. The outline of the investigation is shown below.

- Respondents: 36 respondents (10-60 years old)
- Sample: 10 types of carbonated drink bottles randomly selected for each respondent out of 40 total types
- Method: Interview about the sample (open-ended question)
23 image terms that X Company, a manufacturer of plastic bottle drinks, uses in a fixed-point observation to the extracted image terms, in order to make them more comprehensive. The results are summarized in Table 1.

Table 1 A table of image terms

<table>
<thead>
<tr>
<th>First Level</th>
<th>Second Level</th>
<th>Third Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>A feeling of carbonic acid</td>
<td>Carbonic acid</td>
<td>Strong carbonic acid</td>
</tr>
<tr>
<td></td>
<td>No carbonic acid</td>
<td>Weak carbonic acid</td>
</tr>
<tr>
<td>Price</td>
<td>Expensive</td>
<td>A feeling of coolness</td>
</tr>
<tr>
<td></td>
<td>Cheap</td>
<td>Fresh</td>
</tr>
<tr>
<td>Domestic or foreign</td>
<td>Foreign</td>
<td>A feeling of summer</td>
</tr>
<tr>
<td></td>
<td>Japanese</td>
<td>Clear (transparent)</td>
</tr>
<tr>
<td>Human</td>
<td>For females</td>
<td>A feeling of ice</td>
</tr>
<tr>
<td></td>
<td>For males</td>
<td>Cool</td>
</tr>
<tr>
<td></td>
<td>For children</td>
<td>Refreshment</td>
</tr>
<tr>
<td></td>
<td>For students</td>
<td>Juicy</td>
</tr>
<tr>
<td></td>
<td>For young people</td>
<td>Natural</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Artificial</td>
</tr>
</tbody>
</table>

Using the image terms in Table 1, we select those that can be reflected in the package design of plastic carbonated drink bottles. In the next two sections, we match various language data with these image terms in order to unify the terms and also to compare the images that the company should convey with the images that customers derive from the package design.

3.2 Determine Company Images

We determined company images that companies should convey by setting a purpose. X Company intends to raise the brand image of Product A that is one of the carbonated drinks, a well-known brand. Therefore, we regard the images of Product A that customers have as the company images. We derived customers’ image of Product A through an investigation. The outline of the investigation is shown below. We employed an open-ended question to extract customers’ opinions.

- Respondents: 68 respondents (20-60 years old)
- Method: Interview (open-ended question)

We adopted the images that can be reflected in product design. We then rearranged the image terms in descending order by the number of responses. Based on the Pareto principle, we regarded the image terms for which the accumulation ratio for the number of replies reached 80% as the image terms that should be assigned to Product A.

X Company also intends to provide images in connection with the product concept for Product B, which is new. Therefore, we had the person in charge of X Company select the image terms that should be assigned to Product B from the image terms in Table 1.

Based on the above-mentioned procedure, the image terms that the company should assign to Products A and B are shown in Table 2.

Table 2 Company images of Products A and B

<table>
<thead>
<tr>
<th>Image terms</th>
<th>Number of respondents</th>
<th>Ratio</th>
<th>Accumulation ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nostalgic</td>
<td>24</td>
<td>16.2%</td>
<td>16.2%</td>
</tr>
<tr>
<td>Fresh</td>
<td>23</td>
<td>15.5%</td>
<td>31.8%</td>
</tr>
<tr>
<td>Carbonic acid</td>
<td>19</td>
<td>12.8%</td>
<td>44.6%</td>
</tr>
<tr>
<td>Sweet</td>
<td>13</td>
<td>8.8%</td>
<td>53.4%</td>
</tr>
<tr>
<td>A feeling security</td>
<td>8</td>
<td>5.4%</td>
<td>58.8%</td>
</tr>
<tr>
<td>A feeling summer</td>
<td>6</td>
<td>4.1%</td>
<td>62.8%</td>
</tr>
<tr>
<td>Total number of respondents</td>
<td>148</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Product B

<table>
<thead>
<tr>
<th>Image terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulating</td>
</tr>
<tr>
<td>For adults</td>
</tr>
<tr>
<td>Refreshment</td>
</tr>
<tr>
<td>Sweet</td>
</tr>
<tr>
<td>Bitter</td>
</tr>
<tr>
<td>Strong carbonic acid</td>
</tr>
<tr>
<td>Fragrant</td>
</tr>
</tbody>
</table>
3.3 Understand Customer Images

Next, we conducted an investigation of customer images that consumers perceive from the present package design of Products A and B. We used another open-ended question to extract customers’ opinions. The outline of the investigation is shown below.

- Respondents: 68 respondents (20-60 years old)
- Method: Interview (open-ended question)

Similarly, we unified the image terms in Table 1 by matching the language data obtained through this investigation with the terms. The resulting image terms, in descending order of the number of replies, are shown in Table 3.

### Table 3 Customer images of Products A and B

<table>
<thead>
<tr>
<th>Product A</th>
<th>Number of respondents</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nostalgic</td>
<td>19</td>
<td>15.3%</td>
</tr>
<tr>
<td>A feeling security</td>
<td>16</td>
<td>12.9%</td>
</tr>
<tr>
<td>Simple</td>
<td>15</td>
<td>12.1%</td>
</tr>
<tr>
<td>Familiar</td>
<td>11</td>
<td>8.9%</td>
</tr>
<tr>
<td>Fresh</td>
<td>10</td>
<td>8.1%</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Total number of respondents</td>
<td></td>
<td>124</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product B</th>
<th>Number of respondents</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruity</td>
<td>19</td>
<td>15.3%</td>
</tr>
<tr>
<td>Not healthy</td>
<td>16</td>
<td>12.9%</td>
</tr>
<tr>
<td>Foreign</td>
<td>15</td>
<td>12.1%</td>
</tr>
<tr>
<td>Stimulating</td>
<td>11</td>
<td>8.9%</td>
</tr>
<tr>
<td>For young people</td>
<td>10</td>
<td>8.1%</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Total number of respondents</td>
<td></td>
<td>111</td>
</tr>
</tbody>
</table>

3.4 The Images that can be Reflected in the Future Package Design

We compared company images with customer images to clarify the ones to be reflected in the future package designs for Products A and B. A comparison of Table 2 and 3 shows that images such as “nostalgic” are shown in both tables, and there is a small difference in the number of respondents between the tables. Therefore, we concluded that the present package design already conveys these images.

On the other hand, images such as “carbonic acid” are shown only in Table 2, or there is a big difference in the number of respondents. Thus, these images are not reflected in the current package design. Therefore, we chose some images from this group to be reflected in the future package design.

Based on this analysis, we clarified images to be reflected in the future package designs for Products A and B.

4. Reflect Images in the Package Design

4.1 Extract Design Elements

We extracted the design elements of plastic carbonated drink bottles in accordance with customers’ viewpoints using the method Kaneko et al. [18] proposed. Because label designs are more flexible than bottle form designs, we believe that the design elements of labels are extracted more often than those for the bottle form. Therefore, we used a sample of plastic carbonated drink bottles that are currently on the market (Sample 1) and another sample containing different bottle forms with the same label (Sample 2). We then conducted the following investigation.

- Respondents: 25 respondents for Sample 1 (10-60 years old)
- Sample: 40 bottle types in Sample 1, 8 bottle types in Sample 2
- Method: Interview about the sample (open-ended question)

As a result of this investigation, we extracted the basic design elements of labels and bottle forms. Then, we subdivided them in order to be able to grasp their characteristic values. In addition, we measured the characteristic values of the subdivided design elements of the samples used in the investigation in Section 4.2.

Using Product A as an example, we defined the relationship between the design elements and images with the development of the package design, as will be discussed in Section 4.2. On that account, the sample against which we measured the characteristic value of the subdivided design elements is the new package design of Product A. The results are shown in Table 4, which is the correspondence of samples and design elements. Using Table 4, we define the relationship between design elements and images.
### 4.2 The Relationship between Design Elements and Images

Using Product A as an example, we defined the relationship between the design elements and images by using the method Kaneko at el. [18] proposed in order to develop a suitable package design. Product A has some constraint conditions, such as “product logo is printed on label.” Therefore, we utilized the samples that fulfill the constraint conditions. Using these samples and the image terms, which express the company images that were clarified in section 3.2, we conducted an investigation to examine the relationship between design elements and images. The outline of the investigation is shown below.

- **Respondents:** 166 respondents (10-60 years old)
- **Sample:** 15 bottle types of product A that fulfill the constraint conditions and 2 new types for product A

**Method:**
- Questionnaire
- Semantic differential method (seven-point scale)
- 4 bottle types randomly selected for each respondent from 17 total types. Respondents evaluated the selected types according to the image terms selected in section 3.4.

We related the image and the design elements using a multivariate regression/quantification method of the first type, in which the characteristic value of the design elements in Table 4 are the predictor variables, and the average value of obtained rating data for each image term is the response variable.

The equation obtained by a multivariate regression/quantification method of the first type includes only the predictor variables effective for the response variable. A multivariate regression/quantification method of the first type can be applied even when qualitative data and quantitative data are mixed. For quantitative variables, we use the specific values in Table 4. For qualitative variables, we use the data of “with” or “without” for each element.

Equation (1) indicates the design elements that are effective in the “carbonic acid” score as an example.

\[
\text{carbonic acid} = -2.892 + 0.016 \times (\text{shoulder length}) + 0.104 \times (\text{Maximum diameter}) \times \begin{cases} \text{with} & : 0.309 \\ \text{without} & : 0 \end{cases} \]  
\[
\times \begin{cases} \text{with} & : 0 \\ \text{without} & : -0.329 \end{cases} 
\]  

We can grasp the design elements that affect the images and be guided toward improving the present package design based on equation (1). For example, it was understood that to increase the shoulder length of the present bottle is effective for “carbonic acid.” Similarly, we identified the design elements that can improve the evaluation of each image to be reflected in the future package design.

### 5. The Method to Improve Package Design of the Plastic Bottle Drink

Based on the above, we propose a two-step method: first, clarifying the images to be reflected; and, second, determining how to reflect these images in the package design of a plastic bottle drink.
Step1: Clarifying the image to be reflected in future package design
- 1.1: Extracting the image terms that can be reflected in package design
- 1.2: Determining company images that the company should convey by setting a purpose
- 1.3: Understanding customer images that customers perceive from the present package design
- 1.4: Matching the language data obtained through step 1.2 and 1.3 with the image terms
- 1.5: Comparing company images with customer images
- 1.6: Determining the image to be reflected based on the result of step 1.5

Step2: Reflecting the images in the package design of plastic bottle drink
- 2.1: Extracting the design elements of the plastic bottle drink
- 2.2: Grasping the relationship between design elements and images using a multivariate regression/quantification method of the first type
- 2.3: Designing the package using the above regression equation

6. Verification

We verified the effectiveness of the equation obtained in section 4.2. The result of product A was shown as an example.

We prepared 2 bottle types for test samples, referred to as sample A1 and sample A2. Next, we measured the characteristic values of design elements of samples A1 and A2 and calculated predicted values by substituting the characteristic values for the regression equation. On the other hand, customers evaluated whether the images that were reflected in package design were perceived from samples A1 and A2. Customers evaluated these images using a seven-point scale. Then, we compared the predicted values and the evaluation scores of sample A1 with those of sample A2 and assessed the large/small relation of both the predicted values and the evaluation scores. Table 5 shows the results.

Table 5 The results of comparison between the predicted value and the evaluation score of product A

<table>
<thead>
<tr>
<th>Image terms</th>
<th>Value/Score</th>
<th>Sample A1</th>
<th>The large/small relation</th>
<th>Sample A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonic acid</td>
<td>Predicted value</td>
<td>5.044</td>
<td>&gt;</td>
<td>4.006</td>
</tr>
<tr>
<td></td>
<td>Evaluation score</td>
<td>4.364</td>
<td>&gt;</td>
<td>3.519</td>
</tr>
<tr>
<td>Fresh</td>
<td>Predicted value</td>
<td>5.112</td>
<td>&gt;</td>
<td>4.48</td>
</tr>
<tr>
<td></td>
<td>Evaluation score</td>
<td>4.606</td>
<td>&gt;</td>
<td>4.296</td>
</tr>
</tbody>
</table>

In Table 5, the findings reveal that the relation that was obtained based on the predicted value matches the relation based on the evaluation scores. Therefore, the regression equation was mostly useful.

7. Discussion

7.1 The Contribution and Implications of This Study

This section demonstrates the significance of this study. We extracted the image terms that are reflected in the package design of plastic carbonated drink bottles through an investigation using 40 types of bottles. Then, we added the image terms that X Company uses in a fixed-point observation. We believe that this is useful information when we consider the product concept of plastic carbonated drink bottles.

Also, because we used an open-ended question in our interviews, we could grasp customers’ potential opinions. X company conducted a fixed-point observation in the past, and we compared the results of an open-ended question with the fixed-point observation. Consequently, it was understood that important image terms were left out by fixed-point observation. Therefore, we conclude that open-ended questions facilitate a more thorough exploration of customers’ opinions.

However, the fact that the language data obtained by our investigation varies with the use of the open-ended question was a problem. Therefore, we matched the language data with the extracted image terms in order to derive the images to be reflected in the package design and to unify the terms.

Furthermore, this study discussed a method to clarify the image that should be reflected in package design. This study compared company images with customer images. Then, it focused on the gap in the number of respondents for company vs. customer images. We determined that the images with the large gaps were the ones that should be reflected in the future packaging. Thus, this study defined criteria for the selection of the images. The concrete criteria allow for improvements in the package design.

7.2 Comparison with Previous Study

Tashiro et al. [17] developed a method of identifying images that are not transmitted in the current package design. The difference between this study and that of Tashiro et al. is the method for dealing with the language data obtained by the open-ended question.

Tashiro et al. analyzed not only adjectives such as “carbonic acid” and “fresh” but also nouns that express things associated with the concept, such as “Character appearing on commercials.” This method is useful because nouns are also important elements when there is no constraint on the package design and during the initial evaluation of the concept.

However, as in this study, if enterprises want to improve their package design just by changing design elements, it is difficult to reflect nouns in the package design due to inherent constraints. Therefore, we conducted an investigation to identify the images received by customers from the packaging of commercially available carbonated drinks. Then, we created a table of image terms to be reflected in the package design. Most of these image terms are adjectives. We unified the
expressions of images with the image terms by matching them with the language data obtained from the investigation. This table makes it easier to compare the three types of images, making it possible to identify those that should reflect in the packaging.

8. Conclusion and Future Research

This study proposed a method to improve package design of plastic bottle drinks through several investigations. First, we extracted image terms through an open-ended question. Then, we determined the company images that the company should convey and the customer images that customers perceive from the present package design of products. We clarified the images to be reflected in package design based on customer evaluation by comparing both images.

Moreover, we explored the relationship between these images and design elements using a multivariate regression/quantification method of the first type to guide the process of how to reflect the images in package design. Finally, we proposed the method to develop the package design based on the regression equation. Furthermore, we confirmed the effectiveness of the proposed method.

In future research, we need to create a new package design based on the proposed method and verify the validity of the obtained regression equation. Moreover, we need to apply it to plastic bottles for all teas to verify the usefulness of the proposed method.

References
