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EXTRACTION OF CUSTOMER'S LATENT VIEWPOINTS BY MUTUAL EVALUATION

Hideyoshi Yanagisawa[1] and Tamotsu Murakami[1]
[1] The University of Tokyo

ABSTRACT
To respond to increasingly diversifying customer's needs of a product, it has become important to acquire potential viewpoints of the customer's criteria for product evaluation in the design process. Furthermore, emotional needs, such as design styling and user-friendliness, have become increasingly important for a differentiation strategy in a market in which products have similar performances and functionalities. To acquire the customer's emotional need and its cognitive structure, a laddering-based interview is often conducted. Frequently appearing patterns among the acquired answers are considered to be representative of the customer's viewpoints. However, the truly effective viewpoints of the customers are often hidden in their subconscious. The majority answers may represent viewpoints of which most subjects are consciously aware but which are not so effective in suggesting innovative designs. On the other hand, the minority opinions may include potential and important viewpoints. In this paper, we demonstrate this experimentally using the case study of a plastic-bottle design. To extract such potential viewpoints, we conduct a mutual evaluation experiment in which the subjects evaluate their own and other subjects' viewpoints extracted with a laddering-based interview. The results showed that commonly unexpected viewpoints, of which most subjects are unaware, included more effective viewpoints than the commonly expected ones, which frequently appeared among the subject's viewpoints in the interview. Thus, the truly important viewpoints of a customer's criteria for product evaluation are hidden in the subconscious, and not easily extracted by only interviews. The mutual evaluation among subjects helps to extract such latent viewpoints.

Keywords: Latent customer's viewpoint, emotional needs, mutual evaluation, laddering, Kansei.

1 INTRODUCTION
In consumer products, customers' needs have been diversifying due to a saturated market where many products have similar functionalities and performances. With such diversification, the customer has come to focus more on the emotional and sensuous quality of a product, such as its aesthetics and usability. According to the psychologist A. Maslow, human needs shift from common physiological needs to personal psychological needs[1]. This view suggests that sensuous needs are likely to increase further in the future. To respond to such continuously diversifying sensuous needs, it has become important to determine the effective customer's needs and to design according to those needs.
It is, however, difficult to grasp such sensuous needs as compared to other needs because sensuous qualities are subjective, not easy to externalize and often latent.
Several researches have been carried out to investigate the customer's subjective feelings regarding a product[1-7]. Most of them have focused on how to translate emotional needs to physical design attributes. Emotional needs, such as impressions, feelings, evoked emotions, etc., are represented by subjective words. Adjectives, such as "Stylish", "Massive" or "Elegant", are frequently used to express needs toward aesthetic design. Since such words are subjective and not directly quantifiable, mapping between the words and measurable design parameters is conducted using sensory tests and statistical methods. Several techniques for mapping have been developed and applied [3-6].
Before the translation process, it is necessary to extract the appropriate words and their related design attributes. The words should relate to the customer's emotional needs and the design attributes should fit the customer's attention. To extract such words and design attributes, interviews with

representatives of customers are often carried out. A structured interview method such as Kelly's laddering technique[8] and the evaluation grid method[9] is widely used to elicit a customer's viewpoint.

To understand an emotional need represented by a subjective word, it is necessary to acquire a cognitive structure to show its meaning. Frequently appearing patterns in the cognitive structures are often regarded as representative of the customer's common viewpoints. Words and design attributes for the mapping process are extracted from those representative viewpoints. However, the truly effective viewpoints of customers are often hidden in their subconscious. Although most subjects are consciously aware of the majority viewpoints, they may merely be the average needs and not so effective in suggesting innovative designs. On the other hand, a minority opinion may include potential and important viewpoints even though few customers externalize such viewpoints. To respond to a diversifying market, it is not enough to satisfy only ordinary needs.

The aim of this research is to extract such potential viewpoints of customers and to show their effectiveness. We propose an experimental method to extract and evaluate such potential viewpoints and, as a case study, carry out an experiment using a plastic-bottle design. The results of the experiment show the importance of extracting such potential viewpoints and the validity of the proposed method for such extraction.

2 RELATED WORKS

To translate customer needs to design specifications, quality function deployment (QFD)[10] is widely used. In QFD, the designer scores the degree of relation between customer needs and design technical components in the quality matrix. It is, however, difficult to score the relation in terms of emotional needs, such as design aesthetics, because they depend on the customer's sensitivity. In the field of *Kansei* engineering[2-5], techniques have been developed to quantify the relation between the customer's subjective impression or feeling, which is called *Kansei* in Japanese[2], and a physical design attribute. The semantic differential method[11] is often used to score the impression of a product with adjective pairs of opposite meanings, which relate to the customer's emotional needs. The quantitative relation of the scored impression and the physical design attributes are investigated using statistical methods, such as multivariate regression analysis.

For acquiring customer's needs, several techniques have been developed and applied, such as observation, interviews, protocol analysis, sorting, laddering, repertory grids and ethnographic methods. Those techniques have both merits and demerits. Meiden and Rugg summarized the strengths and weaknesses of each of the methods for requirement elicitation and proposed a framework called the 'acquisition of requirements to assist practitioners'[12]. This review, however, does not specify a method appropriate for emotional needs. An interview method based on the laddering technique is often used for acquisition of such emotional needs. Laddering is a structured questioning methodology derived from Kelly's repertory grid technique [8]. This technique enables one to acquire the hierarchical structure of the customer's psychological viewpoints. The customer explains his/her emotional needs using subjective and ambiguous words. Another person, such as the interviewer or designer, may have an incorrect understanding of the subjective words. With the laddering based interview, the interviewer uses a small set of probes to acquire concrete reasons for the subjectively expressed needs. In other words, this technique helps the user to externalize his/her cognitive structure of needs and makes it easy to understand the subjective needs. Furthermore, the interviewer can extract not only emotional words but design attributes related to those words as well. Other general advantages of laddering can be found in [12], such as the need for less expert guidance, its friendliness to elicitor and respondents, etc.

Frequently appearing patterns of the structure acquired by laddering are often used as representatives of the customer's common viewpoints and chosen as the words and attributes for the mapping process. In marketing science, Griffin and Hauser [13] found that the frequency of a customer's mention does not appear to be a good substitute for an experiment of functional needs acquisition. We assume that the truly effective viewpoints of customers are often hidden in their subconscious. Such viewpoints are unlikely to be frequently externalized by words. In this paper, we confirm this assumption with an experiment.

3 EXPERIMENTAL METHOD

3.1 Overview

It is assumed that a viewpoint frequently mentioned by customers is an ordinary opinion that the customer can easily externalize. The majority of customers easily expect such viewpoints. On the other hand, a viewpoint unexpected to a customer may include a more effective, potential viewpoint than an ordinary one. A viewpoint normally unexpected by customers is a potential viewpoint. The frequency of potential viewpoints should be low because they are rarely externalized. In this experiment, we compare the effectiveness of personally expected and unexpected viewpoints. We also compare viewpoints expected and those not expected by the majority of customers.

The flow of the experiment is as follows. First, we carry out an interview based on the evaluation grid method to elicit the customer's viewpoints within a cognitive hierarchical structure. The evaluation grid method is widely used for acquiring the customer's emotional needs and their cognitive structure. Next, the same subjects mutually evaluate the obtained viewpoints in terms of their effectiveness, unpredictability and agreement. In the interview, a subject may have difficulty conceiving all of his/her concerns towards a product in an exhaustive manner. The subject may not be able to externalize a subconscious viewpoint to which he/she would attach real weight. The viewpoints extracted from other subjects may help to identify them. The aim of carrying out mutual evaluation is to externalize the truly effective viewpoints.

In order to verify the effectiveness of a potential viewpoint of which the subject is not consciously aware, it is necessary to quantify the degree to which the subject has expected the target viewpoint. We calculate the expectedness of a viewpoint using its similarity to those of other subjects. Based on the expectedness, we compare the effectiveness of an expected viewpoint with an unexpected one.

The average expectedness among all subjects represents the commonality of consciousness of the target viewpoint. With this indicator, we compare a commonly unexpected viewpoint with a commonly expected one in terms of its effectiveness. By this comparison, we can verify the effectiveness of the extracted minority potential viewpoint.

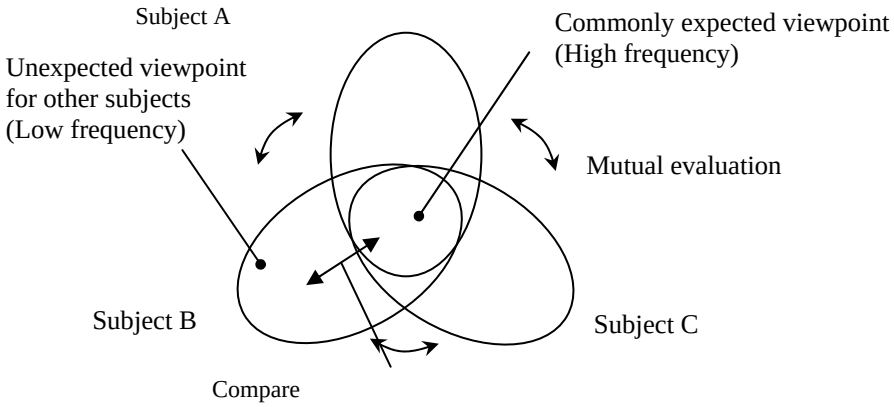


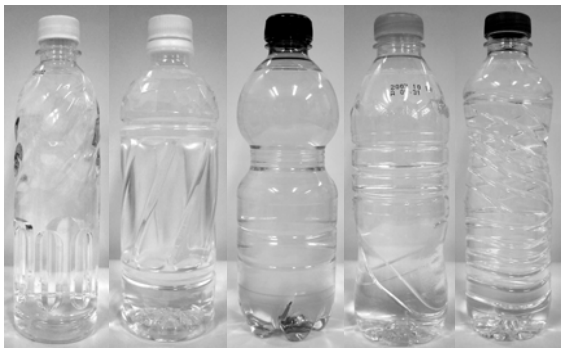
Figure 1. Commonly expected and unexpected perspectives for evaluating a product

3.2 Case study

We use a plastic bottle design as a case study and focus on its emotional quality such as aesthetics and usability. The shape of plastic bottles has been diversifying due to recent differentiation strategies in the market. The package design is an important factor for a product that is difficult to differentiate by the content, such as water.

We select 10 shapes of a 500ml plastic bottle as evaluation samples, as shown in figure 2. To avoid any influences based on brand image or content, we removed the label and filled the bottles with water.

(1) (2) (3) (4) (5)



(6) (7) (8) (9) (10)

Figure 2. Plastic bottles used in evaluation experiment as design samples

3.3 Phase 1: Acquisition of customer's viewpoint

We acquire the customer's viewpoints and the cognitive structure of those viewpoints by applying an evaluation grid method-based interview. The evaluation grid method[9], which is widely used for acquiring emotional needs, is a method by which the customer evaluates products comparatively in their own words, and allows the interviewer to readily structure their viewpoints. The procedure of the experiment is as follows.

1) Holistic evaluation of design samples: The subject who is a representative of the customers selects the best and worst samples and places them on both ends of a table. He/she evaluates the rest of the samples using a five-rank hierarchy and places them between the best and worst ones.

2) Acquisition of the evaluation structures with the laddering technique: The interviewer probes the reasons for the holistic evaluation and constructs a hierarchical structure comprised of a "reason" chain, or ladder. First, the interviewer asks the reason why the interviewee thought the sample was good or bad compared to other samples which were scored differently. Next, the interviewer asks a series of questions based on the ladder-up and ladder-down techniques until the customer externalizes every viewpoint and his/her cognitive structure that the interviewer can objectively understand.

The ladder-down technique aims to acquire the reason behind a reason. For example, the asking question would be "You mentioned the shape is good because the shape is easy to grip. Why do you think this shape is easy to grip?" The answer may be "Because the middle part is constricted." On the other hand, the ladder-up technique aims to acquire a dominant conception of the answered reasons. For example, the question would be "You mentioned this shape was good because the shape is constricted. Why do you think that a constricted shape is good?". The answer may be "Because a constricted part is easy to grip". By repeating the ladder-up and –down processes, the interviewer constructs a hierarchically-structured reason chain. As many ladders as possible should be extracted without making the subject (interviewee) uncomfortable.

3.4 Viewpoint structure-based question and laddering support system

To control the question-asking process for acquiring the customer's viewpoints, we employ a structured question (Figure 3). The question consists of four items: positive/negative, the design factor, the attention and the state. First, the interviewer asks whether the reason is a positive or negative viewpoint. The design factor is an evaluation perspective of a design such as its aesthetics or usability. The attention is a component, such as the gripper, the basilar part, etc., and its attribute, such as shape, texture, material, colour, etc., to which the interviewee pays attention. The state is the state of the attention.

To support the interviewer to ask structural questions and control the laddering, we developed a laddering support system, as shown in figure 4. The system consists of a laddering tree view and an input menu for entering the reasons (ladders). The input menu consists of the four items given above. The interviewer can select an item that fits the interviewee's answer from a prepared list. If the interviewer cannot find an appropriate item, he/she adds the item to the list. The system registers the entered answer in the list. The system shows the entered reason (ladder) as a tree structure. The interviewer can reduce the risk of omitting relevant questions by checking the tree view.

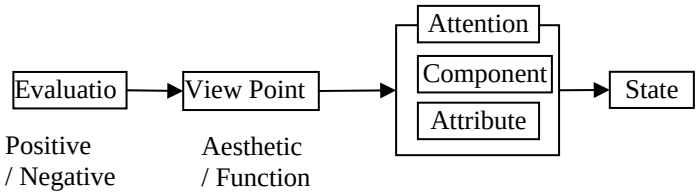


Figure 3. Structure of evaluation viewpoint

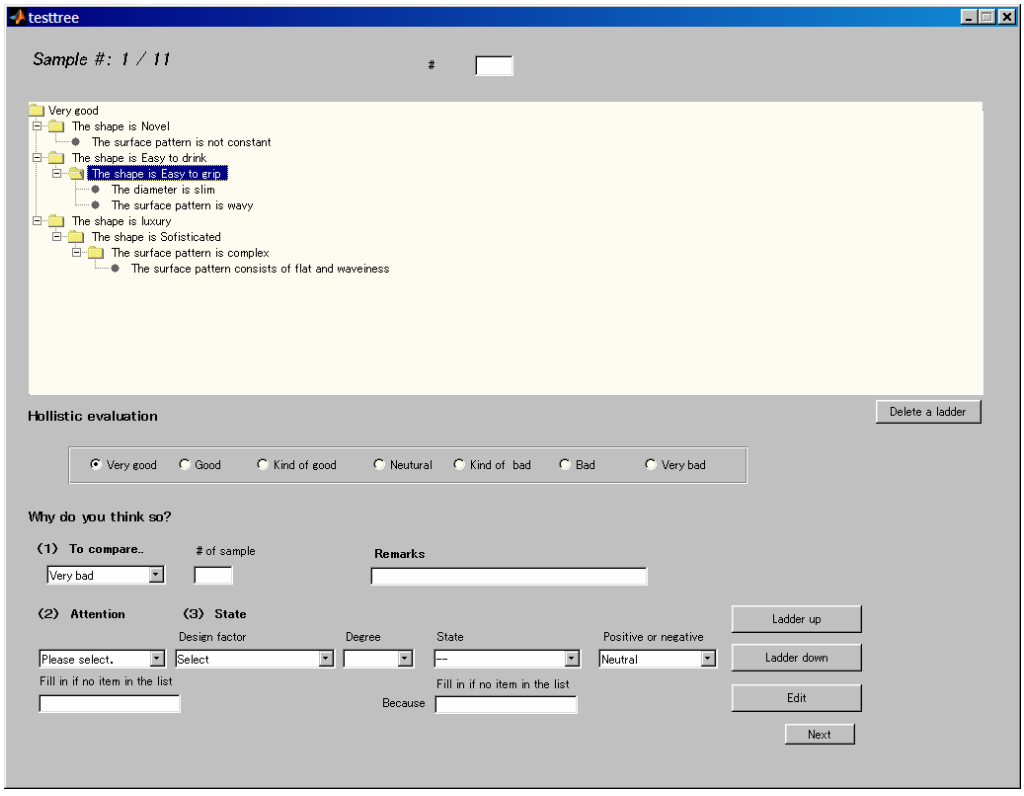


Figure 4. Laddering support system

3.5 Phase 2: Mutual evaluation of acquired viewpoints

To verify the effectiveness of unexpected viewpoints acquired from others, we conduct a mutual evaluation of the viewpoints. The subjects also evaluate their own viewpoints. The evaluation consists of three aspects: agreement, unpredictability and effectiveness. Agreement is the degree to which the subject agrees with the target viewpoint. Unpredictability represents the extent to which the subject expected the viewpoint in phase 1. Effectiveness is the extent to which the viewpoint affects his/her holistic evaluation of a sample. To avoid the influence of memory, we carried out the experiment a week after phase 1. The procedure of the experiment is as follows.

1) Divide acquired evaluation structure into unit viewpoints

We divide the acquired evaluation structure into minimum units of viewpoints. The unit viewpoint is a set containing a ladder that is directly related to the holistic evaluation and its lower reasons. The unit viewpoint consists of the subjective impression and the objective reason. For example, if the unit viewpoint is 'Simple because the diameter is constant and there are few surface patterns,' 'Simple' is the subjective impression and the remainder is the objective reason. We call them 'impression reason' and 'attribute reason'. (Figure 5)

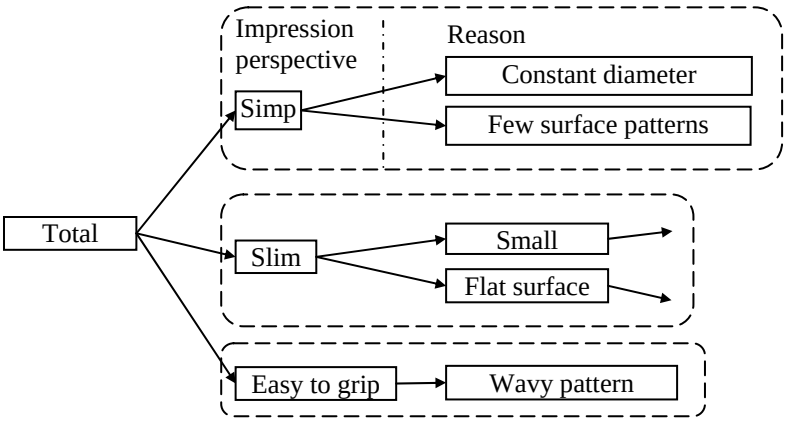


Figure. 5 Example of minimum unit of perspective

2) Choose unit viewpoints for the mutual evaluation

We choose 97 unit viewpoints for use in the mutual evaluation, which are related to a positive evaluation. Any redundant viewpoint is discarded.

3) Conduct mutual evaluation of unit viewpoint

The same subjects who were interviewees in phase 1 evaluate the selected unit viewpoints. The evaluation consists of the following three items.

- Unpredictability:

The subject evaluates the unpredictability of the unit viewpoint based on five ranks: 1) I have noticed the viewpoint, 2) I have not noticed the viewpoint but that is not surprising, 3) I have not noticed the viewpoint and that is relatively surprising, 4) I have not noticed the viewpoint and that is surprising and 5) I have not noticed the viewpoint and that is very surprising.

- Agreement:

The subject evaluates the extent to which he/she agrees with the viewpoint by selecting from three items: 1) I agree with the viewpoint, 2) I partly agree with the viewpoint and 3) I do not agree with the viewpoint. When the subject selects 2), he/she must select which of the following he/she does not agree with: the impression or the cognitive reason.

- Effectiveness:

The subject evaluates the extent to which the viewpoint affects his/her holistic evaluation. He/she chooses from seven levels: from positively very effective (3) to negatively effective (-3).

3.6 Expectedness of unit viewpoint

The unpredictability of a viewpoint, scored in phase 2 of the experiment, is obtained after the subject has seen the viewpoint. However, his/her answer may be an illusion. The subject may select "1) I have noticed the viewpoint" even though he/she has not done so. This is known as a hindsight bias, which is the psychological characteristic of taking for what he/she had expected a result after it has appeared [14]. Thus we can only regard the unpredictability as a subjective impression of unpredictability.

We introduce an objective criterion of expectedness. If a similar viewpoint exists in the subject's own viewpoints, the degree of expectedness is high. If no similar viewpoint exists in his/her viewpoints, he/she may not have actually noticed it. To quantify the indicator of expectedness, we define the similarity between viewpoints. Let a family $P = \{E, C\}$ be a unit viewpoint, where E is a set of impression reasons and C is a set of cognitive reasons. The similarity of another's viewpoint $P_i = \{Ei, Ci\}$ to one's own viewpoint $P_j = \{Ej, Cj\}$ is represented in terms of impression reasons by the following formula.

$$D_e(E_i, E_j) = \frac{|E_i \cap E_j|}{|E_j|} \tag{1}$$

where, $|X|$ denotes the number of components of the set X. In the same way, the similarity of cognitive reasons is as follows.

$$D_c(C_i, C_j) = \frac{|C_i \cap C_j|}{|C_j|} \tag{2}$$

The degree to which subject p expected an impression reason of the jth viewpoint of subject q is as follows.

$$S_e(E_{qj} \mid p) = \max_i(D(E_{pj}, E_{qj})) \tag{3}$$

where E_{pi} denotes the impression reason of the ith viewpoint answered by subject p.

In the same way, the degree to which subject p expected a cognitive reason of the jth viewpoint of subject q is

$$S_c(C_{qj} \mid p) = \max_i(D(C_{pj}, C_{qj})) \tag{4}$$

where, C_{pi} denotes the cognitive reason of the ith viewpoint answered by subject p. We call Se and Sc the impression expectedness and the cognitive expectedness, respectively.

4 EXPERIMENTAL RESULT AND DISCUSSION

4.1 Comparison of expected and unexpected viewpoints

In phase 2 of the experiment, some subjects answered that they had noticed a viewpoint that they had not externalized in phase 1. In other words, the subjects took for that they had expected an unexpected viewpoint. For example, in phase 1, one of the subjects evaluated the viewpoints from only aesthetic aspects, such as 'Fresh -> Clear -> Flat surface' and 'Simple -> Few surface texture and Flat surface' for sample #2. He should regard those viewpoints as the most important reasons for his holistic evaluation. However, with regard to viewpoints of usability aspects such as 'looks easy to drink -> can grip anywhere -> appropriate diameter and flat surface' and 'looks easy to drink -> fit comfortably in one's hand -> slim and no constricted part', the same subject answered 'I have noticed the viewpoint.' and gave the evaluation that their effectiveness is positively higher than the viewpoints given by himself. Thus, the unpredictability obtained in phase 2 is a subjective impression. It is not an appropriate indicator of whether the subject actually expected that viewpoint. We use the expectedness discussed in 3.6 to split the unit viewpoints evaluated in phase 2 into expected and unexpected ones. The expected viewpoints represent the subject's own viewpoints that he/she gave in phase 1.

It is commonly assumed that the effectiveness of an expected viewpoint is high because the subject stated that it was the reason for his/her holistic evaluation. However, we found low scores of effectiveness among the expected viewpoints. In other words, the subjects evaluated their own viewpoints as having a low effectiveness.

Figure 6 shows the average effectiveness of the expected viewpoints and their 95% confidence intervals. The absolute value of the effectiveness is used to show the magnitude of the effect. The average effectiveness varies among the subjects. Half the subjects display effectiveness levels of less than 2, i.e., 'the viewpoint affected his/her holistic evaluation'. Only one subject reaches the maximum effectiveness (3). Thus, the expected viewpoints, externalized by the subjects using the laddering technique, do not always have a major effect on their holistic evaluations.

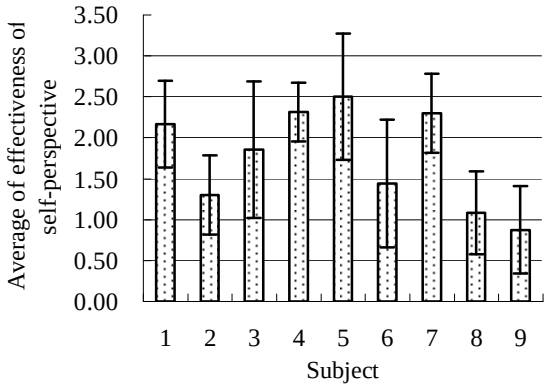


Figure 6. Average effectiveness of expected viewpoint

On the other hand, the unexpected viewpoints show a high effectiveness. Figure 7 shows the number of three viewpoints -- expected, partially expected and unexpected -- that scored effectiveness higher than the upper value of the 95% confidence interval of expected viewpoints. It can be seen that, for most subjects, the less expected the viewpoints, the greater in frequency. That is, highly effective viewpoints exist in unexpected viewpoints more than in expected ones.

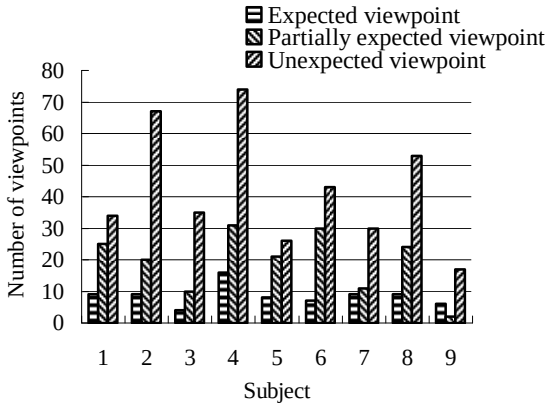


Figure 7. Number of viewpoints whose effectiveness exceeds max value of confidential interval of effectiveness of expected viewpoint

The above results show that expected viewpoints consciously cited by a subject are insufficient for extracting the truly effective viewpoints. Consciously answered viewpoints do not always have the greatest effect on his/her holistic evaluation. Instead, the subject discovers latent, more effective viewpoints among unexpected viewpoints that were consciously externalized by others.

4.2 Relation of common expectedness and effectiveness

Patterns of viewpoints frequently acquired from subjects are often regarded as common and important customer's viewpoints. Such viewpoints may only be extracted from a large number of subjects because many people are aware of and readily externalize them. Unexpected viewpoints, by definition, are much fewer, and the results in 4.1 show that they contain more effective ones than the expected viewpoints.

Here, we introduce an indicator called common expectedness representing the degree to which a viewpoint is commonly expected by all subjects. We discuss the relation between the common expectedness and the effectiveness of a target viewpoint.

The common expectedness of subject *q*'s viewpoint *Pq* = {*Eq*, *Cq*} is given by the following equations, given respectively for impression reason and cognitive reason:

$$\frac{\sum_{p} S_e(E_q \mid p)}{n-1}, \qquad p \neq q \tag{5}$$

$$\frac{\sum_{p} S_c(C_q \mid p)}{n-1}, \qquad p \neq q \tag{6}$$

where *n* is the number of subjects. If all subjects expected the viewpoint, the indicator is unity. If no other subject except *p* expected it, it becomes 0.

Figure 8 shows the relation between the average effectiveness and the common expectedness of impression reasons. The effectiveness of the viewpoint converges to around 1 and 1.5 as the common expectedness increases. The effectiveness varies from 0.5 to 2.5 at low common expectedness.

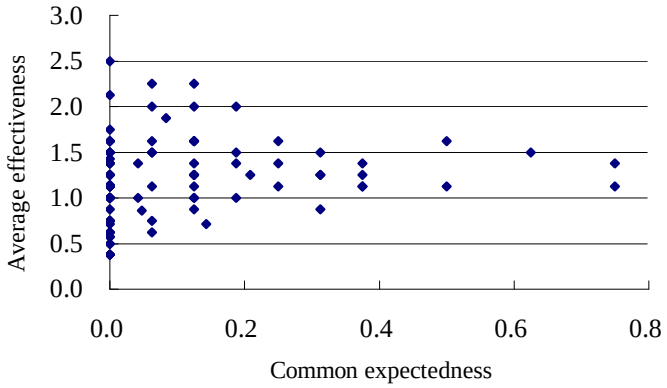


Figure 8. Relation of common expectedness and effectiveness

The effectiveness of commonly expected viewpoints is relatively stable but not so high, around 1.0, or 'relatively effective'. Commonly unexpected viewpoints contain those with higher effectiveness than commonly expected ones. To extract the most effective viewpoint, it is not enough to embrace frequently answered viewpoints, which represent commonly expected ones, as being solely representative of the customers' voice. Rarely answered patterns, of which most subjects are unaware and which are often ignored, contain the most effective viewpoints.

4.3 Difference of effectiveness and subjective unpredictability

The commonly unexpected viewpoints vary in their effectiveness. We found that the subjective unpredictability, which the subjects evaluated in phase 2, is a unique factor that relates to differences in effectiveness. Figure 9 shows the relation of the average effectiveness and unpredictability. There is a negative correlation between them. In other words, those viewpoints that most subjects believed they had assumed are highly effective. The viewpoints most subjects believed they had noticed had an average effectiveness greater than 2 (effective).

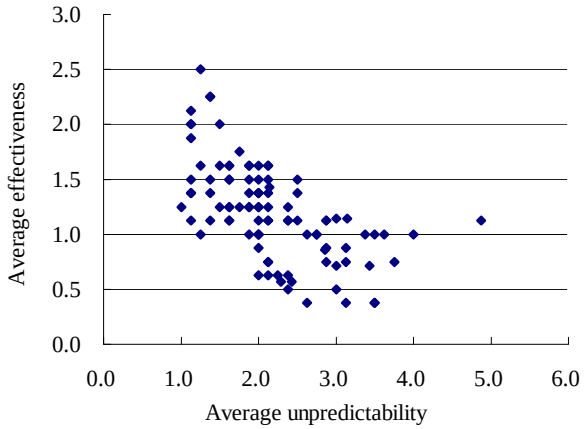


Figure 9. Relation of average effectiveness and average subjective unpredictability

Figure 10 represents the relation between the average (subjective) unpredictability and the common expectedness. When the common expectedness is zero, the average unpredictability varies widely. We can state then that those viewpoints that most subjects had not externalized (i.e., low common expectedness) but subjectively still believed that they had assumed in phase 1 (i.e., low average unpredictability) were the ones that scored high in effectiveness. Thus, it is important to acquire latent viewpoints that the subjects consciously answer in the interview. The mutual evaluation serves to extract such effective latent viewpoints.

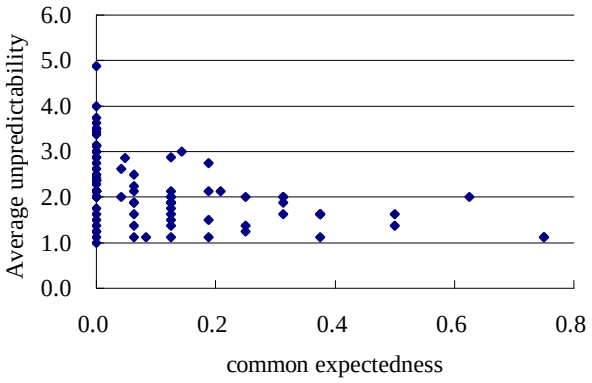


Figure 10. Relation of average unpredictability and average common expectedness

5 CONCLUSION

In this paper, we discussed the importance of acquiring latent emotional needs in today's increasingly diversifying market. We assumed that the truly effective viewpoints of customers are hidden in their subconscious and not expected by most customers. In other words, viewpoints rarely externalized in the interview may include more effective ones rather than the frequently answered ones, which are often used as representatives of the customer's viewpoint. In order to confirm this assumption, we conducted an experiment with a laddering-based interview and the mutual evaluation method, which supports the interviewer to acquire latent effective viewpoints, using a plastic bottle as an example. We obtained the following results from the experiment.

- The expected viewpoints, including those given by the subjects in the interviews, were not of the highest importance for each subject although they did possess a degree of importance. We found the highest effectiveness among the unexpected viewpoints.
- With the proposed experimental method, we found more perspectives among the unexpected viewpoints that contributed to the subject's criteria for product evaluation than among the expected viewpoints.
- Commonly unexpected viewpoints contain more important ones than commonly expected ones in the subject's criteria for product evaluation.
- Commonly unexpected viewpoints that most subjects believed they had assumed are highly effective.

From the above results, we found that the truly important viewpoints in a customer's criteria for product evaluation are hidden in the subconscious. Such viewpoints are not easily extracted through interviews alone. The mutual evaluation among subjects helps to extract such latent viewpoints.

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Contact: H. Yanagisawa
The University of Tokyo
Department of Engineering Synthesis, School of Engineering
7-3-1, Hongo, Bunkyo-ku
113-8656, Tokyo
Japan
Phone: +81-3-5841-6329
Fax: +81-3-5841-6329
e-mail hide@desgin.t.u-tokyo.ac.jp
URL: http:// www.design.t.u-tokyo.ac.jp/~hide/index-e.html