Comparison of Psychological Evaluation of KANSEI Lighting Using Large and Small Numbers of Subjects

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Abstract. It is an important issue whether the results of psychological experiments targeting a small number of people can be extended to a large number of people. We are conducting joint research between the university and the company on KANSEI lighting that combines glass art and lighting. About 1,800 visitors were asked to evaluate the developed KANSEI lighting at an exhibition intended for the general public. We used the evaluation items that had already been conducted on a small number of people. Therefore, the results of both experiments could be compared. In this paper, we report the results of comparing an evaluation experiment with a large number of people and that with a small number of subjects.

Keywords: Kansei lighting, Large number of subjects, Psychological experiment

1 Introduction

KANSEI evaluation is often conducted using psychological experiments. Psychological experiments conducted in university laboratories usually focus on exacting conditions, and the number of subjects is often limited to a few dozen. In addition, since the target is mainly students, the age distribution is also biased. For this reason, when we report the results of psychological experiments using university students at academic conferences, etc., we are often asked questions about the generality of the results when the subjects are extended to a large number of ordinary people. For such questions, a typical answer is, "we will consider this as a future issue." However, it is rarely considered because it is challenging to conduct psychological experiments on a large number of ordinary people in the same conditions as those on a small number of people.

In this research, we compared the results of a small-scale psychological experiment conducted in our laboratory, mainly using students, with the results of a psychological

experiment conducted on the same problem on a large number of ordinary people. Thus, we will present an answer to the above question.

Kyoto University and Mitsubishi Electric have conducted joint research to develop new KAKNSEI lighting that appeals to people's sensibility by applying art created by one of the authors, Naoko Tosa. As a result, we developed a prototype of KANSEI lighting named "Light Table." First, we evaluated this Light Table in a small-scale psychological experiment targeting dozens of Kyoto University students [1]. Then we had the opportunity to exhibit it at Mitsubishi Electric's showroom. We conducted a questionnaire survey targeting visitors and asked about 1,800 to evaluate it.

In this paper, we will report the results of comparing psychological experiments with a large number of people and those with a small number of people.

2 Light Table

One of the authors, Naoko Tosa, has been creating video artwork called "Sound of Ikebana" by giving sound vibrations to viscous liquids, such as paint, and shooting the jumping-up paints with a high-speed camera at 2000 frames per second [2].

The "Sound of Ikebana," obtained as a two-dimensional video image, has an organic and beautiful shape. When exhibiting this video art, there have been many requests to make it a three-dimensional shape. One of the attempts to make the Sound of Ikebana three-dimensional is to use multiple high-speed cameras to film the creation of the Sound of Ikebana and to create the 3D Sound of Ikebana from the images captured by the multiple cameras [3].

As another attempt to create a three-dimensional version of the Sound of Ikebana using a different material, we tried to create a similar shape using glass. As the actual Ikebana is made up of multiple types of flowers and plants, combining the created glass art pieces, we tried to create a three-dimensional object similar to the Sound of Ikebana.

As a glass art production method, we used "hot work," where glass is melted by heat and then molded. We created various shapes by twisting and dropping the soft glass. In the process, we also tried coloring the created glass art by adding various pigments. Figure 1 shows examples of the glass art pieces created.

Fig. 1. Examples of produced glass art pieces.

Using these glass art pieces as parts, creating a shape that combines multiple parts, placing them on a table, and illuminating them from the side, we found that a beautiful table that appeals to human sensitivity can be created. It was named the "Light Table" [1][4].

In addition, we found that by using the light source which emits parallel light, an even more beautiful light shape called caustic was created. Parallel light produces cleaner caustic than ordinary diverging light. Parallel rays can reach a long distance, so they are suitable for car lights, etc.

Also, by hitting parallel rays of light on glass or water, a collection of reflected or refracted light is generated to create a unique and beautiful shape. This is called “caustic [5]”. Sunlight, far enough away from the light source, is a parallel ray, so when it hits the surface of the water, it forms a beautiful glow through the waves on the water's surface, which is an example of caustic.

Glass art is suitable for creating caustic, and in fact, using Mitsubishi Electric's light source creates beautiful caustic, as shown in Figure 2. Rotating this table changes the caustic produced over time, creating more effective light shapes.

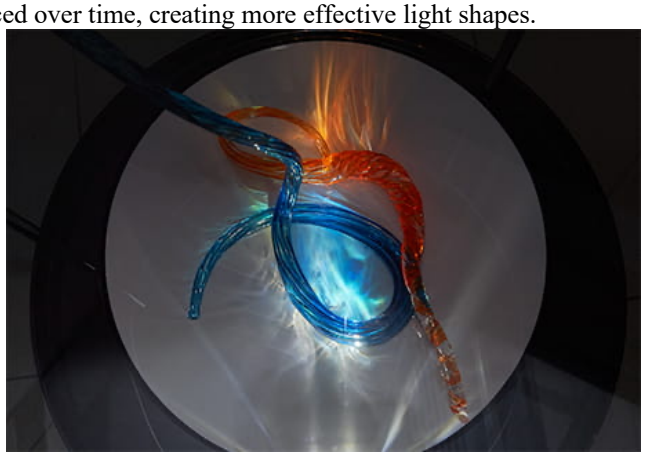

Fig. 2. Light Table

3 Psychological evaluation experiment of "Light Table"

3.1 Basic concept

There are many emotional evaluations based on psychological experiments, and they can be divided into KANSEI evaluations as research at universities and those aimed at commercialization at companies. The former attempts to analyze the characteristics of human sensibility by setting strict conditions and finely analyzing the difference in evaluation between different conditions. Subjects are mainly university students, and the number of people is often limited to a few dozen. Therefore, a problem is whether or not the KANSEI evaluation conducted on a small number of students at a university has generality when extended to a large number of ordinary people.

On the other hand, KANSEI evaluation by companies aims at commercialization, so generality is emphasized rather than strictness. In order to emphasize generality, the number of subjects is often significant. However, there are several limitations. One is that the results often belong to trade secrets and are often not disclosed. Another is that evaluation is often conducted using a questionnaire format at product exhibitions, etc. However, as the aim is to have people purchase the product as a product, the evaluation items usually differ from the KANSEI evaluation at universities. Therefore, only some studies have compared these two different assessments.

As one answer to such a problem, we decided to compare the evaluation of a small number of people at the university and the evaluation of a large number of people targeting the general public. We have already conducted and published an evaluation experiment with a small number of people at a university [1]. Since the evaluation experiment was conducted with a large number of people this time, we decided to compare the results of the evaluation experiment with a small number of people.

3.2 Evaluation by a small number of people

A total of 24 Kyoto University students and staff (13 males, 11 females, ages 20 to 40) were used as subjects for the evaluation of the Light Table [1][4].

3.3 Evaluation by a large number of people

In contrast to the evaluation of a small number of people at a university, we evaluated the Light Table for a large number of ordinary people. We had the opportunity to exhibit the Light Table at the exhibition space "METoA Ginza" owned by Mitsubishi Electric in Ginza. Many people visited the venue during the event, and about 1,800 evaluated the Light Table.

3.4 Evaluation items

A questionnaire was prepared to evaluate the Light Table, and we asked the subjects to answer the questionnaire on a 5-point scale. The questions consist of three groups: "What do you feel about the lighting?" (impression), "What kind of effect does the lighting have?" (effect), and "What kind of scene is lighting suitable for?" (scene). They consist of a total of 19 items belonging to these three groups. Table 1 shows the content of specific questions. Regarding the item "What do you feel about the lighting?" we decided on the evaluation items based on previous research [6][7][8]. In addition, we formed questions about "What kind of effect does the lighting have?" and "What kind of scene is lighting suitable for?" through discussion among the participants of this joint research.

Table 1. Contents of the questionnaire

1. What do you feel about the lighting? (Impression) Comfortable – Uncomfortable Friendly – Unfriendly Beautiful – Not beautiful Calm – Restless Interesting – Boring Warm – Cold Changeable – Not changeable Luxury - Sober Unique - Mediocre	**2. What kind of effect does the lighting have? (Effect)** I can relax – I cannot relax I can be creative – I cannot be creative. I feel energetic – I do not feel energetic I can face difficulty – I cannot face difficulty I feel refreshed – I do not feel refreshed **3. What kind of scene is the lighting suitable for? (Scene)** Appropriate for sleeping – Inappropriate Appropriate for eating – Inappropriate Appropriate for relaxing – Inappropriate Appropriate for working – Inappropriate Appropriate for chatting – Inappropriate

4 Comparative analysis of evaluation results for large and small groups

4.1 Experiment results

For each of the three major question groups: “What do you feel the about lighting?”, “What kind of effect does the lighting have?” and “What kind of scene is the lighting suitable for?” Figs 3, 4, and 5 show graphs obtained by averaging the evaluation values. (Each figure also shows the variance analysis results, which will be described later.)

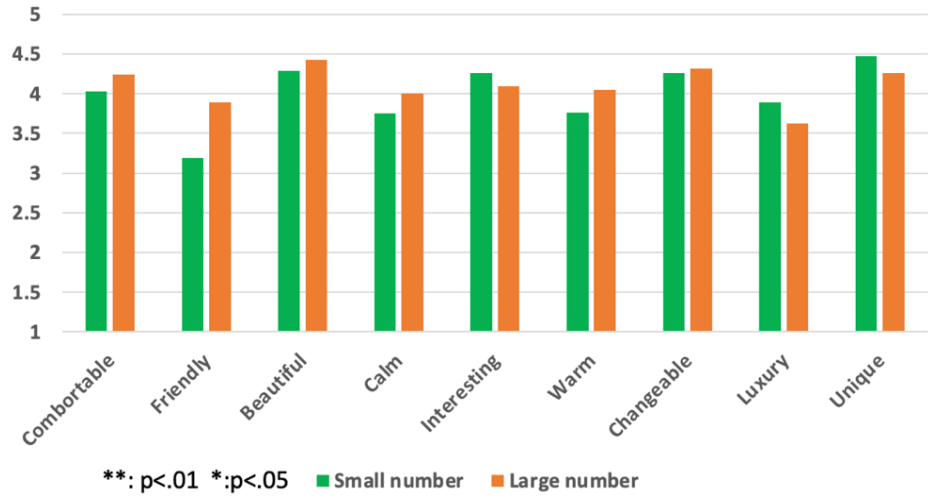

Fig. 3. Mean value of evaluation results for "What do you feel about the lighting?"

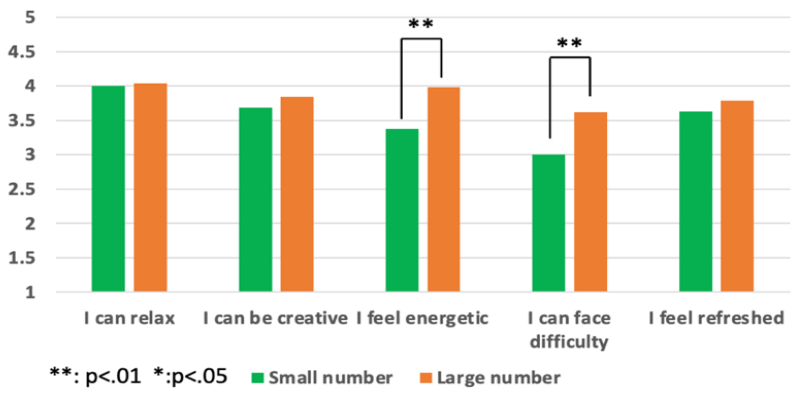

Fig. 4. Mean value of evaluation results for "What kind of effect does the lighting have?"

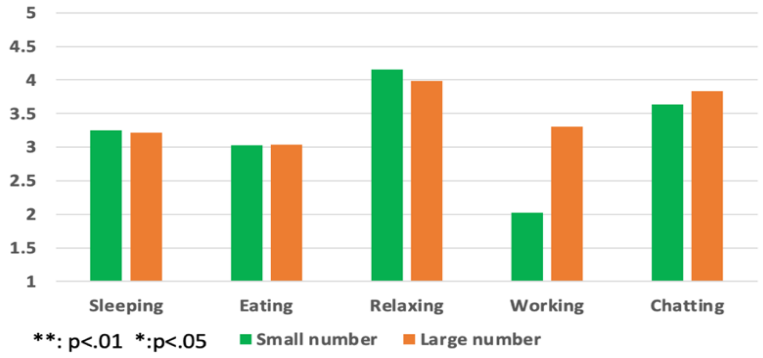

Fig. 5. Mean value of evaluation results for "What kind of scene is the lighting suitable for?"

4.2 Considerations

(1) Consideration on "What do you feel about the lighting?"
The trends for both small and large groups are very similar. This evaluation is based on the type of target audience (small group, large group) and evaluation items (comfortable, friendly, beautiful, calm, interesting, warm, changeable, luxury, and unique). Therefore, we conducted a two-factor analysis of variance (two-way ANOVA) to determine whether there was a significant difference between small and large numbers of participants in the evaluation items.

As a result, the main effect was insignificant for the two groups ($F(1897, 1)=0.824$, $p=.364$). This result shows no significant difference between the small and large groups.

(2) Consideration on "What kind of effect does the lighting have?"
The trends for each evaluation item for small and large groups are very similar. However, regarding the evaluation items of "I feel energetic" and "I can face difficulties," the results of the small group are considerably lower than those of the large group. More

than 70% of the people in the large group are office workers. They have more experience than students after entering society and are more tolerant of difficult situations. This explains the difference between the two evaluation items.

This evaluation consists of 2 factors with 2 conditions and 5 conditions respectively: the type of the number of people (small group, large group) and the evaluation items (I feel relaxed, I can be creative, I feel energetic, I can face difficulties, and I feel refreshed). Therefore, we conducted a two-factor analysis of variance (two-way ANOVA) to determine whether there was a significant difference between small and large numbers of participants in the evaluation items.

As a result, the main effect on the number of people was significant at the 5% level ($F(1897,1)=4.04$ $p=.045$). Then multiple analysis (Holm method) was performed on the number of people for each evaluation item, and the results are as follows.

I can relax: p=n.s., I can be creative: p=n.s., I feel energetic : p=.004(**),

I can face difficulties: p=.003 (**), I feel refreshed: p=n.s.

This shows that ANOVA confirmed the results intuitively obtained from Fig. 4 mentioned above.

(3) Consideration on "What kind of scene is the lighting suitable for?"

The trends for each evaluation item for small and large groups are very similar. This evaluation consists of 2 conditions: the type of the number of people to be targeted (small group, large group) and 5 evaluation items (sleeping, eating, relaxing, working, and chatting). Therefore, we conducted a two-factor analysis of variance (two-way ANOVA) to determine whether there was a significant difference between small and large numbers of participants in the evaluation items.

As a result, the main effect was insignificant for the number of people ($F(1897, 1)=2.47$, $p=.116$). From this result, we can conclude that there is no significant difference between a small number of people and a large number of people regarding "What kind of scene is the lighting suitable for?"

However, from Fig. 5. for the evaluation item of "working," the evaluation for the small group is considerably lower than that for the large group. As a precaution, multiple analysis (Holm method) was performed on the number of people for each evaluation item, and the results were as follows.

Sleeping: p=n.s., Eating: p=n.s., Relaxing: p=n.s., Working: p<.01(**), Chatting: p=n.s.

This confirms that the result for the small group is significantly lower than that of the large group. The reason is probably the same as in the case of Fig. 4. At the same time, office workers evaluate KANEI lighting as effective in an office environment.

5 Conclusion

It is an exciting question in psychological experiments whether the results of psychological experiments conducted in university laboratories on a small number of students can be extended to a large number of ordinary people. In this research, we conducted a psychological evaluation experiment with a large number of subjects and that

with a small number of subjects, targeting KANSEI lighting that combines glass art and lighting.

As an evaluation experiment with a small number of people, we have already conducted an experiment targeting 24 people, including university students. Regarding the psychological evaluation of a large number of people, we conducted a questionnaire survey asking the visitors when the KANSEI lighting was exhibited for the general public. About 1,800 visitors responded to the questionnaire, double-digit compared to the psychological experiments conducted on dozens of university people.

We compared the results of two psychological evaluation experiments; the results with a small number of subjects with those with a large number of people. When we analyzed the results based on ANOVA, we found that there is mostly no significant difference regarding the number of people. This is an exciting result because it shows that the results of psychological experiments conducted on a small number of people at universities are essentially the same as the results of psychological experiments conducted on a large number of ordinary people.

As this experiment was limited to KANSEI lighting, however, in the future, it will be necessary to verify the generality of the results by expanding the experiment to other subjects.

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