KANSEI EVALUATION OF THREE-DIMENSIONAL GEOMETRICAL SHAPES USING PICTORIAL IMAGES

MiYong Lee 1, SeungHee Lee 2

[1] University of Tsukuba Graduate School of Comprehensive Human Sciences, Doctoral Program in Kansei, Behavioral and Brain Sciences, Japan
[2] University of Tsukuba Graduate School of Comprehensive Human Sciences, Major of Kansei, Behavioral and Brain Sciences, Japan

ABSTRACT (250 WORDS MAX)

Since the shape of an object can differ according to the angle of perception, it is considerably difficult to classify various shapes systematically. In a field of design study, it was observed that evaluation by a product brand is done more often than the universal shape classification. This study intends to consider three-dimensional geometrical basic shapes and to propose an experiment for subjects to classify these shapes based on their own impressions and emotions.

During the experiment, the subjects were asked to process the evaluation three times, changing the contextual parameter: considering that each shape represents firstly an indoor product, secondly an outdoor product, and finally a portable product. Thanks to these three evaluations, the influence of the usage environment on human's *Kansei* could be confirmed. *Kansei* is a Japanese term which means psychological feeling or image of a product.

In this study, we were able to relate shapes and emotions based on individual *Kansei.* Therefore, we propose that it may be possible to evaluate a product, using basic shapes as evaluation media. Furthermore, as the evaluation was done for three different environments of use, we were able to confirm their influence on human impression. The experiment result may be considered as restricted to a local area and to a specific culture as subjects are only Asian students living in Japan.

As further studies, as a shape-mediated impression evaluation was proposed in this paper, a comparison with already existing, most of the time word-mediated impression evaluation techniques could be performed.

Keywords: Kansei evaluation, emotion, three-dimensional geometrical shape, cluster analysis

1   INTRODUCTION

The shape of an object is an important element as it provides human beings with visual impressions. However, since the shape of an object can differ according to the angle of perception (for example, a cone is seen round when viewed from the top, and more triangle-shape like when seen laterally), it is considerably difficult to classify various three dimensional shapes systematically. In a field of design study, it was observed that brand evaluation ("As the body is smooth, the main colour is white, and the point colour is pastel tone, that looks like Apple's design!") is done more often than the shape classification.

Therefore, this study intends to consider three-dimensional geometrical basic shapes and to propose an experiment for subjects to classify these shapes based according to their own impressions and feelings (precisely on their own *Kansei* - a term peculiar to Japan, which is often translated *as the high order function of the brain as source of inspiration, intuition, pleasure/displeasure, taste, curiosity, aesthetics, and creation*).

Though, for the same shapes, impressions may be different because of its size and its environment. For example, we usually feel that a small dog is cute, but a heavy dog may be felt fearful. Also, if a daily life product, which one always gets used to, becomes very big, the one may fell coercion and strain. Focusing on this point, the subjects were asked in this experiment to process the evaluation three times, changing the contextual parameter: considering that each shape represents firstly an indoor object, secondly an outdoor object, and finally a portable object. In spite of the difficulty to distribute justly

undefined shapes, this issue by providing the subjects information related to the size of the shape according to three contextual groups. Thanks to these three evaluations, the influence of the environment of use on human's *Kansei* could be confirmed.

2 OVERVIEW OF EXPERIMENT

For the experiment, various three-dimensional geometrical shapes were selected including a globe, a cube, a triangular prism, a cone, and cut piece. As wood is natural and commonly used material, we suggest that it has less influence than other materials. An image-board, gathering the fifty photographed shapes, was created and was shown to each subject during the experiment. The shapes selected for this experiment are not the whole shapes existing in the nature, but they were selected as the most representative panel of shapes seen in everyday life.
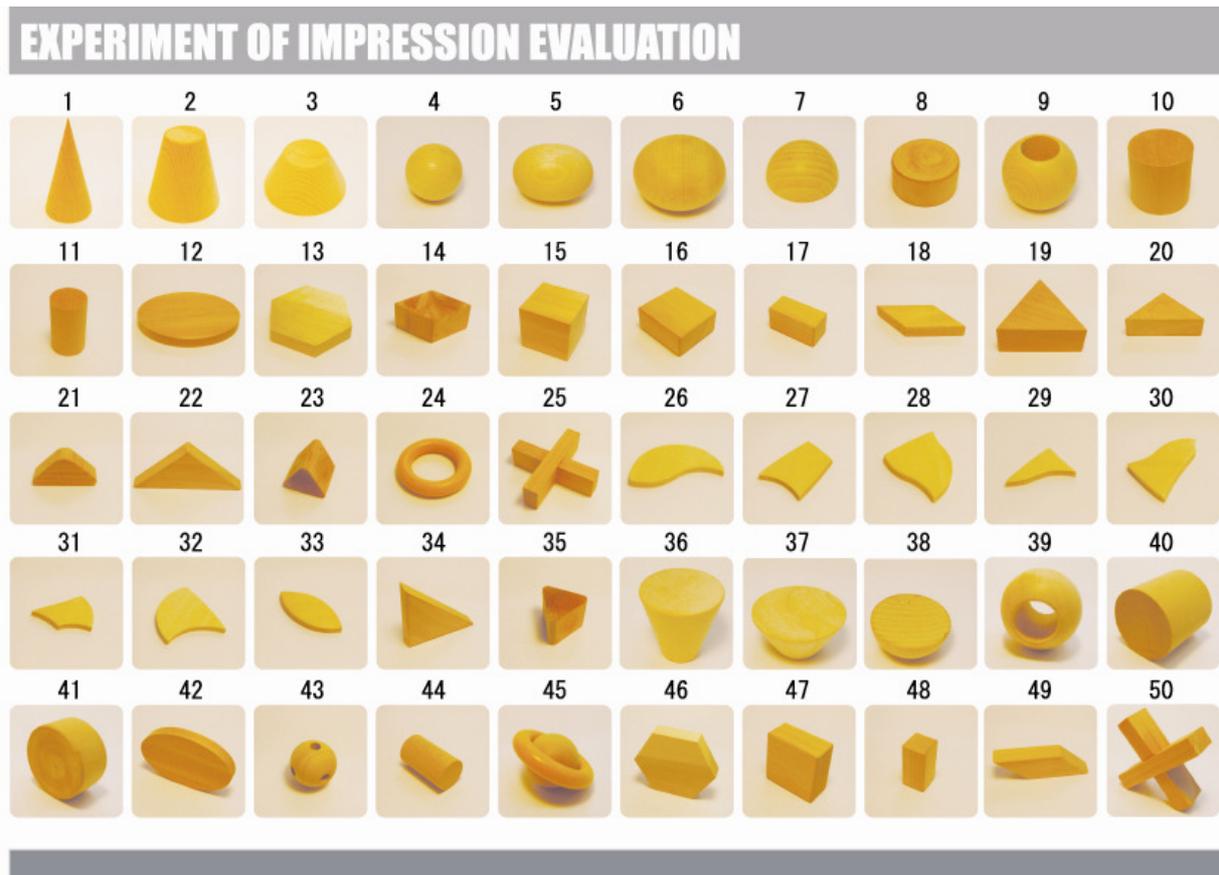
Figure 1. Image-board for impression evaluation

The eighteen evaluation items used for this experiment were these proposed by the *Dictionary of Article Meanings* proposed by the HAKUHODO Institute of Life and Living (in Japan, 2003). These items are expressing human feeling, as shown on Table 1. As the language of experiment was Japanese, emotional data had been used as provided by HAKUHODO Institute of Life and Living. The terms provided in the Table 1 are translated in English by the authors but were not used during the experiment.

To process the experiment, the subjects are asked to select to order the best, the second best, and then the third best image that fit the most with the evaluation item, and to write them down in the same order. For example, to the evaluation item "A shape that makes you feel happy", the subject chooses the maximum three shapes from the image-board, which make oneself feels happy, and writes down the numbers in order of importance on the evaluation paper like Figure 2. In the experiment, the samples of the image-board were recognized as shapes of real articles. Subjects evaluated 18 items three times (an indoor object, outdoor object and portable object). The subjects were fifty university students (21 females, 29 males). They were undergraduate or graduate students with an average of 23.6 years old from 18 to 36, from various disciplines. As subjects are all Asian, this result may be influenced by Asian culture.

The primary analysis consisted in counting the number of chosen objects, and the objects were grouped by principal component analysis and cluster analysis. For each evaluation item, the impression of the objects of use (human's *Kansei*) was evaluated, and the environmental influence on object size was confirmed.

Table 1. Evaluation items of expressing emotion

Category	Emotion
A	A shape that makes you joyful
B	A shape that makes you feel excited
C	A shape that makes you feel highly motivated
D	A shape that makes you feel happy
E	A shape that makes you feel relaxed
F	A shape that makes you feel gentle
G	A shape that makes you feel superior
H	A shape that makes you feel open to others
I	A shape that makes you feel innocent
J	A shape that calms your anxiety
K	A shape that distracts you from loneliness
L	A shape that distracts you from anger
M	A shape that gives you consolation
N	A shape that makes you feel lonely
O	A shape that makes you feel frustrated
P	A shape that makes you feel embarrassed
Q	A shape that makes you feel anxious
R	A shape that makes you feel depressed

Figure 2. The experiment situation

3 RESULTS AND ANALYSES

3.1 Evaluation item

Evaluation items related to joyfulness, happiness and relaxation were largely answered completely (i.e. most subjects input 3 shapes), whereas others were often incomplete (2 or less shape input).

The impression related to indoor objects were mainly emotions of Category A (A shape that makes you joyful), Category E (A shape that makes you feel relaxed), and Category F (A shape that makes you feel gentle). These emotions are mostly considered as improving the feeling of comfort.

Compared with indoor, the outdoor object had mostly responses related to emotion part of Category B (A shape that makes you feel excited) and Category G (A shape that makes you feel superior). These emotions are mostly considered as upward tendency. The portable object had mostly responses related to emotion part of Category G (A shape that makes you feel superior), Category P (A shape that makes you feel embarrassed) and Category R (A shape that makes you feel depressed). The portable object had answers related to both positive and negative emotional categories.

Also, it is suggested that the more an emotion is elicited (i.e. Category A was evaluated 238 times, relatively more than others), the more this emotion can be strongly represented by an object. In other words, as the Category A was often answered, it is considered that the emotion joyfulness can strongly be expressed by objects. On the other hand, as the Category P was evaluated 151 times, shapes are not able to show express this feeling strongly.

Table 2 shows the number of selected categories for each context (indoor/outdoor/portable), for all the subjects.

Table 2. The number of the selection of each emotion

Category	Indoor Object	Outdoor Object	Portable Object	Total
A	91	68	79	238
B	54	62	57	173
C	67	63	63	193
D	77	69	71	217
E	85	69	72	226
F	84	69	70	223
G	60	64	66	190
H	68	58	55	181
I	67	58	59	184
J	78	69	69	216
K	72	58	64	194
L	74	55	66	195
M	76	66	73	215
N	76	69	68	213
O	69	53	56	178
P	49	50	52	151
Q	73	72	74	219
R	51	49	57	157
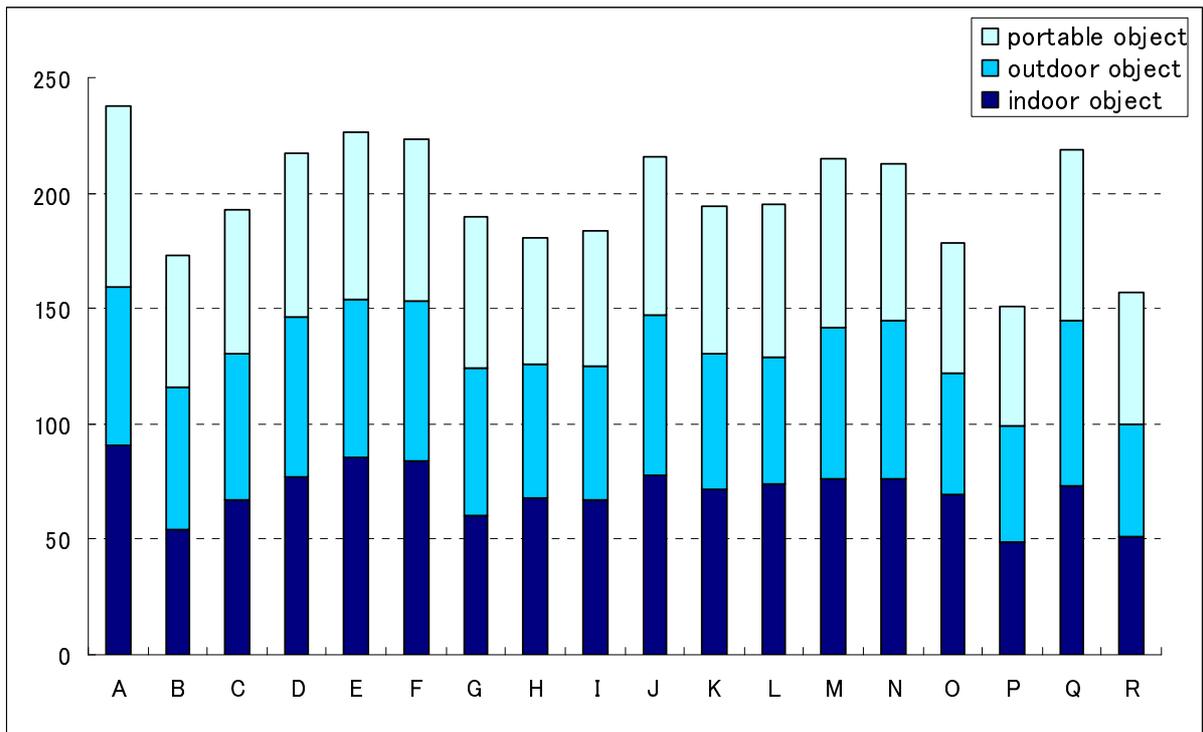
Figure 3. The cumulative frequency of the selection of each category

3.2 Shape Impression

Even rounded shapes seem similar, but elicited impressions may be much diversified. The volume of cube shape influences impressions: a big volume elicits a feeling of superiority (G) and small volume elicits loneliness (N). Cut shapes elicit joyfulness (A) or anxiety (Q) by a cut sectional impress. Cross and sharp shapes were related mostly to excitement (B) and anxiety (Q). For each context (indoor/outdoor/portable), Figure 4 shows the five shapes chosen most among the fifty shapes. The yellow-parts of bar graph are represented by a letter when at least 20% of the subjects selected it.
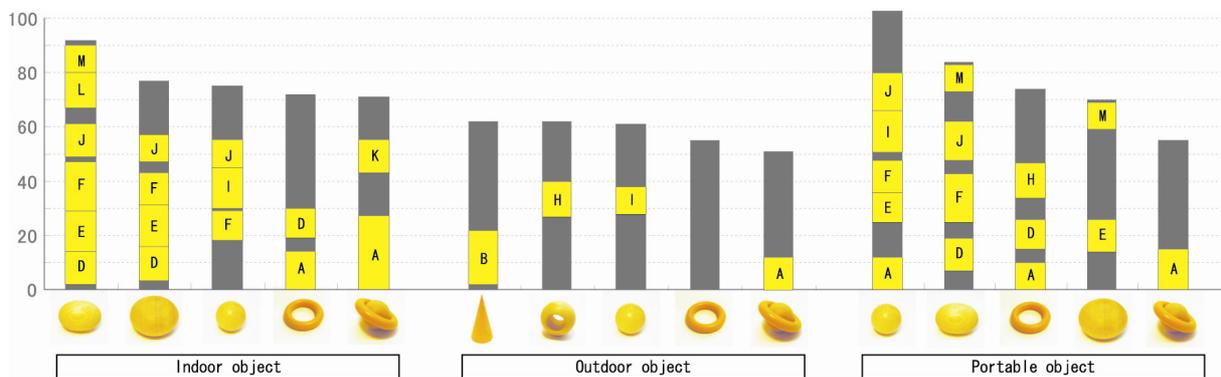
Figure 4. The frequency of higher 5

Above all, the oval shape, such as an egg, was evaluated by combining the Categories F (A shape that makes you feel gentle), E (A shape that makes you feel relaxed), D (A shape that makes you feel happy), L (A shape that distracts you from anger), J (A shape that calms your anxiety), M (A shape that gives you consolation). Also, the egg shape elicited a more gentle impression than the regular sphere. Therefore, even when shapes were very close (e.g. egg, ball …), elicited impression were different from one subject to another. As for polyhedrons of cube, prisms and wedge, results were few to consider their analysis as relevant and trustable.

Compared with other ones, outdoor objects elicited much excitement and impressions superiority. As for the cone in particular, the impression of excitement was strong. That did not appear in other environments, and may be due to the specificity of this shape: an ascending movement. However, it is

interesting to note that the expanded cylinder (top-cut cone (Shapes No. 2 and 3 of Figure 1)) did not elicit at all an impression of excitement. Therefore, it is suggested that the top of shapes is eliciting feelings of excitement more strongly than other parts of the shape. Moreover, for each item only one impression was elicited for more than 20%, which is peculiar to outdoor context (Table 4). This reflects that in the outdoor context, impression elicited by a specific object is fairly stable among subjects. Finally, it can be noticed that distribution of impression evaluation is similar for portable and indoor objects.

The Tables 3, 4, 5 show the distribution of the fifth more rated shapes. The yellow-areas are categories used for evaluation by at least 20% of the fifty subjects, and the grey-areas by at least 10% of them.

Table 3. Evaluation count of indoor object

20% and over	10% and over															*Including a plural number		
Image	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Total
	2	0	0	12	15	18	1	0	1	12	6	13	10	0	0	1	0	1	92
	2	0	1	13	15	12	0	2	2	10	5	6	8	0	0	0	0	1	77
	3	1	2	8	4	11	1	0	15	10	3	5	8	1	1	0	2	0	75
	14	1	4	11	6	5	1	6	3	3	5	3	7	1	0	2	1	1	74
	27	3	3	4	3	1	0	1	1	0	12	2	1	2	3	4	0	4	71

Table 4. Evaluation count of outdoor object

20% and over	10% and over															*Including a plural number		
Image	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Total
	2	20	5	0	0	0	9	0	1	0	1	1	0	4	7	2	9	1	62
	7	1	6	6	3	3	1	13	2	1	2	4	5	2	2	3	2	0	62
	3	2	2	9	3	8	1	0	10	6	6	3	6	1	0	0	1	0	61
	3	1	4	8	3	4	1	7	4	5	3	7	3	0	0	2	0	0	55
	12	4	3	6	3	2	1	0	1	1	8	3	4	1	0	2	0	0	51

Table 5. Evaluation count of portable object

20% and over	10% and over															*Including a plural number		
Image	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Total
	12	1	4	8	11	12	2	1	15	14	6	7	7	0	1	1	1	0	103
	5	0	2	12	6	18	2	0	3	14	3	8	10	0	0	1	0	0	84
	10	2	3	11	4	4	0	13	6	4	2	6	7	0	0	1	0	1	74
	4	0	2	8	12	9	1	0	3	5	8	7	10	0	0	1	0	0	70
	15	1	7	4	2	1	3	0	1	2	8	2	2	1	1	5	0	0	55

3.3 Classification by cluster analysis

The results of the experiment were obtained by principal component analysis (PCA) and by cluster analysis. PCA involves a mathematical procedure that transforms a number of (possibly) correlated variables into a (smaller) number of uncorrelated variables called *principal components*. The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible. Cluster analysis is a class of statistical techniques that can be applied to data that exhibit natural groupings. Cluster analysis sorts through the raw data and groups them into clusters. A cluster is a group of relatively homogeneous cases or observations. Objects in a cluster are similar to each other. They are also dissimilar to objects outside the cluster, particularly objects in other clusters. From the clusters featured in this experiment, we determined that:

- The first group (I) is constituted of the streamline shapes made of one continuous surface (such as of globe or egg) and eliciting mostly gentleness.
- The second group (II) is constituted of shapes made of continuous surface with a hole (donut, napkin ring,…) and eliciting mostly joyfulness and liberating.
- The third group (III) is constituted of many shapes eliciting mostly excitement and high motivation.
- The fourth group (IV) is constituted of many shapes eliciting mostly uneasiness anxiety.

The shapes which had not been often selected by the subjects were neither displayed on the result graphs (Figures 5, 6, and 7) and were not grouped.
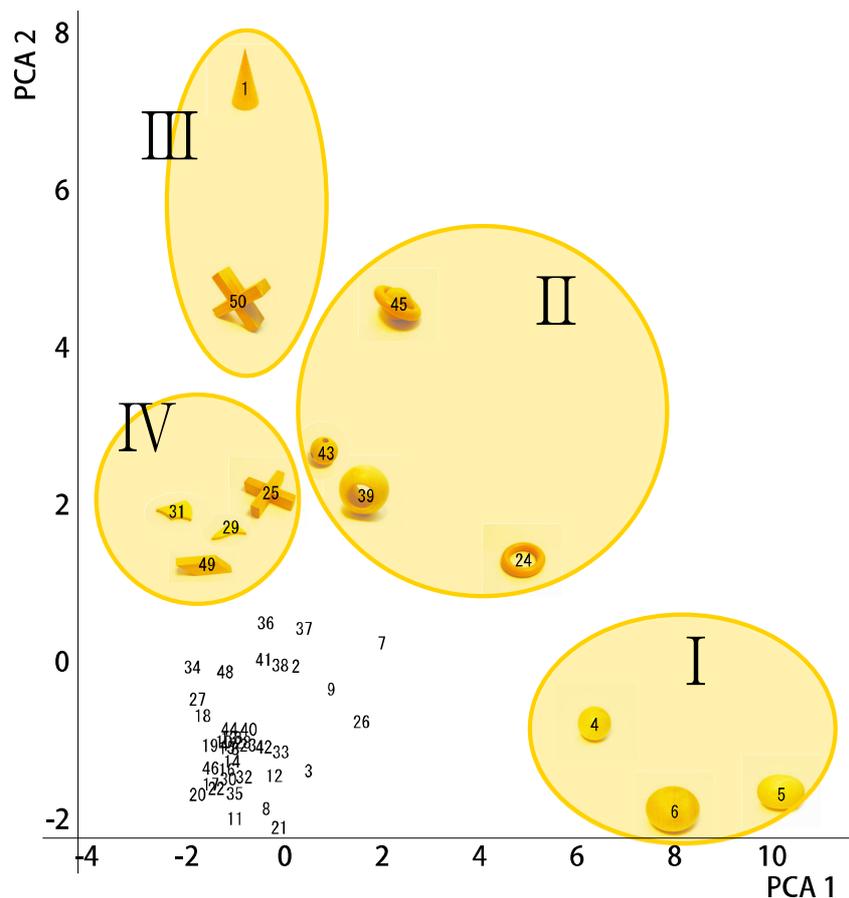
Figure 5. Classification of indoor object
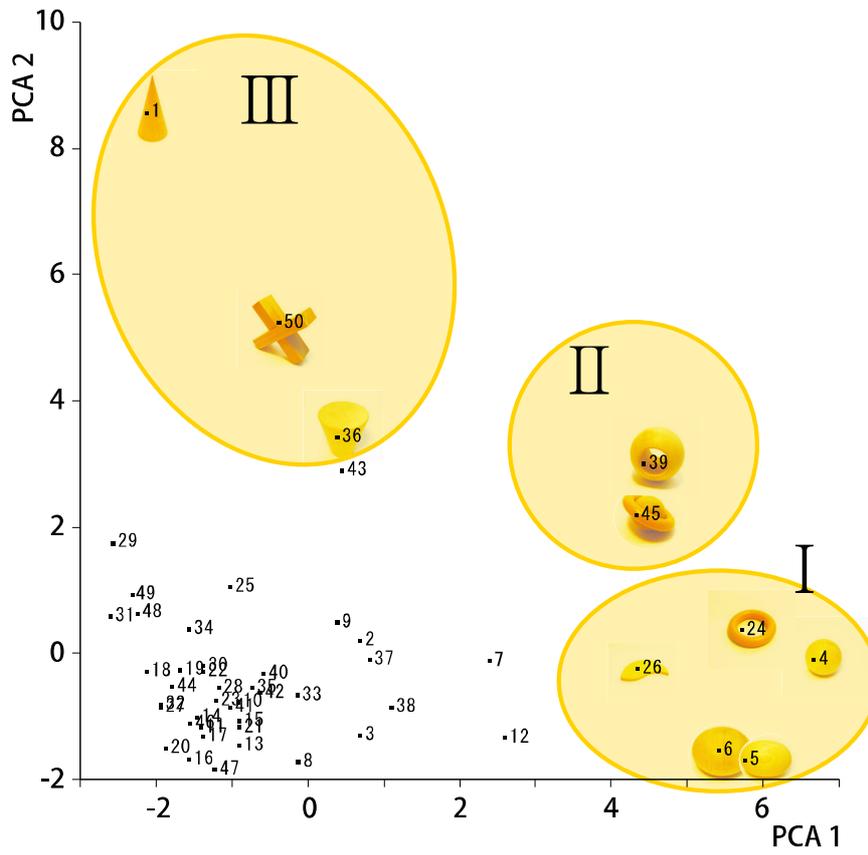
Figure 6. Classification of outdoor object
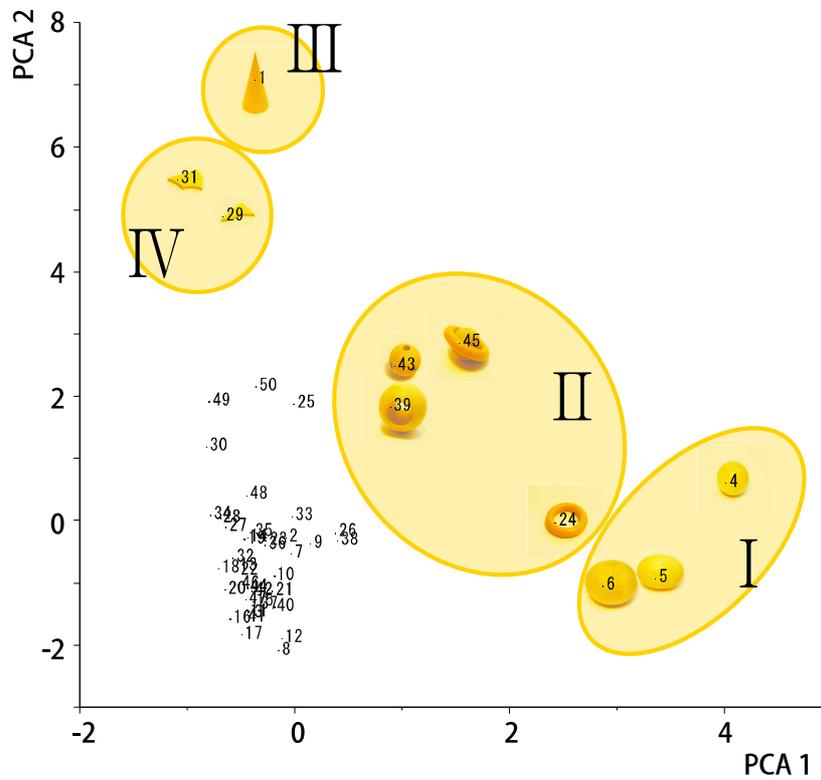
Figure 7. Classification of portable object

4   DISCUSSION AND CONCLUSION

There were some studies of products and forms, which were evaluated by the subject groups. In this study, there is a significance having paid attention to the difference of delicate feelings based on individual *Kansei*. Though in an experiment about such feelings and emotions, the same subject may give different answers at different times, we think approach emphasizing the *Kansei* is necessary like this study.

This experiment was evaluated by three types; first is the evaluation items of expressing emotion, second is the impression evaluation by each shapes, and the last is classification of shapes that had a similar attribute. Evaluation items related to joyfulness, happiness and relaxation were answered completely, whereas others were often incomplete. This means that one is conscious in feelings such as joyfulness, happiness and relaxation about shape.

Considering the environments of use, it was figured out that indoor and portable environments output had approximately similar results. Yet, results were very different from the outdoor environment ones. Compared to the former environments, the items "excitement" and "openness" were answered much more frequently. This argues that as the size or the environment influence the type of elicited feeling, it is important to consider such parameters for future research.

Globally, the analysis pointed out that the curved shapes were associated often with the positive impressions of gentleness and happiness. Moreover, as polyhedrons were rarely used for evaluation of shapes, the analysis relevancy was too low to output trustable results. However, as there are many polyhedron-like objects in the real world, a more detailed study is required to render and compare all existing shapes from wedge to cubic ones.

Ball and ring (Shape No. 4 and 24 of Figure 1) were estimated for various impressions about object recognized to small size such as the portable objects, and an impression of corn (Shape No. 1) was strong only in outdoor object. It means that size is an important element affecting an impression of objects, and then the subject judged it according to a given condition.

In this study, we were able to relate shapes and human's *Kansei*. Therefore, we propose that it may be possible to evaluate a product, using basic shapes as evaluation media. Furthermore, as the evaluation was done for three different environments of use (indoor, outdoor, and portable objects) we were able to confirm their influence on human impression.

5   FURTHER CONSIDERATIONS

The subjects of this experiment are all Asian students living in Japan. Therefore, it is necessary to perform the same experiment in Europe or other western countries, and to compare the result of this study.

As further studies, a shape-mediated impression evaluation was proposed in this paper, a comparison with already existing word-mediated impression evaluation techniques could be performed. That is a necessary step in order to start the establishment of a shape-based evaluation method, a priori considered as more relevant in *Kansei* information processing studies than word-based evaluation ones.

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Contact: A. N. Author MiYong Lee
institution/university   University of Tsukuba
department   Graduate School of Comprehensive Human Sciences, Doctoral Program in Kansei, Behavioral and Brain Sciences, Japan
street   Ibarakiken, Tsukubashi, Tennoudai 1-1-1
PO Box, City   305-8577
Country JAPAN
Phone +81.80.5174.9576
Fax
e-mail restart9@kansei.tsukuba.ac.jp
URL (optional)