

Association and Evaluation of Scent and Product in User Experience using Kansei Method

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Abstract: In this paper, we discuss about the association and simultaneous evaluation between scent and product in user experience. In a preliminary step for this study, we used an online-based survey questionnaire to inquire about the user's previous experience with commonly scented products and their perceptual opinion when scent is combined with some other range of personal products. Following indications from our survey result, we set up an experiment to explore the integration of scent in the user interactions with personal products. Using smartphone as a product sample, twenty (20) subjects were presented with variant of scents and images showing various scenarios of user-product interaction clarified with short descriptive words. Using this process, we attempted to elicit both connotative meaning and affective responses using SD (Semantic Differential) method and SAM (Self-Assessment Manikin) tool. Hence, we carried out an analytical evaluation of the responses by using PCA(Principal Component Analysis) and Cluster Analysis in order to evaluate the similarity among different aromas and various scenarios of using smartphone based on the intuitive perception of scent and smartphone user experience.

Key words: *Scent, Product, User experience, KANSEI information*

1. Introduction

The application of scent in product and product marketing is evolving as an innovative way of making the product brand more noticeable while improving the product recognition. The deliberate and controlled application of scent is used by designers, scientists, artists, perfumers, architects and chefs [1]. While currently there are increasing range of new design products incorporating scent as a new medium of interactive interface, product branding are being enhanced with unique scent while the architectural designs of space are forging a new living experience with the character of scent. The action of firms in recent years suggested that imbuing products with scents can enhance brand equity [2]. It is envisaged that in the near future, scent will play an important role in not only creating exceptional situations but also in enriching our daily life.

Already, there are two fields of scent research. One is ambient scent and the other is object scent research [2]. This study focuses on object scent which is more personal, portable, and able to create a sustainable user experience. Previous researches have shown that the combination of just any scent with the product will only not guarantee a positive result but might also evoke a negative emotional experience with the products [3]. Thus, it is more important to use a scent which is appropriate and matchable to create a pleasurable experience that coheres with the user's Kansei while they interact with products.

This paper investigated about scent and product in our daily life, and evaluated the impression of similarity among the aromas and the images of user-product interaction of using smartphone. For the evaluation, words are usual for adjusting and analysis of information, but sometimes it is difficult to understand the information intuitively, and the problem can be solved by metaphorical and comparatively expression [4]. Therefore, both verbal and non-verbal measurements were used to evaluate the stimuli. Semantic Differential (SD) scale is a verbal psychological measurement which is very popular in Kansei Engineering study [5]. It measures the connotation of objects, events, concepts or attitudes [6]. Self-Assessment Manikin (SAM) is an expression based picture-scale that directly measures the major affective dimensions [7].

2. Questionnaire

2.1 Questions and Results

An online questionnaire was set to investigate information about people's experience with scent and product in daily life. In the questionnaire, people were asked to answer 5 questions. 23 people (12 male, 11 female) participated, most of them are in their twenties. Table 1 shows the questions and options and the result of each question.

Table 1. Questions and Results of Questionnaire

No.	Question	Options (frequency, percentage)
1	Which of the following products do you think it is better to have a scent combined with(multiple answers)	ball-point pen(0, 0.0%), soap(20, 87.0%), furniture(4, 17.4%), marker pen(3, 13.0%), car(5, 21.7%), phone(5, 21.7%), curtain(7, 30.4%), toothpaste(13, 56.5%), earring(4, 17.4%), notebook(4, 17.4%), tissue(11, 47.8%)
2	Have you ever felt a good smell when you are opening the package of a product or using a product? If you have, what kind of product?	No, I haven't(7, 30.4%) Yes, I have(16, 69.6%)
3	If a product maker is planning to add a scent to (all of) its products, do you think the scent should be	a common scent(16, 69.6%), an uncommon scent(7, 30.4%)
4	If there is a scent coming out when you open the package of the Apple's new iPad, which kind of scent would be most expected or can make you excited?	a scent mix of plastic wrap and aluminum come directly from the factory(8, 36.4%) a scent of printed ink(3, 13.6%) a scent of apple fruit(8, 36.4%) a scent of distinctive perfume(3, 13.6%)
5	How do you feel about the scent of an antiseptic solution?(multiple answers)	mysterious(2, 8.7%), innovative(2, 8.7%), calm(7, 30.4%), solemn(9, 39.1%), lovely(0, 0.0%), passionate(3, 13.0%), clean(17, 73.9%), impassive(4, 17.4%), high impact(3, 13.0%), dynamic (2, 8.7%), static(3, 13.0%)

2.2 Discussion

In the first question, the most chosen options are those items which will touch our body when we are using them (soap, toothpaste, tissue). Among them, soap and toothpaste have the function to retain the smell on our body. All of the 3 products will be close to our nose when used. When people are using a product, they will prefer to smell a comfortable scent even the scent can-not stay enduringly (tissue). Therefore comfortableness is also an important factor of scented product. The 4th most chosen option is curtain. When people are opening or closing

the curtain, the operation will cause air movement, which can bring us some fragrances if the curtain is perfumed. According to the result, this kind of scent interaction is expected. Ball-point pen was not chosen by anyone. It appears that a smell may disturb the user when he/she want to concentrate on work.

The second question showed that about 70% people experienced good smell when opening a package of a product. The most answered category was electronic products and cosmetics. According to the result of the third question, a scent mix of plastic wrap and aluminum come directly from the factory was one of the most expected scents when opening a new iPad. And it is the real smell come out of a new iPad package which is known by every Apple fans [8]. This kind of smell can tell us what we bought is fresh, new, high-technology, and cool. Another most selected scent is the scent of apple fruit. Scent of apple fruit is not familiar with electronic products, but it is a common smell that we can easily recognize, and as the symbol of Apple, people would like to feel the smell of apple fruit when opening Apple’s products. These two kinds of scent are most expected and able to make us excited.

According to the result of third and fifth question, people prefer common scents. It is supposed that an uncommon scent will confuse user, when users have no association because of the lack of the experience of that smell. When there is an experience of a scent in common, people feel it in common. The result also supports the opinion that the emotion association with scent comes through experience [9].

People prefer that products should be scented when the product has the operation or interaction such as opening something or moving it close to our nose. For scented product, people expect common scents, and the scent should either match the emotion of using the product or make user associate the image of the brand or design of the product.

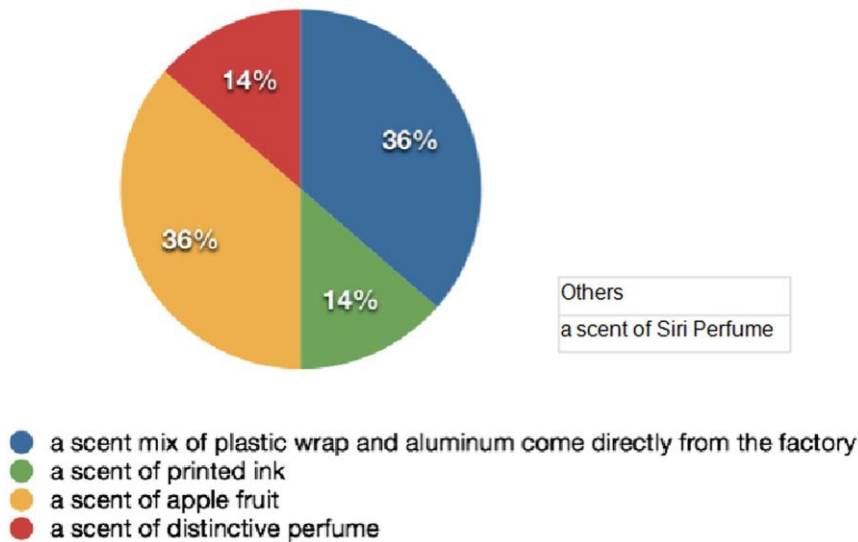


Figure.1 Result of Question 4

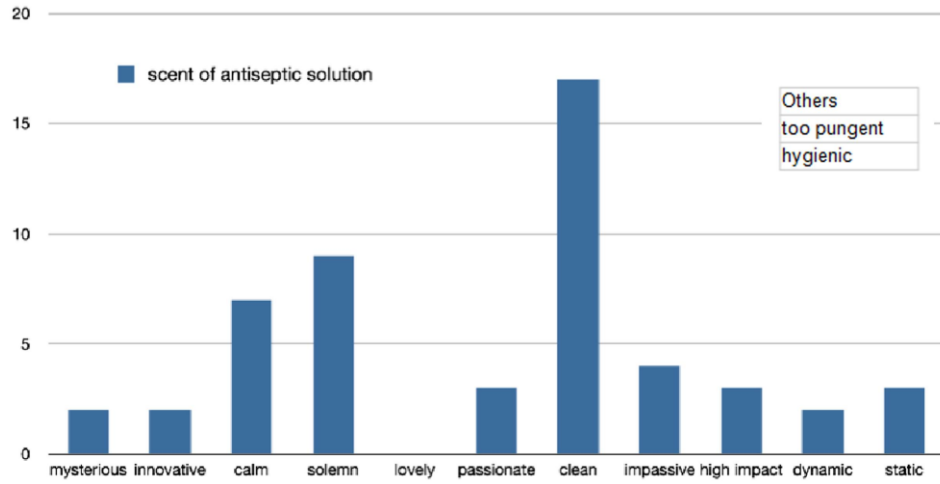


Figure.2 Result of Question 5

3. Experiment

3.1 Selection of Stimuli

Firstly, we did the selection of scent stimuli and product image stimuli. As for the scent stimuli, 9 aromas (A1, A2, ..., A9) were selected. All of them are the most common essential oils in the aroma market. Smartphone was selected as the product sample, which can easily represent various scenarios of user-product interaction because of the universality and the versatility. Additionally, we made 8 image cards (I1, I2, ..., I8) of different scenarios of using smartphone, and attached descriptive words on the back of the cards. Table 2 shows the summary list of scent stimuli including the familiarity and properties of the smell and Figure 3 shows the summary list of image stimuli.

Table 2. Summary of Aroma Stimuli

Code	Essential Oil	Familiarity*	Properties of Smell**
A1	Green Apple	1.95	Very Sweet, Fruity, Washing
A2	Juniper Berry	0	Fresh, Woody-balsamic, Slightly Sweet
A3	Orange Sweet	2.95	Very Sweet, Fruity
A4	Vanilla	1.55	Very Rich Sweet
A5	Rosemary	-0.5	Herbaceous, Pungent, Medicinal,
A6	Lavender	-0.5	Herbaceous, Floral,
A7	Tea Tree	-0.7	Spicy, Pungent,
A8	Peppermint	2.75	Clean, Fresh, Minty
A9	Geranium	-0.95	Calming, Floral, Slightly Sweet

* The data of familiarity comes from the experiment of this paper using a 9-point scale from -4 point (very unfamiliar) to 4 point (very familiar)

** This data summarized the descriptions by various sources [10][11][12][13][14] and the comments of the subjects during the experiment of this paper

3.2 Procedure and Measurement

Twenty (20) subjects were presented with 9 essential oils (A1, A2, ..., A9) and 8 image cards (I1, I2, ..., I8). Subjects were instructed to smell the aromas by holding the little bottles by themselves and smell coffee grounds between consecutive scent stimuli to refresh [2]. After the scent stimuli, there was a 5 minutes break and their comments were recorded during the break time. Then subjects were presented with the image cards. Each stimulus was evaluated by SD method and SAM using a questionnaire. The questionnaire includes differential word pairs (Table 3) and the paper and pencil version of Self-Assessment Manikin [15] (Figure 5). Subjects were asked to rate in the scales of 9 points for each word pairs and SAM scales. For instance, “very formal” is -4 point, and “very casual” is 4 point. The other hand for the SAM scales, we used the 9-point picture-scale that directly measures the two major affective dimensions: pleasure and arousal [7]. Figure 4 shows the details about the procedure of the experiment. Subjects followed procedure A for 9 times as there were 9 stimuli of essential oils, and after a 5 minutes break, they followed procedure B by evaluating 8 image cards for 8 times. The questionnaires they filled for both procedure A and B are the same.



Figure.3 Summary of Image Stimuli

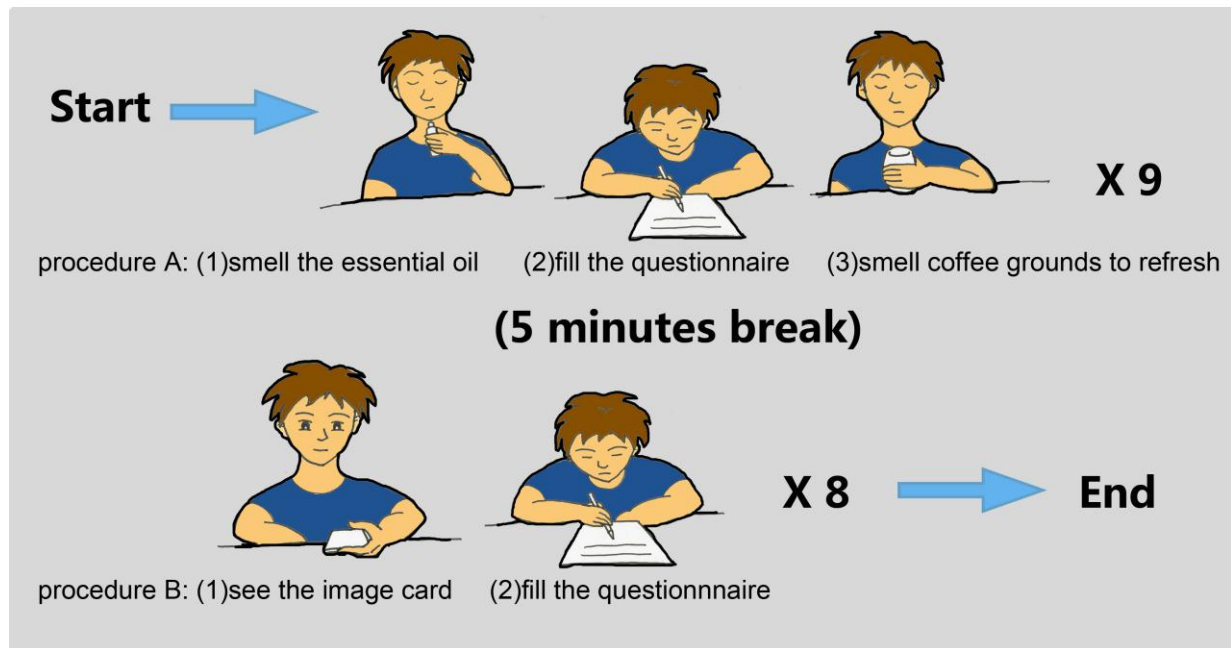


Figure.4 The experimental procedure

Table 3. Pair of adjective (SD scales)

No.	Pair of adjective
1	formal - casual
2	intricate - simple
3	gentle - harsh
4	serious - jokey
5	dynamic - static
6	private - social
7	flashy - conservative
8	interesting - boring
9	maturish - childish
10	manly - womanly
11	composed - agitated
12	clear - vague
13	amateurish - professional

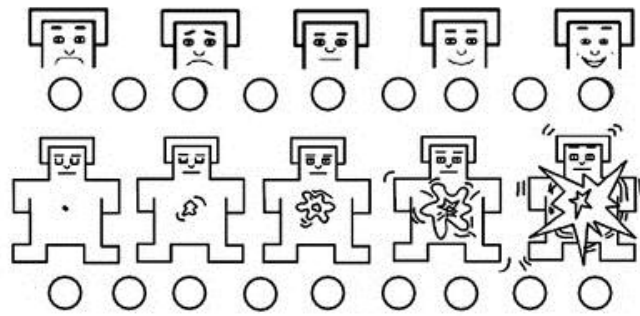


Figure.5 The Self-Assessment Manikin (SAM):
Pleasure (top) and arousal (bottom) scales

4. Results and Discussions

4.1 Results of SD method and SAM

The evaluation values of SD method were analyzed by PCA (principal component analysis) using IBM SPSS statistics [16]. Table 4 shows the component loadings of PCA. Principal component 1, 2, 3, 4 showed about 83% cumulative proportion. Additionally, cluster analysis (ward's method) was used to analyze the principal component scores. Figure 6 shows the cluster dendrogram. Figure 7 shows the simultaneous evaluation by pleasure-arousal score scatter plot.

Table 4. Component loadings of PCA

Component	Total Variance Explained					
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.264	40.495	40.495	5.264	40.495	40.495
2	2.475	19.039	59.534	2.475	19.039	59.534
3	1.819	13.996	73.529	1.819	13.996	73.529
4	1.250	9.618	83.147	1.250	9.618	83.147
5	.908	6.983	90.131			
6	.523	4.027	94.157			
7	.273	2.103	96.261			
8	.198	1.527	97.788			
9	.121	.931	98.719			
10	.079	.606	99.325			
11	.067	.518	99.843			
12	.018	.139	99.982			
13	.002	.018	100.000			
14	5.264	40.495	40.495			

Extraction Method: Principal Component Analysis

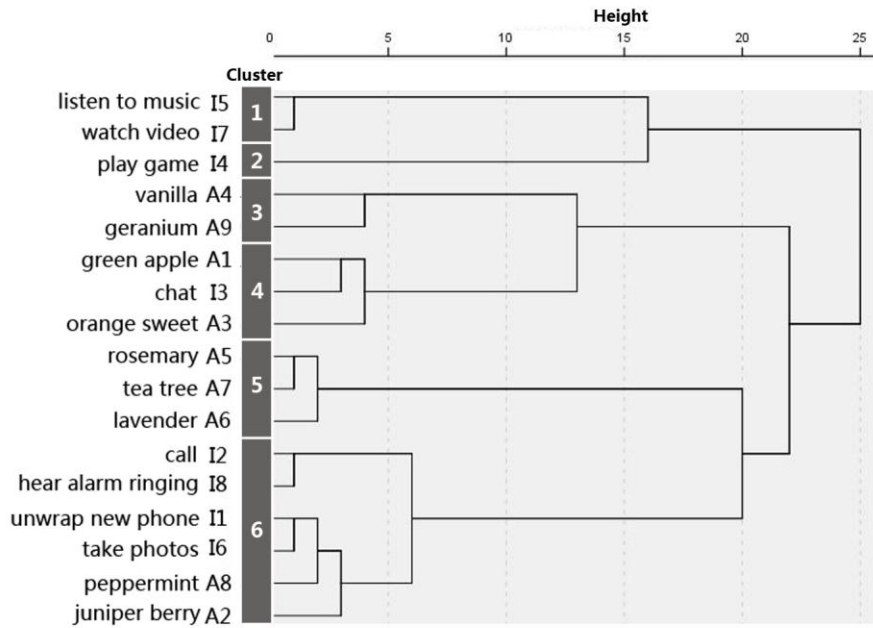


Figure.6 Classification using cluster analysis

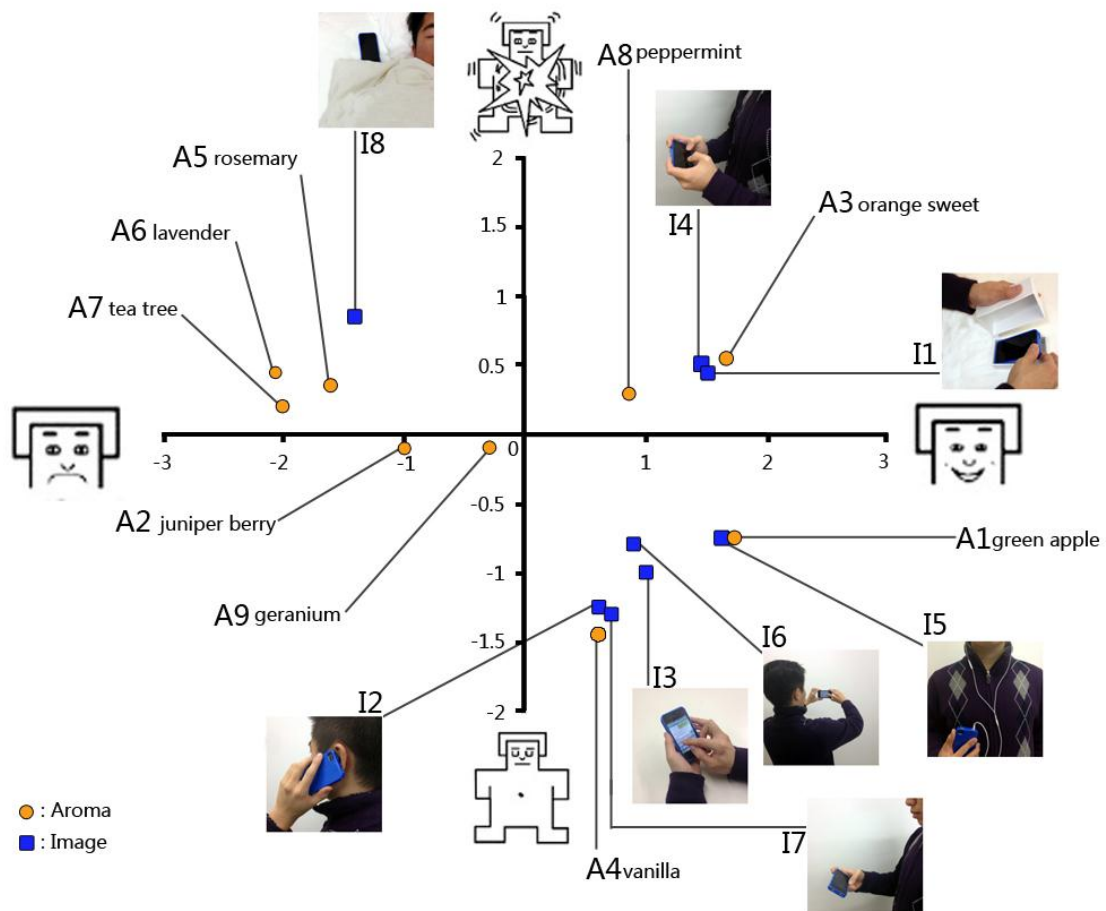


Figure.7 Self-Assessment Manikin scatter plot

4.2 Discussions

As a verbal measurement, the result of Semantic Differential method (Figure 6) shows the evaluation in connotative meaning of the stimuli [6]. Based on the classification using SD method, A1, I3 and A3 are grouped into cluster 4. I2, I8, I1, I6, A8 and A2 are grouped into cluster 6. Accordingly, these objects have similarity in connotation. Therefore, the action I3 (chat) has high similarity with the scent A1 (green apple) and scent A3 (orange sweet), and the scent A8 (peppermint) and A2 (juniper berry) have high similarity with the action I1, I6, I2 and I8, especially I1 (unwrap new phone) and I6 (take photos). The action I5, I7 and I4 have no similarity with any scent, and the scent A4, A5, A6, A7, A9 have no similarity with any action, either.

On the other hand, as a nonverbal measurement, the result of SAM (Figure 7) shows the evaluation in affective responses of stimuli [17]. According to the scatter plot of the result of SAM, the action I1, I4 and the scent A3 are almost at the same pleasure-arousal level. The scent A8 is very close to them, which has a lower level of both pleasure and arousal. So, I1 (unwrap new phone), I4 (play game) have high similarity with A3 (orange sweet) and A8 (peppermint) in affective dimensions. These objects are the only ones which are perceived to be both pleasant and arousing. Unwrapping new phone and playing games make the user excited and pleasant. According to Table 2, A3 (orange sweet) and A8 (peppermint) have an absolutely different sense of smell, but both of them have a very high score of familiarity. Many subjects recognized A3 and A8 during the experiment. A1 (green apple) has a sweet, fruity sense of smell, which is similar to A3 (orange sweet), but most of the subjects could not recognize it. They perceived it as a kind of washing smell (e.g. shampoo, etc.). Therefore, familiarity plays an important role in affective response of scent. A1 (green apple) is extremely close to I5 (listen to music), both of them have a high level of pleasure and they are in the calm part of the scatter plot. The action I2, I7 and the scent A4 are very close, they were perceived as very calm and a little pleasant. The scent A5, A6, A7 and the action I8 were perceived as unpleasant and arousing stimuli. There is no stimulus perceived as very calm and unpleasant in this experiment.

The scent A5, A6 and A7 are unfamiliar to the subjects, and they have similar sense of smell (pungent, herbaceous, etc.), therefore they have no similarity with presented actions in connotative dimensions but, in affective dimensions, the action I8 (hear alarm ringing) is similar to them due to the unpleasant and arousing emotion of the user.

The action I4 (play game), I5 (listen to music) and I7 (watch video) can be classified into the action of entertainment, they are casual and they have no similarity with any scent in connotative dimensions. However, in the affective dimensions, I4 (play game) is very close to A3 (orange sweet), I5 (listen to music) is very close to A1 (green apple), and I7 (watch video) is very close to A4 (vanilla). All of these scents (A1, A3 and A4) have a very sweet sense of smell (table 2). Therefore, actions of entertainment and sweet scents have a high similarity in affective responses.

The action I2 (call) and I3 (chat) which are supposed to be the most basic functions of smartphone involving communication between at least two users, showed similarity in the affective responses using SAM. However, according to the classification using SD method, they are grouped into two different clusters (cluster 4 and cluster 6). So, they are quite different in connotative meaning. In cluster 4, I3 (chat) is combined with A1 (green apple) and A3 (orange sweet), which are sweet fruity scents. Another sweet scent (A4, vanilla) is in cluster 3, which can be combined with cluster 4 at the height of 15. On the other hand, in cluster 6, I2 (call) is combined with A2

(juniper berry) and A8 (peppermint), both of which have a fresh sense of smell. Therefore, in the verbal connotative meaning, I3 (chat) has the tendency to be associated with sweet scents, and I2 (call) has the tendency to be associated with fresh scents.

5. Conclusions

This paper investigated about scent and product in our daily life, and then evaluated the impression of similarity between scents and product actions of users when using smartphone in both connotations and affective responses. As a verbal measurement, SD method was used to evaluate the connotative meaning, and SAM was used to evaluate the affective responses as a nonverbal measurement.

It was shown that there are similarities between scents and user's actions in both connotative meaning and affective responses. However, the similarities are different in the two dimensions because Kansei worked in different ways in verbalization and non-verbalization. For the application of scent in design, it is important to choose the proper method so as to evoke the objective part of Kansei of users, either the understanding of connotative meaning or the intuitive affective responses.

Towards improving the richness and quality of user-product interaction experience, the study recommends that the inclusion of an olfaction-based experience in the design process will be a promise to keep for the next generation of product designs.

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