A study on the Emotional Relevance between Fruit-Surface and Perception of Vision and Touch

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Abstract: when it comes to product experience, it is essential to research into the emotion caused by vision and touch since human experience is mainly acquired from these two senses and emotion is one of the major factors constructing human and plays a vital role in the field of affective design. Therefore, this study aims to research into the emotional variation among vision, touch and the multi-perception through the texture of fruit-surface. In the experiment, subjects would be asked to perceive 15 texture of fruit-surface through vision, touch and the multi-perception separately, and report emotional response with drawn facial expression and Likert Scale. Multidimensional Scaling (MDS) and Cluster Analysis were applied to figure out the emotional relevance between the texture and the perception. According to the result of this research, the texture of fruit-surface could be divided into four types in terms of emotional response, and each type corresponds to different physical characteristics. The results of this research can be applied in the field of affective design, and providing designers a new perspective by applying affective experience. The research of fruit-surface may also provide some contribution to the new texture development.

Key words: Visual Perception, Tactile Perception, Multi-Perception, Emotion, Texture of Fruit-Surface

1. INTRODUCTION

Emotion is the person's attempt or readiness to establish , maintain, or change the relation between the person and her or his changing circumstances, on matters of significance to that person.[1] Instead of the word 'emotion', Russell defined 'prototypical emotional episode' as a complex set of interrelated subevents concerned with a specific object. The object is the person, condition, event, or thing (real or imagined; past, present, or future) that the emotional episode is about.[2] For instance, a person feels pleasant and starts dancing because of hearing a lovely music, and another one is scared and run out of the building because of the earthquake. A prototypical emotional episode necessarily includes the object in the event and overt behavior in relation to the object and 'core affect.' Core affect is similar to what Thayer called activation[3], what Watson and Tellegen called affect[4], and what others have called feeling or mood. Core affect refers to the most elementary consciously accessible affective feelings that need not be directed at anything.[2] Consider the word calm. Someone may feel calm after caressing a fluffy blanket and then closes the eyes. Another time, the person feels calm for no known reason. The first case would be a prototypical emotional episode, the second not. Both involve core affect. This study focuses on the emotion which is induced by perceiving texture, namely a prototypical emotional episode, and the 'core affect' corresponds to the 'emotion' in this research.

Emotion plays a vital role in human-product interaction. Positive emotion would stimulate product purchase intentions.[5], repurchase intentions[6], and product attachment.[7] When using complex technology, positive emotion may decrease usage anxiety[8] and contribute to the experience of usage comfort.[9] Besides, negative usage emotions also contribute to rich and meaningful experiences.[10] In brief, Emotion is one of the important factors constructing product experience. In the field of affective design, people also struggle for applying emotion in product design. Based on scenario, storytelling and theory of affordance, Teng & Chuang proposed a new design method- form arousal design model, and claimed that the product designed by this method could give users rich affective experience.[11]

Texture is the key feature on the surface of products, and it has a great impact on the appearance and usability. Vision and touch both are important sensory systems to perceive texture. People use touch to perceive temperature, weight or hardness, and use vision to perceive lust, colors or painting. Visual-tactile perception is the multi-perception of vision and touch, namely perceiving objects simultaneously by vision and touch. People often use vision and touch simultaneously to perceive most objects like the vein on the trunk or the hair of a dog. Different texture makes different visual and tactile experience for users, and designers should pay much attention to these two senses for users. Kenya Hara- the art director of MUJI organized a design exhibition of 'HAPTIC' in 2004 [12]. The exhibition inspired designers to reconsider the meaning of tactile perception on affective experience (see *Figure 1*).

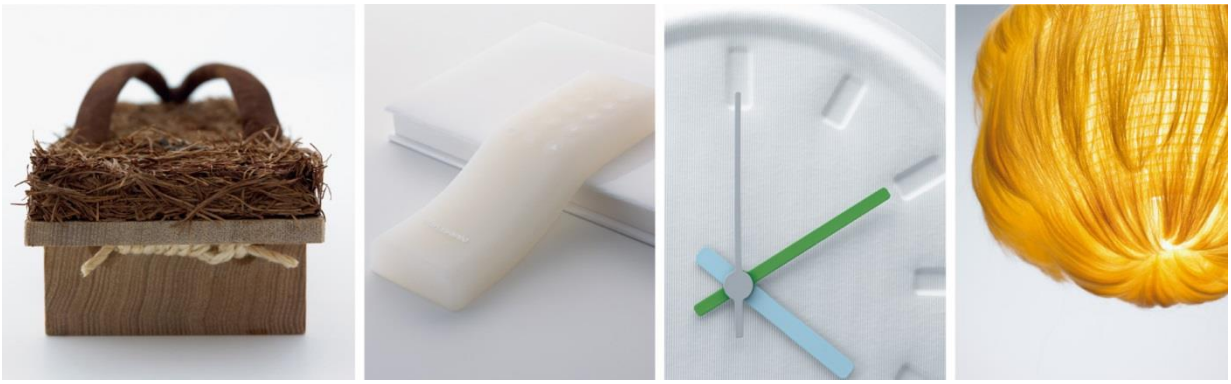

Figure 1. The works in the exhibition of 'HAPTIC' [12]

It is also interesting to manipulate the correlation between vision and touch. Take visual-tactual incongruities[13] as an example. Sometimes, you feel something different from what you (thought you) saw. If you feel something unexpected, you will be surprised. You may be surprised when something is heavier, softer or cooler than you expected and feel interested, amused, fascinated or confused. This example illustrates that designers can create various affective experience for users by manipulating some characteristics of vision and touch. In order to collect various affective experiences, fruit-surface will be used as specimen in this study because we can expect that subjects would respond apparently different to various fruit-surface. Besides, few research had discussed the affective experience of fruit-surface, so the research of fruit-surface may also contribute to new texture development and stimulate the creativity for designers.

Although visual and tactile perception both are important for perceiving texture, users would focus on different perception for different texture. People may focus on the softness of a white pillow regardless the appearance. An

other time, the person may focus on the beautiful printing on the pillow regardless the feeling of touch. According to different prodcut or situation, the designer may hope that the user would focus on specific perception. For some products like the screen of computer, the clock on the wall or the curtain of the windows, the designer may hope the user focus on vision regardless the feeling of touch. For the products like the mouse of computer, the steering wheel, the gear shift lever, or the hadle of tools, the designer may hope the user focus on the comfortable feeling of touch. However, what texture should be applied for a specifc product or situation to manipulate human perception? Based on the background information, this study aims to find out the emotional relevence of the three perceptions for various fruti-surface texture.

2. METHODOLOGY

2.1 Subjects

The study population consisted of 41 subjects, 18 males, and 23 females. The range of average age is between 18 and 30. 29 subjects out of 41 were product design background and others are not. All the subjects have the experience of seeing or touching the fruit which was applied in the experiment, and had normal ability to perceive the specimen by vision and touch.

2.2 Texture of Fruit-Surface

This study collected various fruits of the season from traditional market, supermarket and fruit stand. In order to unify the surface area of each specimen, the fruit which was not big enough was filtered out. 15 species of fruit were selected and listed as follows: banana, coconut, pitaya fruit, pineapple, orange, wax apple, tomato, guava, apple, papaya, carambola, hami melon, kiwi and sugar apple. Each specimen was made into a box (8*8*4cm) and the area of fruit surface was about 4*4cm (see *Figure 2*).

Figure 2. Specimens of fruit-surface

2.3 Emotion Measurement

The instruments for measuring emotion can be divided into two categories which are verbal instruments and non-verbal instruments. Non-verbal instruments (measuring brain wave, eye movement, etc.) are objective but can only reliably assess a limited set of emotions [14]. Moreover, non-verbal instruments cannot assess mixed emotion. With verbal instruments (e.g. PAD emotion scales [15]), subjects are asked to evaluate the emotional response by themselves. Although verbal instruments are subjective, they can assess most emotion including mixed emotion. The major limitation of verbal instruments is that they cannot be used in different cultures because for many

emotion words a one-to-one translation is not available. To overcome this problem, ‘Emocards method’ makes use of drawn facial expressions instead of emotion words. Although it is still subjective but it can be used in different cultures, hence Emocards method is available in this study. According to ‘circumplex affective model’[16], the space of emotion consists of two dimensions which are pleasure and arousal (see Figure 2). The Emocards method divides the ‘circumplex’ into eight parts, and each octant represents a state of emotion. Moreover, each state of emotion is represented by two cards that depict drawn facial expressions (see *Figure 3*).

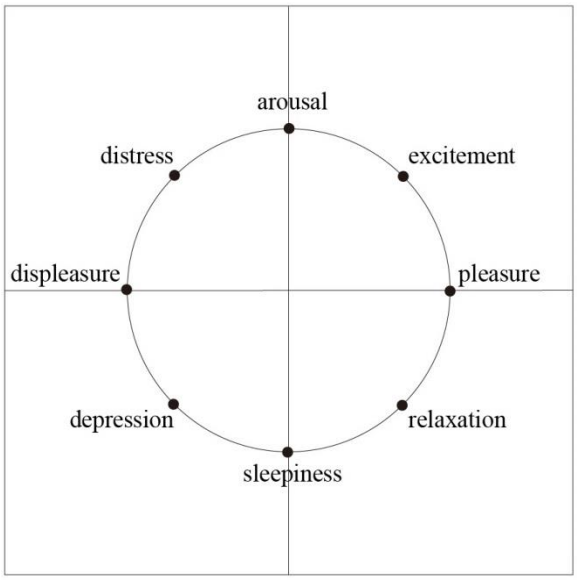

Figure 3. Circumplex affective model [16]

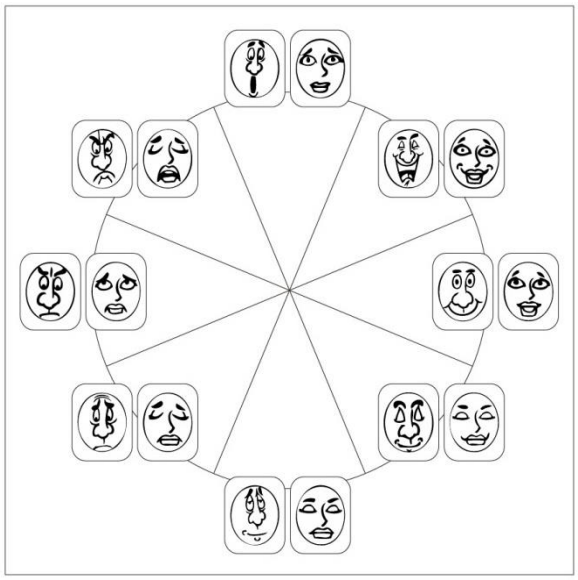

Figure 4. Emocards method is developed on the base of circumplex affective model [17]

2.4 General Procedure

Each subject was invited to a soundproof room in case the subject might be disturbed by noise or other people. In the beginning, the subjects were instructed about the aim and the procedure of the experiment, and asked to focus on the fruit-surface regardless of the taste and smell of fruit and the texture inside. In order to reduce the influence of smell, the subjects were not allowed to get close to the specimen with the nose. In terms of the abilities of memorizing and distinguishing, vision is better than touch, hence the subjects were asked to perceive the 15 specimens with touch first. Each specimen was placed in an opaque box, and the subjects were asked to touch the specimen in the box without vision (see *Figure 5*). In the same time, the subjects assessed their own emotional response and record it in the questionnaire. After the first step, the subjects were asked to perceive the same 15 specimens with vision and not allowed to touch any texture and then record their emotional responses likewise. In the third step, the subjects were asked to perceive each specimen with vision and touch simultaneously, and record the emotional responses again. The sequence of the fifteen specimens and the eight emotions in the questionnaire varied randomly across subjects. After the three steps of perception, the subjects were interviewed about ten minutes. Each subject spent about 50 minutes in an experiment.

Figure 5. The tactile step of the experiment

2.5 Analysis

Fifteen types of texture were involved in the experiment, and each texture corresponded to the three types of perception which are visual, tactile perception, and the multi-perception. Multidimensional Scaling (MDS) was applied to produce the coordinates and distance among each perception in a space of stimuli. In this space, the distance between two points means the dissimilarity of emotional response between two perceptions. Longer distance means larger dissimilarity and vice versa. Cluster Analysis was applied to classify the 15 texture according to the dissimilarity of the three perceptions. ANOVA was used to test and verify the reliability of Cluster analysis and facilitate the discussion of the emotional relevance among the perceptions.

3. RESULTS

3.1 MDS Solution

A two dimensional space was produced by Multidimensional Scaling (Stress=0.055, RSQ=0.987). In order to explain the meaning of this space, Regression Analysis could be applied to produce the vectors of the eight emotions[18] (see *Figure 6*). The direction and sequence of each emotion was similar to the circumplex affective model proposed by Russell [16], hence this study also divided the space into eight parts, and each octant represents the closest emotion state.

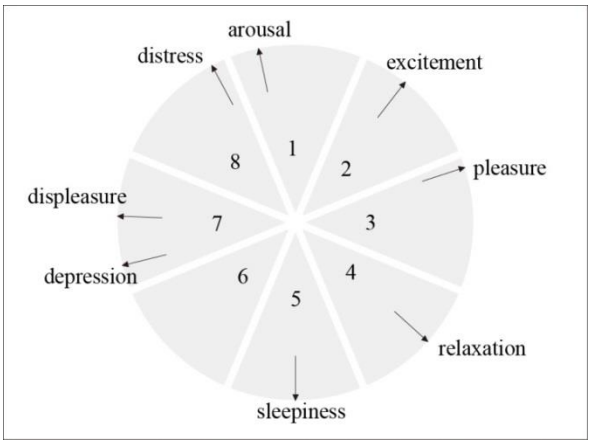

Figure 6. Two-dimensional MDS map

3.2 Cluster Analysis

On the MDS map, the distance between two points means the dissimilarity of the two perceptions in terms of emotional response. Longer distance means larger dissimilarity, vice versa. This study assumed the distance between visual perception and the multi-perception was $\overline{VM}$ (see *Figure 7*), and the distance between tactile perception and the multi-perception was $\overline{TM}$.

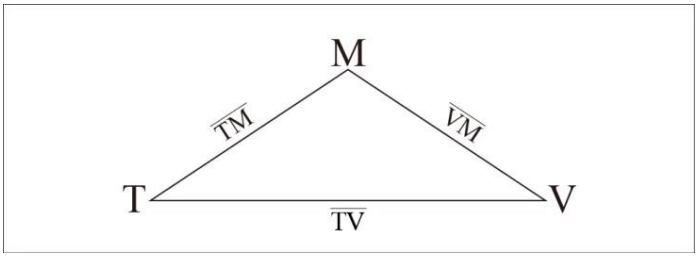

Figure 7. Emotional response of each perceptions in the space of MDS (V: vision, T: touch, M: the multi-perception)

According to Cluster Analysis of $\overline{TM}$ and $\overline{VM}$, the 15 textures can be divided into four clusters, and this study applied ANOVA (Analysis of Variance) to test the four clusters (see Table 1). In terms of cluster 1, $\overline{VM}$ (the average distance between visual perception and the multi-perception) is shorter than $\overline{TM}$ (the average distance between tactile perception and the multi-perception), namely the emotional response of multi-perception is more similar to visual perception. Likewise, the multi-perception is more similar to tactile perception for cluster 2. Therefore, cluster 1 could be named 'vision-oriented', and cluster 2 could be named 'touch-oriented.' In terms of cluster 3, the multi-perception is similar to both the other two perception. In contrast, the multi-perception of cluster 4 is dissimilar to both the other two perception. Therefore, cluster 3 could be named 'aggregation-oriented,' and cluster 4 could be named 'diversion-oriented'

Table 1. ANOVA for the four clusters

	Cluster 1 (n=4)	**Cluster 2 (n=5)**	**Cluster 3 (n=2)**	**Cluster 4 (n=4)**	**F (Sig.)**	**Multiple Comparisons**
$\overline{TM}$	1.79	0.71	0.84	1.12	28.608***	1-2, 1-3, 1-4, 2-4
$\overline{VM}$	0.92	1.19	0.55	1.13	8.162***	1-2, 1-3, 2-1, 2-3, 3-4

(*P<.05，**P<.01，***P<.001)

Figure 8 and 9 respectively shows the texture of ‘vision-oriented’ and ‘touch-oriented’ in the MDS map.

- Vision-oriented (see *Figure 8*): emotional response of vision and the multi-perception both are at the same emotion state. For instance, the emotion states of vision and the multi-perception both are pleasure for orange, but the touch is sleepiness. Vision and the multi-perception both are excitement for hami melon, but the touch is depression. Vision and the multi-perception both are depression for coconut, but the touch is relaxation.
- Touch-oriented (see *Figure 9*): emotional response of touch and the multi-perception are similar. For instance, the emotion state of touch and the multi-perception both are displeasure for pineapple. Touch and the multi-perception both are distress for sugar apple. Touch and the multi-perception both are pleasure for pear and apple. Although touch and the multi-perception are at different emotion states for banana, but these two perceptions are actually closed.

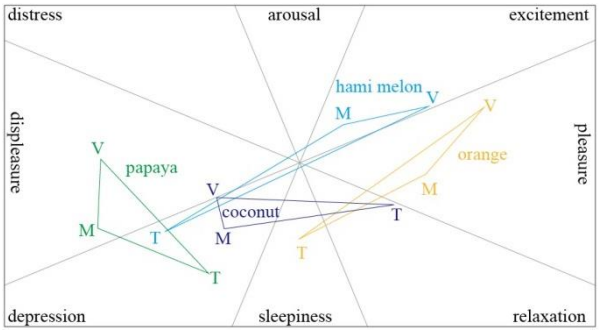

Figure 8. Vision-oriented: vision (V) and the multi-perception (M) are at the same emotion state

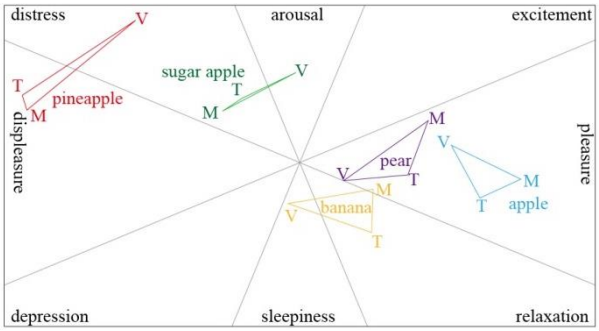

Figure 9. Touch-oriented: touch (T) and the multi-perception (M) are at the same emotion state

Figure 10 and 11 respectively shows the texture of ‘aggregation-oriented’ and ‘diversion-oriented’ in the space of MDS, and would be illustrated as follows.

- Aggregation-oriented (see *Figure 10*): the coordinates of the three perceptions (visual, tactile perception and the multi-perception) are closed to each other, or the three perceptions are in the same emotional state. For instance, all the three perceptions for tomato are closed and at the same emotional state which is ‘pleasure.’ For carambola, though tactile perception is located on the different emotional state with the other two, these three perceptions are actually much closed with each other.
- Diversion-oriented (see *Figure 11*): the coordinates of the three perceptions (visual, tactile perception and the multi-perception) are located on different emotional states. Visual-perception for guava is located on ‘pleasure’, however tactile perception is located on ‘displeasure’ and multi-perception is located on ‘sleepiness.’ Visual-perception for pitaya is located on ‘excitement’, tactile perception is located on ‘depression’ and the multi-perception is located on ‘pleasure.’ Visual perception for kiwi is located on ‘depression’, tactile perception is located on ‘distress’, and the multi-perception is located on ‘displeasure.’ Visual-perception for wax apple is located on ‘depression’, however tactile perception is located on ‘displeasure’ and the multi-perception is located on ‘sleepiness.’

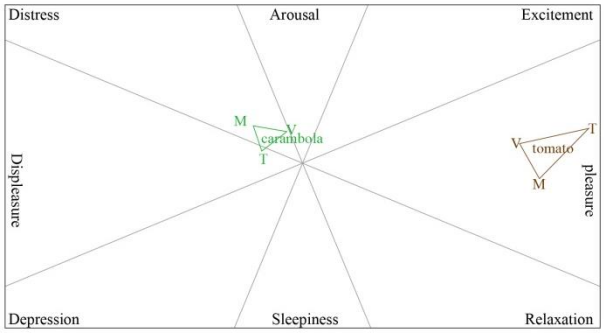

Figure 10. Aggregation-oriented: the three perception are close to each other

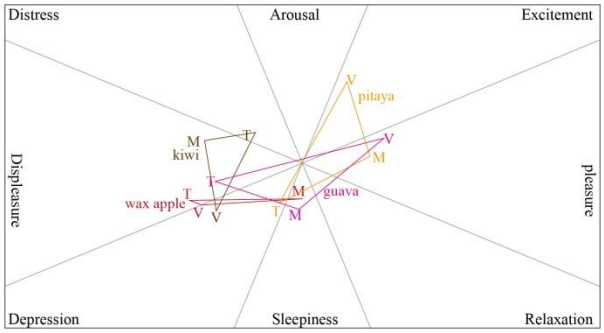

Figure 11. Diversion-oriented: the three perceptions are located on different emotional states.

4. DISCUSSIONS

In this section this study would discuss the physical characteristics for each type of texture with the MDS space. The emotion evoked by the multi-perception in response to the texture would also be discussed.

Vision-oriented: the texture of 'Vision-oriented' was composed of hami melon, orange, coconut and papaya. The common characteristic of these textures was the grain on the surface like the vein on hami melon, the small dots on orange, the black scars on coconut and the dark dots on papaya. Although there were dark spots on both papaya and orange, the dots on orange were uniformly arranged. Likewise, although there were stripes on both hami melon and coconut, the stripes on hami melon were uniformly arranged. Moreover, the emotions evoked by hami melon and orange were excitement and pleasure (see *Figure 12* 錯誤! 找不到參照來源。), in contrast, the emotions evoked by papaya and coconut were displeasure and depression. In conclusion, the main physical characteristic of 'Vision-oriented' was the clear grain on the surface, and uniform grain might evoke excitement and pleasure, in contrast, irregular grain might evoke displeasure and depression.

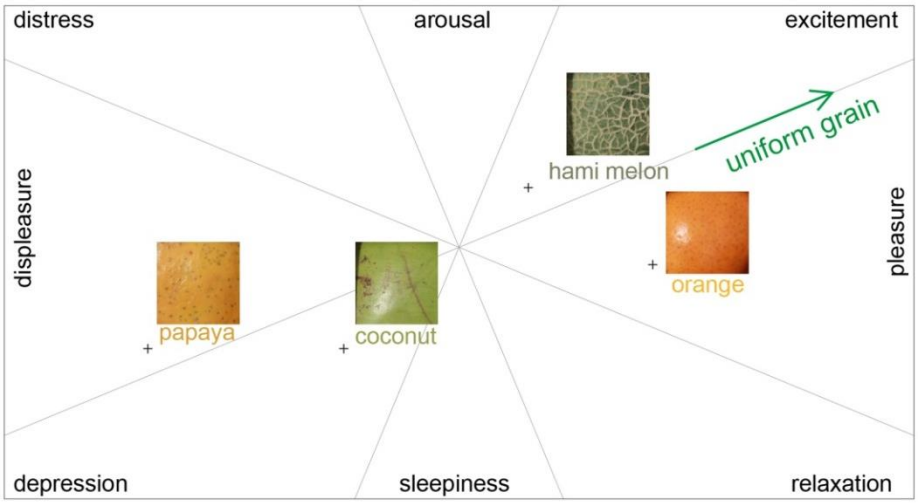

Figure 12. 'Vision-oriented' on MDS map

Touch-oriented: the texture of ‘Touch-oriented’ was composed of apple, pear, banana, sugar apple and pineapple. The textures of this group were either strongly uneven or perfectly flat. Apple, pear and banana were the perfectly flat ones; sugar apple and pineapple were the strongly uneven ones. Moreover, the emotions evoked by apple, pear and banana were all pleasure (see *Figure 13*), in contrast, the emotions evoked by sugar apple and pineapple were distress and displeasure. In conclusion, the main characteristics of ‘Touch-oriented’ were either strongly uneven or perfectly even, and perfectly even texture would evoke pleasure; in contrast, strongly uneven texture would evoke displeasure or distress.

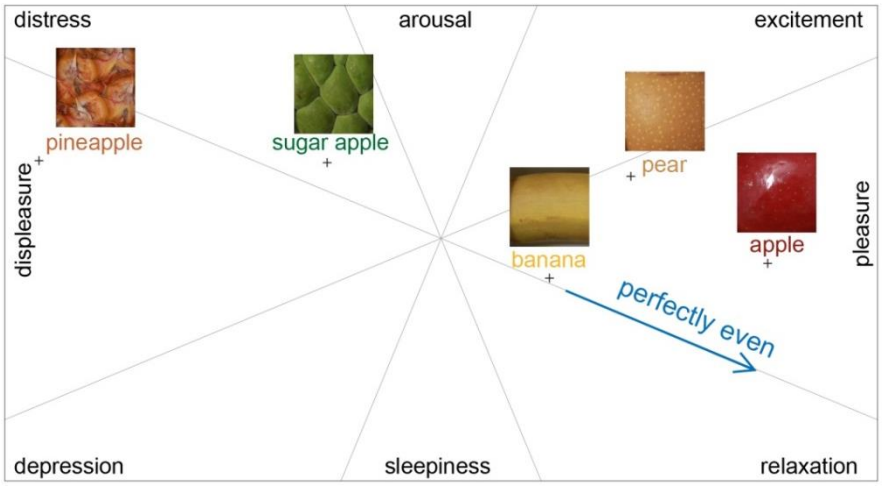

Figure 13. ‘Touch-oriented’ on MDS map

Aggregation-oriented: the texture of ‘Aggregation-oriented’ was composed of tomato and carambola. The common characteristic of these two textures was the flexible, refined and translucent surface. The emotion evoked by tomato was pleasure and the emotion evoked by carambola was distress (see *Figure 14*). Evenness and the color were the main difference between carambola and tomato that carambola was strongly uneven and coolly colored but tomato was perfectly even and warmly colored. In conclusion, the main characteristic of ‘Aggregation-oriented’ was the flexible, refined and tranlucent surface. Perfect evenness and warm color might evoke pleasure, in contrast, strong unevenness and cool colors might evoke distress.

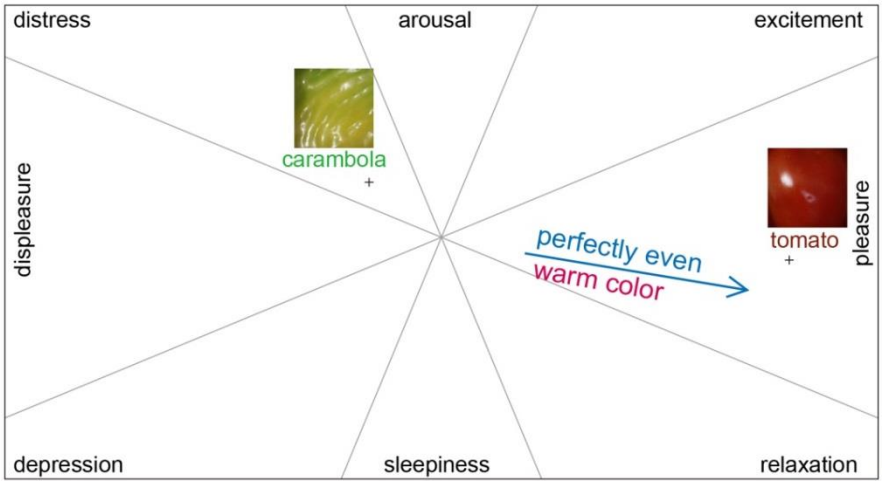

Figure 14. ‘Aggregation-oriented’ on MDS map

Diversion-oriented: the texture of ‘Diversion-oriented’ was composed of kiwi, wax apple, pitaya and guava. According to the interview, the subjects indicated that the feature of these textures was not obvious. Guava and wax apple both were uneven but the feature was not that obvious like sugar apple and carambola; there were some protrusions on pitaya but the feature was not that obvious like pineapple; there was some fur on the surface of kiwi and it was short and not very stiff. The main difference among these textures was the color that pitaya and guava were brightly colored but wax apple and kiwi were darkly colored; pitaya and wax apple were warmly colored but kwi and guava was coolly colored. In conclusion, unobvious feature was the common characteristic of ‘Diversion-oriented.’ Besides, warm and bright color might evoke pleasure (see *Figure 15*), in contrast, dark or cool color might evoke displeasure or sleepiness.

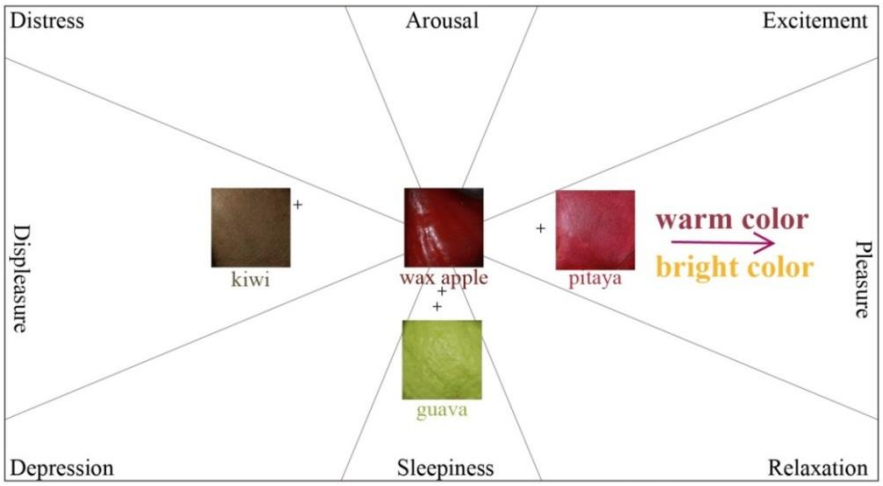

Figure 15. ‘Diversion-oriented’ on MDS map

The main physical features of the texture were integrated in *Figure 16*. These features were the key factors that evoke the emotion, for instance, warm and bright color might evoke pleasure; in contrast dark and cool color might evoke displeasure. Uniform grain might evoke pleasure or excitement; in contrast, irregular grain might evoke displeasure or depression. Perfect evenness might evoke pleasure or relaxation; in contrast, strong unevenness might evoke distress or displeasure.

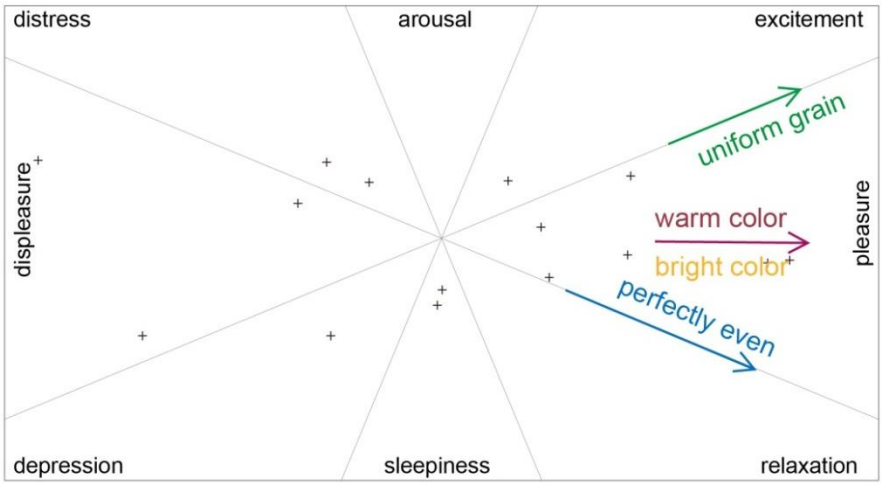

Figure 16. The key features that evoke the emotion

Although this study utilized the true fruits as the specimen, some industrial materials might be available to mimic the physical characteristics to get similar effect. For example the key feature of apple is perfectly even and glossy, so the glossy painting metal or plastic may produce similar tactile experience with it. Tomato and carambola were flexible, refined and translucent, so translucent silica gel may be available to mimic the physical characteristics of them. In particular, the term 'mimic' here means to produce similar tactile or visual experience rather than copying the 'realistic' fruit-surface. In other words, when people perceive the texture of 'touch-oriented', they may not associate with the fruit but they should get richer tactile experience from the texture.

5. CONCLUSION

According to the dissimilarity of emotional response between vision, touch and the multi-perception, the texture of fruit-surface can be divided into four classes. The multi-perception is similar to visual perception for the texture of 'vision-oriented,' and the common physical characteristic is the apparent grain on the surface; For the texture of 'touch-oriented,' the multi-perception is similar to tactile perception, and the texture is either strongly uneven or perfectly flat. For the texture of 'aggregation-oriented,' the multi-perception is similar to both visual and tactile perception and the key feature is the flexible, refined and translucent surface. For the texture of 'diversion-oriented,' the multi-perception is dissimilar to both visual and tactile perception and the feature of the texture is not obvious (slightly uneven but not apparently). Each class of texture represents different affective experiences, and corresponds to different physical characteristics. Designers can choose a proper type of texture according to the marketing strategy or the category of products. The research of fruit-surface may also provide some contribution to the new texture development.

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