

The Study of Emotion Responses when Applying Scents to Products

Tseng-Ping Chiu*, Chun-Heng Ho**

* *Ph.D. Student, National Cheng Kung University Industrial Design Department, pauping8778@gmail.com*

** *Assistant Professor, National Chung Kung University Industrial Design Department, hoch@mail.ncku.edu.tw*

Abstract: Researchers found scent is an important factor that can create and affect human emotions. However, only few study focuses on the effect of applying scent to products in Industrial Design or KANSEI Engineering. Hence, this study will use Pleasure-Arousal-Dominance (PAD) Emotion Scales to investigate the correlation between product image (visual sensory) and scent (olfactory sensory). There are two stages of experiment in this research. The first stage focuses on how visual and olfactory sensory are correlated with emotion separately. In the second stage, we apply the distinct scent samples to those distinct products found in the previous stage to discuss the multi-sensory KANSEI values of the products. The results show (1) Visual sensory: there are highly positive correlations between product character and users' emotion. (2) Olfactory sensory: the scents' characteristic correlated deeply with users' emotion state. (3) Multi-sensory: the ratings of products with vivid characters are influenced by congruent odors, while adding appropriate scents to products without vivid characters would mostly cause positive emotional responses.

Key words: *Emotion Response, Industrial Design, KANSEI Engineering, Product Character, Product Scents*

1. Introduction

Cognitive differences are usually regarded as an important issue in Industrial Design field [1], and the differences are usually caused by the ways that designers and consumers perceive the world differently. Meanwhile, designers usually communicate with users through the product characters they designed, and these characters cause not only the users' perceptive differences but also emotional changes. Because the product characters and perceptive differences are all reflections of users' emotions, understanding emotion is becoming a critical issue in product design. Lewis, Haviland-Jones, and Barrett suggest emotions can guide and fulfill our life and make things in our daily life become meaningful, thus people tend to judge their quality of life through the quality of their personal belongings [2]. On the other hand, since human has five senses, including vision, tactile, auditory, taste and olfaction, we receive external information through these channels and then cause all kinds of complex psychological and physical reactions we have. With the advent of the five-sense design, researchers have shown that KANSEI factors can improve products' image in Industrial Design [3]. In the meanwhile, researchers also suggest KANSEI factors can increase consumers' satisfaction by satisfying their mental needs and making the product become friendlier to the users.

Within five senses, researcher argues that olfaction can retrieve more vivid impressions about things from our memory no matter how long ago than memories retrieved from any other senses [4]. In addition, the memory clues triggered by olfaction are more sensible and emotional than that triggered by other senses [5-7].

Additionally, the use of different scents in a store can affect consumers' emotions and thinking processes [8]. Hence, scent can create and arouse emotions [9] and further enhance product liking [10-12]. Besides, previous studies in scents and marketing find that a proper scent can drive strong purchase intentions [13]. Moreover, researchers indicate that ambient odors are also a critical factor that can drive purchase intentions [14]. That is, ambient odors can improve consumers' emotion and even increase the rating of the products sold in the store. For example, during the period of slack sales the popcorn stall in Disney Land will use artificial popcorn essence to attract customers by the smell [15]. Also, Dunkin Donuts and Starbucks are consciously keeping a fresh coffee smell in their store [16]. On the other hand, previous study also suggests that emotion can affect sense, cognition, intention, and behavior [17]. As a result, we can find that scent has a strong correlation between marketing, consumer behavior, and the retail environment.

In product design, the Mary Biscuit cookie box (Figure 1), designed by Stefano Giovannoni for the manufacturer Alessi, setup a good example to demonstrate that applying scents onto products can affect the users' emotion. This cookie box's cover has a vanilla scent, which will not disappear with the passing of the years. Besides, products with scents can be found on 3C products as well, such as Hyundai cell phone MP280 marketed in November 2005 and ASUS laptop F6V Multi-Color marketed in October 2008. Although there are few cases that successfully integrate scent into product design on the market, little research is focused on the correlation between product scents and product characters.

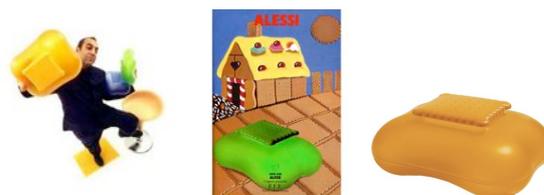


Figure 1. Mary Biscuit cookie box designed by Stefano Giovannoni for Alessi

2. Research Framework

The main goal of this research is to find the correlation between scents and product characters and how it affects users' emotion. We adopt a modified PAD emotion scales proposed by Schifferstein and Tanudjaja [18] to decompose the emotion into three scales, i.e. Pleasure, Arousal, and Dominance, and then discuss how scents combine with product appearance would affect the evaluation of product character through three emotion scales. The hypothetical model is shown in Figure 2 that the use of scents can change users' emotions.

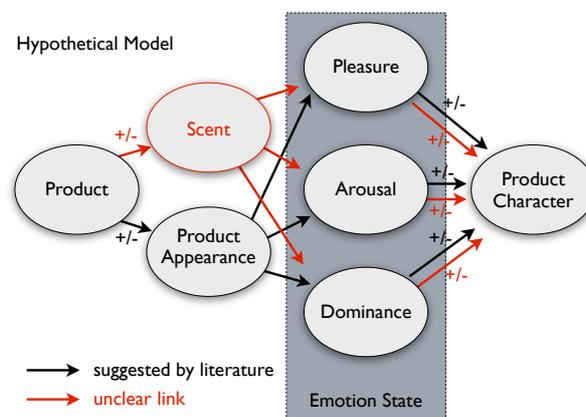


Figure 2. The hypothetical model of current research

There are two stages of experiment in this research. The first stage focuses on how single sensory, i.e. vision and olfaction, interacts with PAD emotion scales. Basing on the results from the first stage, these distinct scent samples were applied onto those distinct products, and then the stimuli were rated with PAD emotion scales again as the second stage. These two stages are discussed in the following two sections correspondingly.

3. Methodology

3.1 First Stage: Single Sensory and Emotion

The first stage focuses on how visual and olfactory sensory are correlated with emotions individually. The goal is to find out the distinct product samples, with and without vivid characters, for vision and the distinct scent samples for olfaction.

3.1.1 Product Characters and Emotions

38 participants, age range 20 to 30 years old, took the questionnaire about the correlations between product characters and emotions online. Participants were not limited to any gender but they must have at least two years experiences in industrial design, including academic training. The questionnaire used five-point Likert scales to rate the emotional responses after looking at the selected products' pictures. The pictures contained the color, form, and character of the products. However, the logo and label were removed and we did not mention that scents would be added to the product in a later stage. The examples of stimuli can be found in Table 1 and there were 81 products in total. The results show that there is a linear correlation ($r = .797$ and $p < .001$) between positive emotional responses and vividness of product characters (Figure 3). That is, the more a product has a vivid character, the more positive emotion people will feel.

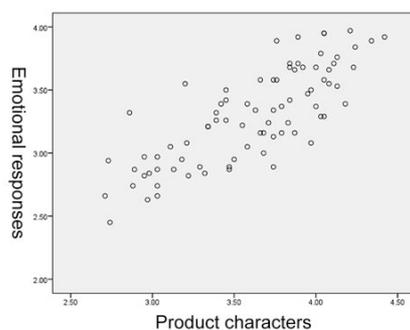


Figure 3. The correlation between positive emotional responses and vividness of product characters

Since the correlation between emotional responses and product characters is significant, we divided the product into two groups, i.e. products with vivid characters and products without vivid characters. Furthermore, in order to apply scents onto products in the next stage, we start to think about the suitability of adding scents to some kinds of products. As previous researchers suggested that conflicts between vision and olfaction would produce negative emotional response [19], people normally do not expect that tableware would come with any smell. Thus tableware is excluded from the stimuli. In addition, we think the products should also be simple and easy to understand so we excluded 3C products as well. Further, we also eliminate those products usually having particular smells such as cosmetic containers to avoid the stereotype of their scents. After screening out the unsuitable stimuli, we cluster the products into two categories, i.e. pot-holder, vase. Thus, we have two groups of

stimuli and each group has two categories, and we pick two samples for each category of products while one with a vivid characters but the other without (Table 1).

Table 1. The stimuli of current study

	Products with vivid characters	Products without vivid character
Pot-holder	Sunflower pot-holder 	Lekue pot-holder 
	Nekko single flower vase 	Menu Rubber Vase 

The average rating shows that the products with vivid characters give people more positive emotion than those without vivid characters (Table 2). Additionally, Independent-samples t-tests indicate that the differences between products with vivid character and those without are all significant in three categories: the pot-holder $t(74) = 6.374$, $p < .001$; the vase $t(74) = 4.688$, $p < .001$. That is to say, among these stimuli, the more vivid character one product has, the more positive emotion it will evoke. Thus, the four products shown in Table 1 are selected as the stimuli for the second stage experiment.

Table 2. The rating of positive emotion for each stimulus

	Vivid Characters	N	Mean	Std. Deviation
Pot-holder	With	38	3.71	0.84
	Without	38	2.45	0.89
Vase	With	38	3.66	0.94
	Without	38	2.63	0.97

3.1.2 Scents and Emotions

Milotic [20] suggested that scents could be classified into ten odor families. In a pilot study, we pick six of them, i.e. *floral*, *herbal*, *fruity*, *sweet*, *woody*, and *citrus*, which are more suitable for imparting to products. For each odor family, the scents we pick are: *jasmine*, *lavender*, *green apple*, *honey*, *pine*, and *bergamot* accordingly. Instead of using compound perfume, we use unitary scents in this study. The scented questionnaire comes with a 4 cm x 6 cm paper blotters that sprayed with one milliliter of unitary scent, and the blotter is sealed with a cover before participant taking the questionnaire. The questionnaire has six pages with six different scents on each page.

30 participants, age range 18 to 30 years old, took the questionnaire and all of them are either college or graduate students. 14 of them are females and 16 are males. The questionnaire uses nine-point Likert scales, range from -4 to 4, to rate the emotional responses according to PAD scales. We adopt 5 word pairs for each scale from Schifferstein and Tanudjaja's study that the *pleasure* scale includes happy-unhappy, satisfied-unsatisfied,

cheerful-melancholic, hopeful-despairing, and surprised-bored; the *arousal* scale includes active-relaxed, wild-lazy, nervous-lethargic, wide awake-sleepy, and stimulated-indifferent; the *dominance* scale includes powerful-powerless, influential-influenced, impressive-humble, independent-dependent, and brave-careful [18]. The results of the rating are shown in Table 3. Analysis of variance showed main effects of scents on emotional responses in *jasmine*, $F(2, 449) = 39.83, p < .001$, *green apple*, $F(2, 449) = 11.35, p < .001$, *pine*, $F(2, 449) = 23.64, p < .001$, and *bergamot*, $F(2, 449) = 6.13, p = .002$. That is to say, there exist significant differences in *jasmine*, *green apple*, *pine*, and *bergamot* on PAD scales.

Table 3. The rating, ranged from -4 to 4, of the emotional responses according to PAD scales

		N	Mean	SD
Jasmine	Pleasure	150	0.51	1.81
	Arousal	150	0.33	2.04
	Dominance	150	0.46	1.92
	Total	450	0.43	1.92
Lavender	Pleasure	150	0.87	1.71
	Arousal	150	-0.25	2.13
	Dominance	150	-1.07	1.80
	Total	450	-0.15	2.05
Green apple	Pleasure	150	0.69	2.03
	Arousal	150	-0.19	2.15
	Dominance	150	-0.34	1.87
	Total	450	0.05	2.06
Honey	Pleasure	150	1.25	2.09
	Arousal	150	0.70	2.23
	Dominance	150	1.13	2.22
	Total	450	1.02	2.19
Pine	Pleasure	150	-0.33	2.32
	Arousal	150	0.70	2.45
	Dominance	150	1.46	2.01
	Total	450	0.61	2.38
Bergamot	Pleasure	150	0.57	1.86
	Arousal	150	0.95	2.06
	Dominance	150	1.36	1.91
	Total	450	0.96	1.97

From the average plot (Figure 4), we can see that, for *jasmine* and *green apple*, the *pleasure* scale has a greater impact than *dominance* scale (post hoc analysis using Scheff indicates $p < .001$ for both *jasmine* and *green apple*); on the contrary, *dominance* has a greater effect than *pleasure* for *pine* ($p < .001$) and *bergamot* ($p = .002$); however, there is no difference on PAD scales for *lavender* and *honey*. Among these six scents, the most *pleasure* scent is *honey* (average rating is 1.25); the most *relaxing* scent that has the lowest rating (-.24) in *arousal* scale is *lavender*; while the most impressive scent that has the highest rating (1.46) in *dominance* is *pine*. Additionally, we

select the highest average rated word pair among six scents in each scale as the representative word pair used for the next stage experiment. The *pleasure* word pair we choose is happy-unhappy (.77), the *arousal* word pair is active-relaxed, and the *dominance* word pair is impressive-humble.

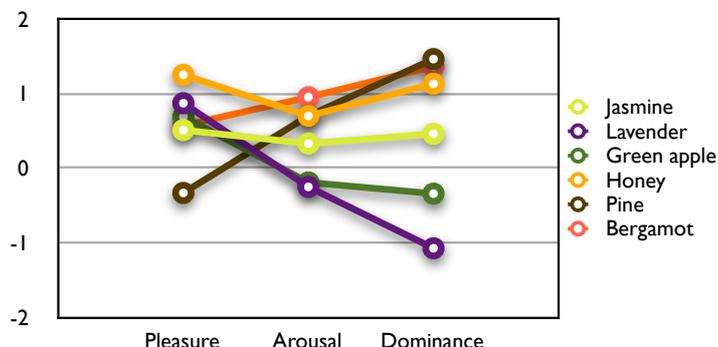


Figure 4. The average rating of PAD scales among scents

3.2 Second Stage: Multi-Sensory KANSEI Values

According to the results found in the first stage, the six distinct scent samples are imparted to the four distinct products. In the following, we discuss what combinations can successfully enhance the multi-sensory KANSEI values of the products based on the rating of PAD scales and two-way ANOVA analysis.

3.2.1 Experiment Design

In the experiment group, the six scents (Figure 4) had applied to the four products (Table 1), while the products in control group do not have any scent. In the experiment, each participant rated the stimuli by comparing the product with and without scents together. Between each scent, we asked participants to smell coffee beans to refresh the olfactory. Although the color is not considered as a factor in this study, it is impossible to find the entire products in exactly the same color. Thus, we asked participants to wear black lens sunglasses to reduce the effect of color perceptions. In addition, they were not allowed to touch the products during the experiments to avoid the impact from tactile sense. The participants must have industrial design background and pass a warm up olfactory test. There are 32 participants, age range 21 to 30 years old, took the experiment about the multi-sensory KANSEI evaluations. Among them, 14 of them are males and 18 are females. The experiment setting is shown in Figure 5.



Figure 5. Experiment setting

3.3 The Suitableness of Applying Scents to Products according to their Character

3.3.1 Paired-Samples T-Tests on Product Characters

A paired-samples t-test indicate that rating scores were significantly higher for pot-holder (Table 4) with vivid character (Mean = 3.23, SD = 1.21) than those without (Mean = 2.81, SD = 1.31), $t(191) = 3.93, p < .001$. For vase (Table 4) with vivid character (Mean = 3.23, SD = 1.16), the scores were significantly higher than those

without (Mean = 2.90, SD = 1.12), $t(191) = 3.51, p = .001$. These mean that adding scents to pot-holder and vase will significantly increase the positive emotions on products with vivid character than those products without vivid character.

Table 4. The rating of the suitability of imparting scents to pot-holder and vase

Categories	Scents	Vivid character			Non-vivid character			Total		
		N	Mean	SD	N	Mean	SD	N	Mean	SD
Pot-holder	Jasmine	32	3.75	0.98	32	3.03	0.90	32	3.39	1.00
	Lavender	32	3.28	1.02	32	2.31	0.90	32	2.80	1.07
	Green apple	32	3.41	1.19	32	3.38	1.43	32	3.39	1.30
	Honey	32	3.16	1.27	32	3.06	1.39	32	3.11	1.32
	Pine	32	2.44	1.37	32	1.78	1.13	32	2.11	1.29
	Bergamot	32	3.34	1.04	32	3.28	1.28	32	3.31	1.15
	Total	192	3.23	1.21	192	2.81	1.31	192	3.02	1.27
Vase	Jasmine	32	3.53	1.11	32	2.97	1.12	32	3.25	1.14
	Lavender	32	3.81	0.90	32	3.06	0.95	32	3.44	0.99
	Green apple	32	3.16	1.11	32	3.31	1.09	32	3.23	1.09
	Honey	32	2.78	0.97	32	2.91	1.20	32	2.84	1.09
	Pine	32	2.78	1.31	32	2.22	1.16	32	2.50	1.26
	Bergamot	32	3.31	1.23	32	2.94	0.95	32	3.13	1.11
	Total	192	3.23	1.16	192	2.90	1.12	192	3.07	1.15

3.3.2 Two-Way ANOVAs with Scents and Product Characters

(1) Pot-holder

A 6x2 ANOVA with product scents (*jasmine, lavender, green apple, honey, pine, and bergamot*) and product characters (vivid, non-vivid) as within-subjects factors reveal a main effects of scents, $F(5, 372) = 15.97, p < .001$, and product characters, $F(1, 372) = 17.09, p < .001$. Since there are only two factors in product characters, we can conclude that it is more suitable for adding scents to the pot-holder with vivid character (MEAN = 3.23, SD = 1.21) than the pot-holder without vivid characters (MEAN = 2.81, SD = 1.31) by comparing their average ratings listed in Table 4.

(2) Vase

Similar to pot-holder discussed above, for vase, a 6x2 ANOVA with six product scents and two product characters as within-subjects factors reveal a main effects of scents, $F(5, 372) = 6.07, p < .001$, and product characters, $F(1, 372) = 8.57, p = .004$. Since there is only two factors in product characters, we can conclude that it is more suitable for adding scents, except for *green apple* and *honey*, to the vase with vivid character (MEAN = 3.23, SD = 1.16) than the vase without vivid characters (MEAN = 2.90, SD = 1.12) by comparing their average ratings listed in Table 4.

3.3.3 PAD scales

According to Figure 4, we pick the most *pleasure*, *relaxing* (the least *arousal*), and *impressive* (*dominance*) scents, i.e. *honey*, *lavender*, and *pine* accordingly to run linear regression analyses. The average rating scores of these three scents when applying to vase and pot-holder is shown in Figure 6. We can see that the variances of PAD scales in pot-holder is less significant than those in vase. Thus, we picked only vase to run further analysis.

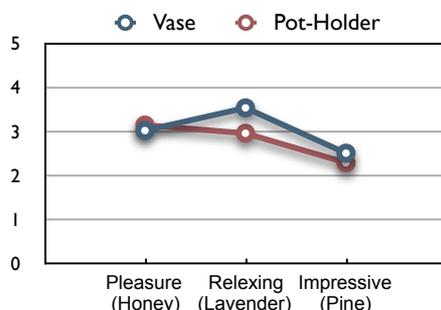


Figure 6. The average scores of scents in PAD scales when applying to vase and pot-holder

The descriptive statistic of positive emotional response and PAD scales is shown in Table 5. We illustrate that applying *lavender* scent to vase in detail (Figure 7). An ANOVA shows a main effect of PAD scales on positive emotional response in applying *lavender* scent to vase with vivid character, $F(3, 31) = 26.29, p < .001$. A linear regression indicates the *pleasure* scale has a significant effect on positive emotional response, $t = 5.93, p < .001$, while the results are not significant on *arousal* and *dominance* scales, $t = -.56, p = .579$ and $t = 1.94, p = .063$. Thus, the unstandardized coefficient of positive emotional response for adding *lavender* to vase with vivid character equals to $2.70 + 0.41 * Pleasure$, and the standardized coefficient of which is $0.71 * Pleasure$. In addition, there is also a main effect of PAD scales on positive emotional response in applying *lavender* to vase without vivid character, $F(3, 31) = 10.64, p < .001$. A linear regression indicates the *pleasure* and *dominance* scales have significant effects on positive emotional response, $t = 3.26, p = .003$ and $t = 2.98, p = .006$. However, the result is not significant on *arousal*, $t = -1.20, p = .240$. Thus, the unstandardized coefficient of positive emotional response for adding *lavender* to vase without vivid character equals to $2.65 + 0.28 * Pleasure + 0.22 * Dominance$, and the standardized coefficient of which is $0.46 * Pleasure + 0.43 * Dominance$.

Table 5. The descriptive statistics of positive emotional responses and PAD scales

	Vase	Vivid character			Non-vivid character		
		N	Mean	SD	N	Mean	SD
Lavender	Emotional response	32	3.81	0.90	32	3.25	0.84
	Pleasure	32	2.03	1.56	32	1.09	1.38
	Arousal	32	-0.41	2.54	32	0.38	2.14
	Dominance	32	2.16	1.57	32	1.44	1.63
Honey	Emotional response	32	3.00	0.92	32	3.03	1.09
	Pleasure	32	0.50	1.97	32	0.46	2.26
	Arousal	32	0.00	1.92	32	0.38	2.39
	Dominance	32	1.34	1.29	32	1.38	1.93

Pine	Emotional response	32	2.78	1.07	32	2.22	1.13
	Pleasure	32	-0.66	2.18	32	-0.75	2.06
	Arousal	32	1.63	2.14	32	1.59	1.79
	Dominance	32	2.09	1.65	32	1.53	1.85

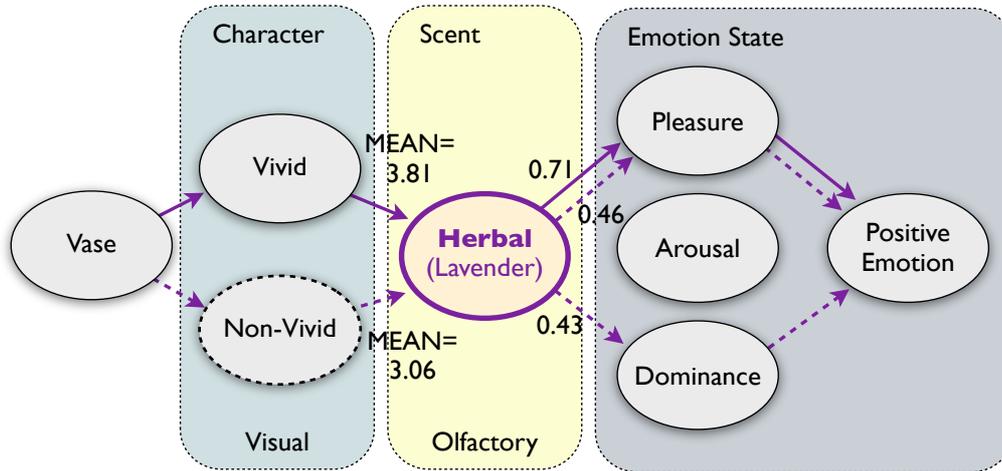


Figure 7. The emotion state affected by adding *herbal* scent (lavender) to vase

4. Discussion

4.1 Vision and Emotion

The results conclude that there is a positive correlation between product character and emotion. Before adding scents to products, people prefer those products with vivid characters than those products without vivid characters across all different product categories. This can be explained by Mullen and Johnson's theory about consumer behavior [21] that when people perceive a product with vivid character, they will have a strong emotional response.

4.2 Olfaction and Emotion

This research uses PAD scales to evaluate the correlations between the six scents and the emotional responses. The results indicate that there are complicated correlations between scents and PAD scales, while the positive emotional responses are affected by the values of PAD scales. Comparing with traditional KANSEI Engineering researches that rely mainly on *pleasure* scale to evaluate the positive emotion, we would recommend the combination of *pleasure*, *arousal*, and *dominance* scales. The PAD scales are especially suitable for multi-sensory KANSEI engineering study that olfaction is involved. Besides, we find there are strong correlations between scents and emotions, which is also consistent with Mullen and Johnson's theory [30] that odor has a strong effect on cognition and memory so that it has a strong influence on emotion. In addition, according to Lindstorm's theory [15] that a series of stimulate, enhances, and bonds will increase the brand loyalty, the use of scents in product design can not only increase the users' positive emotion but also build their sensory brand.

4.3 Multi-sensory and Emotion

The interaction between vision and olfaction can be discussed according to the vividness of product character.

4.3.1 Product with Vivid Character

Owing to the strong correlations between vision and emotion, those products with vivid characters already have high positive emotional responses before adding scents to them. Thus, adding scents to a product with vivid character is not necessary increase user’s positive emotional responses. This might be a reason why previous study [22] found olfactory can not contribute to product liking. According to the suitability of a scent with a particular product, we also find that adding scents to a product would either enhance or diminish the positive emotional responses. The result of current study suggests that the suitability is the key factor for liking. For example, the sunflower pot-holder (pictures are shown in Table 1) has a vivid character of sunflower, thus the most suitable scent for it is floral family which creates the highest positive emotional response (Table 4).

Among PAD scales (Figure 7-9), the results suggest *pleasure* and *arousal* is mainly determined by both vision and olfaction, while *dominance* is primarily affected by olfaction only. Besides, there is no complex interaction between vision and olfaction in terms of product ratings and emotional responses. Previous study proposes when interacting with a product, there is usually one sensory modality dominating the situation that it could gather more information, have more influence, and attract more attention [23]. In this study, people tend to look at and recognize the product character first to have a preliminary idea about the product. Then add olfaction, accompanied with vision, to form a final emotional response. This reaction model is shown in Figure 10.

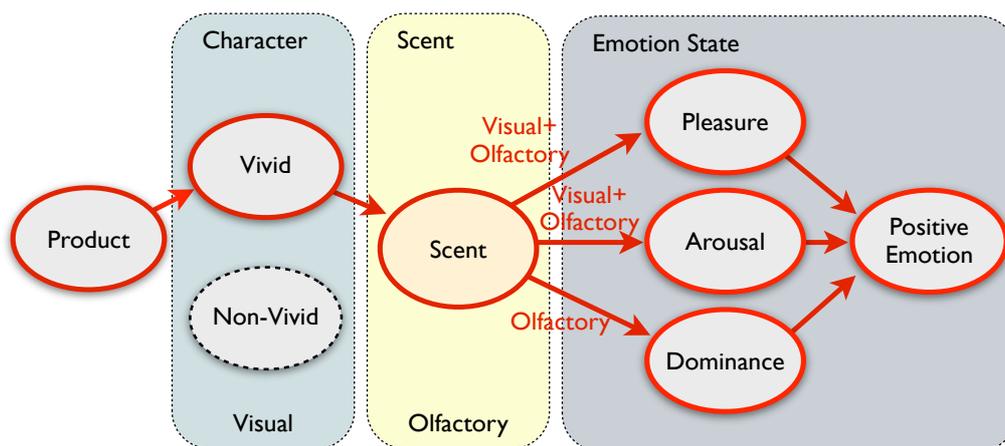


Figure 10. The interaction of vision and olfaction for products with vivid character

4.3.2 Product without Vivid Character

Products without vivid character are less arousing, in vision, than those with vivid character. When people sense and recognize the product preliminarily by vision, they will not have a strong emotional response. However, if we add a suitable scent to these kinds of products, the improvements in positive emotional responses are usually significant. This means when people perceive a product without vivid character, they tend to judge it intuitively by its scent that might give them a strong impression. That is to say, people tend to judge the scents by their own preferences since the product does not have a vivid character that make people to consider the suitability of it. In this study, the Menu Rubber Vase does not have a vivid character. When we add a suitable odor to it, e.g. *jasmine* or *lavender*, people will rate the product mainly by olfaction rather than vision and give it a high rating. The interaction processes are shown in Figure 11. This result is similar to Herz’s argument [5] that olfaction is very powerful in evoking memory cues that contain more sensibilities and emotions than other senses.

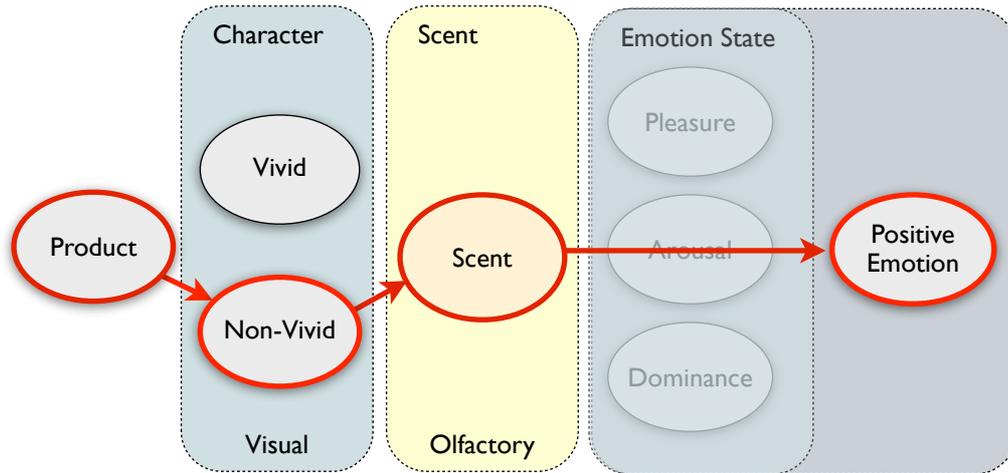


Figure 11. The interaction of vision and olfaction for products without vivid character

The importance of scent has been revealed in the domain of emotion, marketing, brand memory, consumer behavior and so on in previous studies. However, only few study focuses on the effect of applying scent to products in Industrial Design or KANSEI Engineering. The importance of olfaction is usually neglected in the study of sensibility since it does not have a solid measurement scale and the feeling is usually unsubstantial and hard to describe. However, this study use real products to study the correlation between product character and scents and we propose two different models for imparting scents to products with or without vivid characters. Hopefully, this model can provide some guidelines for product designers in considering adding scents to their designs in the future.

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