THE INFLUENCE OF SENSORY PRODUCT PROPERTIES ON AFFECTIVE AND SYMBOLIC PRODUCT EXPERIENCE

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ABSTRACT

Creating pleasurable products requires understanding of the influence of sensory product properties on affective user experience and symbolic meaning of products. This paper gives an overview of a series of studies, in which we investigated the impact of sensory product properties (color, material, sound, smell, and taste) on affective user experiences (pleasure, annoyance, satisfaction, and surprise) and symbolic meanings of products (freshness, warmth, and noisiness). The results demonstrate that the pleasantness of a product could not always be predicted on the basis of the pleasantness of its sensory properties. The findings also suggest that sensory product properties might be linked to symbolic properties through metaphorical meaning of sensory adjectives.

Keywords: product experience, sensory product properties, affective experience, symbolic meaning, sensory metaphors.

INTRODUCTION

Product experience can be defined as "the awareness of the psychological effects elicited by the interaction with a product, including the degree to which all our senses are stimulated, the meanings and values we attach to the product, and the feelings and emotions that are elicited" (Hekkert & Schifferstein, 2008, p.2).

Both in everyday life and in experimental research, it is difficult to differentiate the three main components of product experience outlined in this definition. Sensory perception, especially in the case of visual and auditory modalities, is closely connected to cognitive processes (Goodale & Humphrey, 1998;

Neisser, 1994; Paivio, 2006). Also, some sensory modalities (especially touch, smell, and taste) are strongly associated with emotions (Hinton & Henley, 1993; Sweetser, 1990). Furthermore, affective and cognitive processes, which are usually described as distinct, often blend together in everyday life: our attention is drawn to emotional stimuli; emotional events are retained in memory; and judgment sometimes involves weighing emotional consequences (Hollins, 2010).

Sensory properties of products represent the most 'objective' component of product experience. Indeed, whether we like it or not, we smell the food while cooking it, we hear the sound of a vacuum cleaner while cleaning a room, and we feel the bumps of the road while driving. Sensory experiences tie us to the material world and to the objects that make up our environment. Nevertheless, sensory experiences are not immune to the 'subjectivity' of our affective reactions, symbolic meanings, beliefs, and values that we attribute to products.

In this paper we focus on the interactions between sensory, symbolic, and affective components of product experience.

THE INFLUENCE OF SENSORY STIMULI ON AFFECTIVE PRODUCT EXPERIENCE

In product design, it is important to promote positive, pleasurable product experiences and to prevent frustration, pain, and stress associated with product usage (Hancock et al., 2005). Traditionally, designers were concentrated on preventing bad things from happening during product usage, but recently they are paying more and more attention to creating

pleasurable products (Jordan, 2000), exciting product experiences (Norman, 2004; Desmet, 2002), and enjoyable product-user interactions (Han & Hong, 2003; Helander & Tham, 2003; Khalid, 2004; Krippendorff, 2004; Liu, 2003).

In this context, the idea of one-to-one correspondences between sensory attributes of products and users' affective reactions seems very tempting. Various researchers (e.g., Norman, 2004; Hanckock et al., 2005) created lists of such attributes that result in the users' experience of products and services as enjoyable, pleasurable, and fun. Some examples of attributes that induce positive affect are smiling faces; warmth; comfort; sweet tastes; pleasant smells; bright and highly saturated hues; harmonious music and sounds; rhythmic beats; symmetrical, round, smooth shapes. Attributes that induce negative affect include darkness; harsh, abrupt sounds; startling noises; bitter tastes; sharp objects; rotting smells; decaying foods; sudden, bright lights; extreme temperatures. However, some researchers point out that empirical studies are needed to link these at-tributes to experience (Murphy, Stanney, & Hancock, 2003).

Affective properties of sensations were already noticed by early experimental psychologists. According to Wundt, elementary (or pure) sensations display three components: quality, intensity, and affective tone (Wundt, 1904, p. 282-283). Modern psychologists also suggest that an affective tone can be experienced as a property of the external world rather than as the person's reaction to it (Barrett et al., 2007). Indeed, we experience some people as nice and others as mean, some foods as delicious and others as distasteful, some pictures as beautiful and others as ugly.

The impact of sensory stimuli on affective experience was also reported in empirical studies on consumer behavior. The classic research in this domain is Zajonc and colleagues' investigation of mere exposure, where simply being exposed to a stimulus leads to more positive affective reactions (Kunst-Wilson & Zajonc, 1980; Zajonc, 1968) due to familiarity (Whittlesea, 1993). Consumer studies also find a positive relationship between a typicality of an object (or similarity to other members of a category) and affective evaluation of this object. In general, more typical objects are better liked (Carpenter & Nakamoto, 1996; Simonin & Ruth, 1998; Veryzer & Hutchinson, 1998; Zhang & Sood; 2002).

Berlyne (1970) considered whether novelty has a natural antagonistic effect on familiarity and whether complexity mediates favorable judgments of novel or familiar objects. According to Peracchio and Meyers-Levy (1994), an object that is moderately different from a category will be better liked than either a similar or extremely different object. Similar findings were reported by Hekkert et al. (2003) in the study of the complex relationships of novelty, originality and familiarity in the preferences for consumer products. Other sensory variables that were reported to influence affective judgments include color (Martindale & Moore, 1998), symmetry (Frith & Nias, 1974), and principles of good gestalts (Arnheim, 1954).

THE INFLUENCE OF SYMBOLIC MEANING ON SENSORY PRODUCT EXPERIENCE

No matter how pleasant and enjoyable sensory properties of a product are, the decision to buy and use the product might be influenced by people's attitudes, beliefs and values and by the symbolic meaning people attribute to products (Wood, 1995, Mennel, et al., 1992). A striking example of symbolic influence on taste experience is reported by Annemarie Mol:

"Let me tell you, I don't like Granny Smiths. In the late 1970s and early 1980s we (my political friends and myself) invested a lot in disliking Granny Smiths. At the time they were always imported from Chile, and thus stained with the blood spilled by Pinochet and his men. Once Pinochet had gone, it turned out to be difficult to re-educate my taste. It should be possible, but so far I have not succeeded. Yes, I can eat a Granny Smith apple: bite, chew, swallow, gone. But it does not give me pleasure" (Mol, 2008, p.29).

Consumer studies demonstrate that cognitive processes (concepts, attitudes, ideas) can influence affective and sensory product experiences. In one of the classic studies (Allison & Uhl, 1964), consumers who drank beer with visible brands judged those

beers as highly variable in their taste and preferred beers with their favorite brand label, whereas consumers who drank unbranded beers tended to rate them all as tasting similar to each other. In a recent investigation, Lee et al. (2006) asked participants to drink a glass of a commercially available beer and a glass of their own 'MIT brew,' which consisted of the same beer with the addition of one ingredient — balsamic vinegar. Before people learned that the MIT brew had vinegar, they liked the beer just fine. But when they knew about the vinegar, the beer was perceived as repulsive.

The impact of cognitive beliefs and expectations on preferences is powerful enough to be observed in brain imaging studies. McClure et al. (2004), for example, asked participants who preferred Coke to Pepsi, to drink Coke and Pepsi; participants preferred Coke, but only when they knew it was Coke. The analysis of fMRI images revealed that these preferences were reflected by recruitment of brain areas involved in the processing of reward. In a similar investigation, Plassmann et al. (2008) asked participants to taste one wine several times but told them that the wine was either cheap or expensive. Consumption of 'higher-priced' wines was related to greater activity of reward areas in the brain. In a field study, Shiv et al. (2005) showed that people who had caught colds rated their cold remedies as more effective if they had paid full price for them. Another investigation demonstrated similar placebo effects for analgesics pills: Participants who were told the pill had been discounted were unable to tolerate as much physical pain as those who were told the pill was not discounted (Waber et al., 2008).

Taken together, these studies suggest that preconceptions and ideas about products can modify affective and sensory components of product experience. The taste of beer, wine and Coke, as well as the feeling of physical pain, can be affected by price and brand information.

EXPERIMENTAL RESEARCH

SENSORY DESCRIPTORS
Verbalization is an important component of product experience, because it allows people to recall their experience and to communicate it to others. People describe their product experiences using adjectives that can be divided in three groups: sensory descriptors (e.g., hard, red, noisy); symbolic descriptors (e.g., interesting, expensive, modern); and affective descriptors (e.g., pleasant, beautiful).

Almost all product experiences have associations with more than one sensory modality. The color of a dress can be 'loud'; the voice of a singer can be 'sweet', and so on. Most adjectives that describe product experiences have several meanings, and usually not all these meanings can be translated adequately to another language. For example, the English word 'fresh' has 16 different meanings (Simpson and Weiner, 1989), which can be roughly divided into two groups: 1) new, recent, newly made, recently arrived, retaining its original qualities, not deteriorated or changed by lapse of time; 2) pure, invigorating, refreshing (said especially of air and water), not stale, musty, or vapid. In the Dutch language two different words are used to indicate these two meanings in the case of food products (*vers* for the first meaning and *fris* for the second meaning).

We developed a questionnaire approach to quantify the relative importance of the five sensory modalities for various descriptors of product experience (Fenko et al., 2010a). We suggested that modality importance may be influenced by language differences. To test this hypothesis we used two groups of participants, native speakers of Dutch and Russian.

The results showed that only for the affective descriptors of product experience (pleasant-unpleasant, good-bad) all modalities were about equally important. Symbolic descriptors (such as modern, expensive, or feminine) generally convey the social or personal meaning of products. These descriptors tended to be multisensory, but most of them demonstrated visual dominance. Sensory descriptors (such as colorful, loud, or soft) reflect the perception of sensory information. In addition, sensory meaning may transfer to other domains of experience. We found that sensory descriptors of product experience showed significant language differences. The latter result can be explained by the fact that metaphorical meanings of sensory descriptors differ

between languages. For instance, Dutch and Russian equivalents of the English word '*sharp*' both have the tactile literal meaning (having a keen edge or point). In English and Dutch it is also possible to characterize a high-pitch sound or pungent food as sharp. In Russian another word is used for characterizing a sharp sound, so '*sharp*' has no associations with audition. On the other hand, gustatory associations with sharpness were even stronger for the Russian sample than tactile associations. This result indicates that metaphorical meaning of sensory descriptors may be more important than their literal meaning.

WARMTH

Warmth is an important characteristic for clothes, home interior and some leisure related products. The experience of warmth has both a literal aspect, associated with the thermal characteristics of products, and a figurative aspect, associated with the metaphorical meaning of warmth (i.e., intimacy, coziness). In an experimental study (Fenko et al., 2010b) we aimed to determine the relative importance of material and color for the product experience of warmth. We designed products (scarves and breakfast tables, see Figure 1) using warm and cold stimuli (colors and materials) in four different combinations and asked respondents to evaluate the warmth and pleasantness of each product.
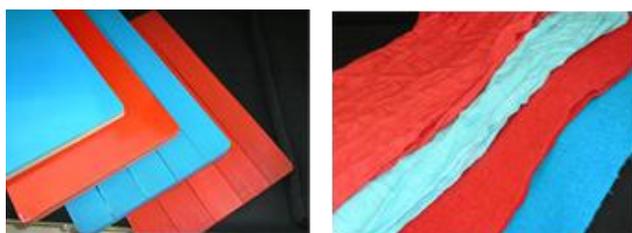

Figure 1. Products (breakfast trays and scarves) used in the experiment on warmth.

The results demonstrated that both color and material contributed equally to the judgments of warmth in both products.

We did not find correspondences between warm and pleasant ratings for the final products. The pleasantness of the scarves depended mainly on the material properties (viscose scarves were significantly more pleasant than woolen scarves), and not on the color. These results indicate that the pleasantness of

complex products cannot be predicted from the pleasantness of their separate sensory properties. We also performed a follow-up interview study to clarify the literal and figurative meanings that people attach to warmth in the context of product usage. We found that the literal meaning is related to physical warmth and comfort, while the figurative meaning is associated with social interaction, intimacy and friendly atmosphere. The figurative meaning was mentioned more often in association with products than the literal meaning.

FRESHNESS

Freshness is important for food products, soft drinks, personal care products and cleaning products. In an experimental study on sensory dominance in the product experience of freshness (Fenko et al., 2009) we created products (soft drinks, dishwashing liquids, and scented candles, see Figure 2) using fresh and non-fresh stimuli (colors and smells) in four different combinations and asked respondents to evaluate the freshness and pleasantness of each product.

Figure2. Products (soft drinks, dishwashing liquids, and scented candles) used in the experiment on freshness.

The results demonstrated that smell dominated the judgments of freshness for soft drinks and dishwashing liquids. However, for scented candles smell and color were equally important in determining freshness. These results could imply that the dominance of smell for the experience of freshness depends on the role of freshness in the product experience. In candles, for which freshness is not a necessary property, vision and smell both contribute to the degree of freshness. On the other hand, for products such as soft drinks and dishwashing liquids,

where freshness is related to their main function, the experience of freshness mainly depends on the olfactory properties of the product.

Pleasantness has been suggested as an odor's most salient attribute (Engen, 1982) and a lot of data indicate the strong link between the sense of smell and affective reactions (Herz, 1998; Herz and Schooler, 2002). Based on the extensive literature on the affective character of olfactory perception, we would expect smell to have more influence on the pleasantness rating than color, but our results only partly confirm this assumption. The most unpleasant samples of both soft drink and dish-washing liquid were those with fresh color and non-fresh smell. These outcomes indicate that negative affective reactions might be due to the inconsistent combinations of olfactory and visual stimuli rather than by the unpleasant smell as such. Probably, evaluations of pleasantness are more dependent on the combinations of stimuli used and their degree of (in)congruence than evaluations of freshness (e.g., Schifferstein & Verlegh, 1996).

NOISINESS

Product noisiness is a multisensory product experience that integrates auditory and visual components. We manipulated auditory and visual properties of alarm clocks and whistle kettles to find out to what extent the overall product noisiness depended on sounds these products made, or could be influenced by the visual appearance of the products (Fenko et al., 2011). We created products combining noisy and quiet stimuli of both sensory modalities according to a full factorial design (see Figure 3) and asked participants to assess how noisy, pleasant and annoying they found these products.

The results demonstrated that the overall experiences of noisiness and annoyance were influenced mainly by the sound for both alarm clocks and kettles, while the contribution of the visual pattern was not significant. For both products we found positive correlations of noisiness with annoyance. The noisiness of the sound had a negative influence on the overall pleasantness of the products.

Figure3. Products (whistling kettles and alarm clocks) used in the experiment on noisiness.

DYNAMICS OF SENSORY AND AFFECTIVE EXPERIENCE

During the various stages of user-product interactions, different sensory modalities may be important and different emotional responses may be elicited. We investigated how a dehydrated food product was experienced at different stages of product usage: choosing a product on a supermarket shelf, opening a package, cooking and eating the food (Schifferstein et al., submitted).

The results show that both sensory and affective experiences change during product usage. At the buying stage, people pay most attention to visual properties of the food package. At the opening and cooking stages olfaction becomes as important as vision. At the eating stage taste becomes dominant. The importance of tactile properties increases at the eating stage, because the tactile properties of the food constitute one of the important components of eating experience.

The dynamics of the affective experience was influenced by both the actual perception of the sensory product properties and pre-existing attitudes and beliefs about a product. At the buying stage, the ratings of satisfaction and dissatisfaction were about equal. But when participants started to interact actively with the product, the mean rating of satisfaction went up, while the rating of dissatisfaction dropped significantly. The most striking dynamics was demonstrated by pleasant surprise: Participants commented that they did not expect the product to smell and taste so good. However, the positive impact

of actual experience was not persistent: At the repurchase stage, the emotion ratings returned to the same level as in the original buying stage.

This research demonstrates that different sensory experiences may have a different impact on the overall product assessment. At the buying stage, when vision is the main source of product information, people mainly rely on their pre-existing attitudes and beliefs. Subsequently, during the interactions with the product, when people have the opportunity to use their other senses (touch, smell, and taste), their evaluations may change. But these changes are probably only temporary, given that emotional responses at the re-buy stage are similar to those found before.

DISCUSSION

The results of our experimental research on warmth, freshness, and noisiness suggest that sensory product experiences have affective components. We found strong correlations between freshness and pleasantness of visual and olfactory stimuli and between noisiness and annoyance of auditory and visual stimuli. The correlation between auditory noisiness and annoyance is widely documented in the previous studies (Bowsher & Robinson, 1962; Griffiths & Langdon, 1968; Berglund et al., 1976; Schultz, 1978). Strong correlation between pleasantness and refreshment ratings were also reported (McEwan & Colwill, 1996). Zellner and Durlach (2003) found that people often confuse freshness and pleasantness. For example, when asked to name refreshing foods or drinks, most people named water, iced tea and ice cream, but some people mention chicken and pizza as refreshing. In our studies, respondents also confused sensory and affective experiences. For example, fruity smells were chosen more often as 'fresh' for a soft drink, and the floral smell was judged as the most 'fresh' for a dishwashing liquid. Respondents commented that fruit smells seemed more 'nice' and suitable for a soft drink, while the floral smell was 'strong' and 'pleasant' and suitable for a dishwashing liquid. Similarly, fleece scored higher than wool on the scale of 'warmth' for a scarf, because 'it does not irritate your skin'.
However, in our studies on multisensory integration, positive correlations between sensory (warm, noisy)

and affective (pleasant, annoying) ratings were found only for single modality stimuli (colors, smells, sounds, etc.). When these stimuli were combined in the real products, correlations were found between noisiness and annoyance, but not between warmth or freshness and pleasantness ratings. These findings suggest that simple one-to-one correspondences between sensory and affective experiences may exist only for abstract stimuli created in a laboratory. When sensory stimuli are experienced together in concert as the properties of real products, situational variables and symbolic meaning of products may influence affective reactions. For instance, in our freshness experiment the least fresh combination of color (purple) and smell (vanilla) was assessed as the most pleasant for the dishwashing liquid, probably because the dishwashing liquid is a boring product, and users appreciated some newness and surprise in it.

Taken together, our experimental studies demonstrate that although correspondences between sensory stimuli and affective reactions can be found within one sensory modality, they cannot predict the affective reactions to the combinations of stimuli of various modalities in real products. Schifferstein and colleagues (2010) also failed to demonstrate the link between the pleasantness ratings of single stimuli and the overall pleasantness of the products. Probably, affective experiences are more dependent on the combinations of stimuli used and their degree of (in)congruence than sensory experiences. Future research is needed into sensory-affective correspondences, which may concentrate on complex multisensory stimuli and look at such variables as consistency/ inconsistency or congruence/ in-congruence of sensory product properties (Schifferstein & Verlegh, 1996; Ludden et al., 2007).

Our findings also demonstrate that sensory product experiences can be influenced by symbolic meanings people attribute to products. For instance, red and yellow are usually perceived as warm colors, while blue and green are perceived as cold colors (Wright, 1962). However, in our study green scarves were rated higher on warmth than yellow scarves. Participants commented that yellow is 'too bright and more suitable for a spring scarf', while green is 'darker and more suitable for a warm winter scarf'.

Furthermore, in the study on noisiness of alarm clocks and whistle kettles, we found differences in sound experience between products. While mean noisiness ratings for whistle kettles varied depending on sound frequency and complexity, all alarm clock sounds were assessed as quite noisy. This result may be explained by a difference in meanings and associations attached to these two products. The sound of a whistling kettle may be associated with the pleasant experience of making tea, while the sound of an alarm clock is typically associated with the unpleasant experience of waking up early in the morning. These memories may influence the experience of noisiness of product sounds.

The results of our food study suggest that mere visual exposure to the product may actualize users' cognitive attitudes and beliefs about the product, while other senses, such as smell and taste, may trigger mainly affective reactions. In spite of the positive sensory experiences and emotions during cooking and eating the product, most participants did not change their pre-existing attitudes about dehydrated food products. As soon as they were back in front of the supermarket shelves, their negative attitudes were activated again by the visual images of products. This may be the reason why it is difficult to change negative stereotypes about some product groups, even when the actual olfactory and gustatory experiences are positive.

Interrelations between sensory experiences and symbolic product properties are very complex and need to be investigated further. Our findings suggest that sensory product properties might be linked to symbolic properties through metaphorical meaning of sensory adjectives. Most sensory adjectives have several meanings that may differ between the languages. Communicating product experience through multiple sensory modalities may evoke different associations in different countries. For instance, '*pure*' is associated with taste for Dutch- and with vision for Russian-speaking consumers, while '*noisy*' can evoke more visual associations in English-than in Dutch-speaking consumers. For designers involved in developing products for various cultural groups, it may be useful to consider symbolic

associations of sensory product properties in different languages.

CONCLUSION

The results of our studies demonstrate the complex interactions between sensory, affective and cognitive components of product experience, which cannot be easily separated and investigated independently. In a continuously changing stream of consciousness, different sensory properties of products such as color, shape, sound, smell, as well as affective and cognitive contents like beliefs or memories, bind together into a single experience (Barrett et al., 2006). It is important for a theoretical model of product experience to take into account the integrative processes that bind together information from different sensory modalities with affective reactions and higher order cognitive processes.

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