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Food Quality and Preference

journal homepage: www.elsevier.com/locate/foodqual

Influence of package design on the dynamics of multisensory and emotional food experience

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ARTICLE INFO

Article history:

Received 20 October 2011

Received in revised form 3 February 2012

Accepted 8 June 2012

Available online 15 June 2012

Keywords:

Sensory
Experience
Package
Dynamics
User–product interaction
Emotions

ABSTRACT

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. At the buying stage, vision was the most important modality, followed by taste. Smell was dominant at the cooking stage, and taste was the most important sensation while eating the food. Analysis of the emotional dynamics showed that ratings for satisfaction and pleasant surprise tended to be lowest during the buying stages. Fascination and boredom ratings tended to decrease gradually over the course of the experiment. Comments mostly reflected responses to sensory qualities, usability aspects, and the nature of the product. At the purchase stage, pre-existing attitudes and stereotypes towards the product group seemed to play a major role in affective reactions, while in the other stages when other modalities were actively involved, participants' emotional judgements reflected mainly their direct sensory experience.

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1. Introduction

When people use and consume products, their experience is not static, but it changes over time. For instance, when a girl wants to make fresh orange juice, she first looks for oranges, grabs one, cuts it in halves, presses it on the press, and collects the juice in a glass before she can drink it. Over these different stages, different types of experiences are evoked consecutively. The role of the senses in these different stages may vary, and in each stage different meanings and cognitive associations may be evoked and different emotions may be elicited.

In order to provide insight into dynamic changes in user experience, we studied the interaction with a food product in an experimental study. Food products are unique among industrial products, because sensory experiences with foods typically involve all five senses: vision, audition, touch, smell, and taste. We selected a dehydrated, packaged food product, because it requires preparation before consumption, which makes the interaction complex and interesting. Before we introduce the current study in detail, we discuss the importance of the various sensory modalities, the emotional responses to food, and the role of packaging in food experience in the following sections.

1.1. Sensory dominance

In the area of food research, the dynamics of sensory perception has mainly been assessed using time–intensity (TI) methodology recording the evolution of the intensity of a given sensory attribute over time during the tasting of a single product (e.g., Larson-Powers & Pangborn, 1978). Recently, the temporal dominance of sensations method (TDS) has been proposed as an alternative to TI (Pineau, Cordelle, Imbert, Rogeaux, & Schlich, 2003; Pineau et al., 2009). In the TDS method, a set of attributes is presented on the computer screen. Along the tasting of one product, the panelist indicates what the dominant sensory perception is and scores the corresponding attribute. Each time the panelist thinks the dominant sensory perception has changed, either in intensity or in quality, he/she has to score the new perception. The TDS method can be easily adapted to include multiple sensory modalities (Labbe, Schlich, Pineau, Gilbert, & Martin, 2009; Lenfant, Loret, Pineau, Hartmann, & Martin, 2009; Sudre, Pineau, Loret, & Martin, 2012).

However, in order to assess consumer perception and acceptance at the key moments of a packaged food experience (not only during eating, but also including buying, storage, and food preparation) other methods are required. Typically, the food industry has studied food experiences by conducting a number of separate, consecutive tests for the different key moments. For instance, consumer buying behavior has been studied by testing different

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packaging designs in a virtual display or on the shelf (e.g., [Burke, Harlam, Kahn, & Lodish, 1992](#)). A broad range of laboratory sensory testing methods, such as quantitative descriptive analysis and texture profiling, have been used to describe the sensory characteristics during eating. Furthermore, home use tests have been conducted to evaluate product storage, preparation and consumption (e.g., [Lawless & Heymann, 1998](#)). However, it may be difficult to relate the outcomes of all these different types of tests to each other. Therefore, we were looking for a more unified approach, in which the different stages of the food experience could be easily linked together.

In the area of industrial design the dynamics of consumer experience has been investigated by asking participants to describe their experience during different stages of the user-product interaction using a single method. This approach focuses on entire usage stages (e.g., eating the product) instead of singular events (e.g., taking a bite) and requires participants to quantify the contributions of all sensory modalities simultaneously. [Fenko, Schifferstein, and Hekkert \(2009\)](#) instructed 243 participants to describe their experiences with durable consumer products while buying a product, after the first week, the first month, and the first year of usage. Their data suggest that the dominant sensory modality depends on the period of product usage. At the moment of buying, vision is the most important modality, but during usage the other sensory modalities gain importance. The roles of the different modalities during usage are product-dependent. Averaged over the 93 products analyzed in their study, after one month of usage touch became more important than vision, and after one year vision, touch and audition appeared to be equally important.

In the present study, we will use the latter approach to study the role of the sensory modalities in the different stages of buying, preparing, and eating an instant food product.

1.2. Food and emotions

The emotional quality of products is becoming more and more important for differential advantage in the marketplace, because current products are often similar with respect to quality and price. Emotions evoked by products enhance the pleasure of buying, owning, and using them ([Hirschman & Holbrook, 1982](#)). Because most people in affluent societies choose foods they like, eating is, for the most part, a positive experience. (e.g., [Desmet & Schifferstein, 2008](#)). Some food likes and dislikes seem to be culture-wide, while others vary within culture ([Rozin and Nemeroff, 1990](#)). Although some foods are consumed primarily out of necessity or for instrumental reasons (obtaining adequate nutrition, losing weight, or being a member of the group), the principal basis for food choice is the attractiveness of the flavor ([Roos & Wandel, 2005](#)).

Nonetheless, food consumption is also associated with negative emotions. These negative emotions help people to avoid the dangers of eating poisonous food. For instance, the cultural evolution of disgust ([Rozin, Haidt, McCauley, & Imada, 1997](#)) suggests that this emotion derives from the food rejection system of mammals as a response to a bad smell and taste of food (which is usually associated with harmful effects). Furthermore, in the developed world where industrially produced food has become abundant and excessive, eating is often associated with fear and guilt ([Kass, 1994](#)). Information about the health effects of eating patterns has become widely available through the media ([Kalucy, 1987](#)). This has led to frequent new concerns about particular dietary items, and has resulted in the rise of confusion and anxiety about food (e.g., [Rozin, 1999](#)). Misinterpretations of medical studies and dietician's recommendations lead to popular beliefs that certain food products are either 'good' or 'bad'. Thus, many people think of fat and salt as toxins: Even a trace of these substances in food is

considered unhealthy ([Rozin, Ashmore, & Markwith, 1996](#)). As a result, consumption of even small amounts of fat and salt may evoke strong emotions of fear and guilt.

Most research on emotions involves some kind of self-report, asking participants to report their feelings in a more or less formal way, from open-ended verbalizations to psychometric scales and questionnaires ([Russell, 2003](#); [Scherer, 2005](#)). Some tools have incorporated graphical elements (typically smiling or frowning faces) (e.g., [Bradley & Lang, 1994](#); [Desmet, 2003](#)), which allow participants to fill them in more intuitively, and make them more suitable for cross-cultural studies. Although psycho-physiological techniques have the advantage that they do not demand the users' attention or depend on their language skills, physiological responses are generally not sensitive enough to distinguish between different types of positive emotions (e.g., [Ludden, Schifferstein, & Hekkert, 2009](#); [Warrenburg, 2002](#)).

In the present study, we will determine the emotions elicited during buying, preparing, and consuming a packaged, dehydrated food product using a self-report questionnaire, in which each emotion descriptor is illustrated by a cartoon character.

1.3. The influence of package on food experience

Packaging affects how the food is perceived and experienced during buying, product usage and consumption. During the buying process, packaging design plays a role in identifying the category and brand to which the product belongs and in conferring meaning or in reinforcing existing associations to the product. The shape and color of packaging play an important role on retail shelves, because consumers who move down long store aisles first see category facings from a distance and at an angle, and start processing the larger visual elements well before they can process finer details or read text (e.g., [Garber, Hyatt, & Boya, 2008](#)). The design of the exact packaging characteristics is critical, because they can suggest a certain identity for its content that may enhance or interfere with its identification and evaluation ([Cardello, Maller, Masor, Dubose, & Edelman, 1985](#); [Piqueras-Fiszman & Spence, 2011](#)). In addition, packaging should help in making the product stand out from its competitors on the shelves.

During consumption, some of the effects of packaging may originate from the physical interaction between the container and its content. For example, off-flavors may occur due to migration of compounds from the packaging material into the food (e.g., [Janssens, Diekema, Reitsma, & Linszen, 1995](#)) and the shape of a container may affect flavor release ([Hummel, Delwiche, Schmidt, & Huttenbrink, 2003](#)). Furthermore, the shape and size of the container ([Raghubir & Krishna, 1999](#); [Wansink, 1996](#); [Wansink & Van Ittersum, 2003](#)) and the magnitude of the opening in the container ([Farleigh, Shepherd, & Wharf, 1990](#); [Greenfield, Smith, & Wills, 1984](#)) have been shown to affect the amount of content consumed.

The sensory characteristics of a container can also affect the experience of its content. For instance, [Becker, van Rompay, Schifferstein, and Galetzka \(2011\)](#) showed that images displaying the shape curvature (angular versus rounded) and degree of color saturation of lemon yogurt packages affected consumers' product attitude judgments and price expectations. [Mizutani et al. \(2010\)](#) found that orange juice presented together with pleasant images was rated fresher and more palatable than the same juice presented with unpleasant images. Furthermore, presenting the juice with images of oranges increased ratings for goodness of the aroma, compared to a condition employing images of non-food objects. As regards non-visual aspects, [Brown \(1958\)](#) found that the crisp sound of a wrapper increased the perceived freshness of bread. [Krishna and Morrin \(2007\)](#) showed that touching a flimsy cup decreased the perceived quality of the water served in the

cup for some of their participants. Furthermore, McDaniel and Baker (1977) found that the ease with which a bag of potato chips could be opened had a direct effect on the perceived crispiness and tastiness of its content, with difficult-to-open bags presumably containing better quality chips.

Schifferstein (2009) investigated the effect of container material on the experience of consuming its contents. He found that in many cases, the consumption experience (i.e., drinking a beverage) followed the experience of the empty containers (i.e., holding an empty cup). This suggests that consumers may transfer packaging experience aspects directly to its content. However, there were also instances in which material characteristics moderated the perception of the content. For instance, the outside temperature of a cup was highly dependent on the material of the container, which affected experience characteristics such as warmth and freshness. In other cases, consumer opinions on the appropriateness of container-content combinations or context-dependent shifts in evaluative perspective moderated the effect of container on beverage drinking experiences (Schifferstein, Smeets, & Hallensleben, 2011).

In the present study, we investigated the effect of packaging on the experience for a dehydrated food product. Two test products consisted of commercial glossy packages, while the other two packages contained a matte finish and had a special tactile feel.

1.4. The present study

In the present study, we investigate which sensory modalities are important and which emotions are elicited during the experience of a dehydrated food product at different stages of product usage: choosing a product on a supermarket shelf, opening a package, cooking and eating the food. The study consists of two experiments that are equivalent in procedure and differ in test products. In the first experiment two existing commercial brands of dehydrated, vegetable-based products and in the second experiment two new package prototypes were tested. The data were analyzed both qualitatively and quantitatively in order to determine the changes in product experience at different stages of product usage and the influence of package design on the overall product experience.

2. Method

2.1. Participants

Participants were recruited from the TU Delft consumer panel that consists of a representative sample of 2000 people (1300 households) from Delft and nearby areas. All participants were occasional consumers of dehydrated food products and did not suffer from food allergies. 47 people participated in the first experiment (20 men and 27 women; ages ranging from 22 to 61 years, mean 39) and 40 people participated in the second experiment (21 men and 19 women; ages ranged from 19 to 59 years, mean 38). Respondents were rewarded with a financial compensation.

2.2. Procedure

Each experiment consisted of 5 stages: (1) choosing the product in the supermarket; (2) opening the package; (3) preparing the food; (4) eating the food; (5) re-purchasing. Participants were guided through the experiment individually. At each of the 5 stages we asked the participant to evaluate their experience with the product.

At the first stage, the participant was standing in front of a set of shelves showing 26 equivalent commercial brands of dehydrated, vegetable-based products in a simulated store environment. For

each package 5 samples were present. The experimenter invited the participant to the simulated store and explained the task: "Please, imagine that you are in a supermarket, standing in front of the shelves. You would like to buy this dehydrated product containing the target vegetable. Please select the one you prefer". The participant examined the products, chose one product, and indicated the motivation for her choice.

In each experiment, two of the 26 products were test products. In the first experiment, the test products were commercial packages of equivalent products of two different brands (B1 and B2). These packages contained large pictures of the vegetable product with many graphic elements in a comparable glossy package. In the second experiment, both packages were prototypes that had a matte finish and a special tactile feel. One package (P1) had large pictures of the vegetable product with many graphic elements similar to the two commercial packages, while the other package (P2) was sober in graphics. Both prototypes carried the same brand and contained the same food product as B1.

If the participant did not select the target test product from the shelves, she was asked to take one of the two test products, examine it, and fill out the first questionnaire. For each of the five sensory modalities (hearing, smelling, touch, taste, seeing) the participant indicated how important she found this modality in the stage of choosing a product in a supermarket (5-point scale, from "not important at all" to "very important") and described why she found some senses more important than others in this stage. Subsequently, she indicated for a set of 12 emotions whether she did not feel it, felt it to some degree, or felt it strongly (3-point scale). The emotions used were contempt, admiration, dissatisfaction, satisfaction, unpleasant surprise, pleasant surprise, aversion, attraction, boredom, fascination, sadness, and joy. These emotions are also used in the PrEmo instrument, originally designed to measure emotional responses to visual appearances (Desmet, 2003) and have been shown to be relevant for describing emotional responses to (eating) food (Desmet & Schifferstein, 2008). Each emotion was presented on paper by a cartoon character and its verbal descriptor (see Desmet, 2003). After rating the 12 emotions, the participant reported which emotion she felt the strongest and described why that was the case.

At the second stage of the experiment, the participant was invited to a kitchen corner and asked to imagine that she had bought the test product, was feeling hungry and wanted to eat some food at home. Then she opened the package, put the contents in a pan, and filled out the questionnaire again. At the third stage, the experimenter showed the participant the cooking equipment, explained how to use it, and handed over the cooking instructions. The participant then cooked the product and filled out the questionnaire for the third time. At the fourth stage, the participant was seated in a dining area and ate the food. After she was finished eating, she filled out the questionnaire. At the fifth stage, the experimenter invited the participant back to the simulated store and asked her to select a product from the shelves and to indicate a motivation for her choice. Subsequently, the participant filled out the emotion questions for the target product for the last time; sensory modality importance was not rated at the final stage. The experiment took approximately 50 min.

2.3. Data analysis

Data from the two experiments were analyzed together. Quantitative data (importance ratings of sensory modalities and emotion ratings for the target products) were analyzed by repeated measures ANOVAs to evaluate changes during the five experimental stages. In accordance with Stevens (2002), we corrected the degrees of freedom with the Greenhouse-Geiser ϵ if $\epsilon < 0.7$, and we averaged the ϵ values from Greenhouse-Geiser and Huynh-Feldt,

Table 1

The main explanations given by participants for their importance ratings for the five sensory modalities (%).

	Buying	Opening	Cooking	Eating
See	Looking at the package to determine what to expect (ingredients, taste) (85.1)	Looking at the powder (color, ingredients) to check what you eat (55.2) Look how to open the package (12.6)	Check if the product looks appetizing (color, ingredients, thickness) (63.2) See when it boils (14.9)	The appearance should be appetizing and it should match the taste (49.4) The appearance should match pictures on the package (1.1)
Taste	Imagine the taste (28.7)	The expectation of the taste (19.5)	Imagining the taste, mainly by the smell (21.8) Taste the product to check if it is good (5.7)	The taste is what it is really all about (92.0)
Smell	Imagine smell of the product (5.7)	Smell gives first impression of taste and quality (82.8)	Check whether the smell is good and the product does not burn (83.9)	Good smell improves the taste (62.1)
Touch	Feel of the package (18.4) and of the ingredients inside (17.2)	Feel of package (6.9) and tactile feedback during opening (20.7)	Feel the thickness of the product (19.5) Feel if there is any powder left on the bottom (1.1)	Thickness product (while stirring) (26.4) and how it feels in your mouth (5.7) Temperature of the product (5.7)
Hear	The sound of the package (2.3) and ingredients (3.4) Sound of the product name (4.6)	Hear powder in the package (2.3) Hear sound of tearing the package (3.4) When you hear air escaping from the package, you know it is fresh (1.1)	Hear if the product/water is boiling (10.3)	Sound when product falls back in bowl (1.1)

* The percentage of participants that commented on the indicated topic. The sum of the answers is more than 100%, because participants were allowed to give multiple answers.

when $\varepsilon > 0.7$. Post-hoc analyses with Bonferroni adjustment were performed to test the significance of the differences between means. The qualitative data consisted of motivations why some modalities were judged to be more important than others or why a particular emotion was felt the strongest. We started the qualitative analysis by looking for themes in these responses. Responses with similar themes were then categorized into groups on the basis of their semantic similarity. Three experts agreed on the categories. For instance, clarifying the role of the sensory modalities in the buying stage resulted in categories such as 'looking at the package to determine what to expect', 'imagine the taste', 'feel the package' and 'feel the ingredients inside' (see Table 1). We computed the frequencies of responses in each category. Qualitative data are reported together with the quantitative data, to facilitate the interpretation of research findings.

3. Results

3.1. Sensory modalities

Repeated measures ANOVAs were performed on the importance ratings of the sensory modalities with Stage and Modality as within-participants factors and Product as between-participants factor. The differences between the four products resulted in a significant main Product effect [$F(3, 83) = 4.6, p < 0.01, \eta^2 = 0.14$] and contributed to a significant three-way interaction [$F(21.8, 604) = 1.6, p < 0.05, \eta^2 = 0.06$]. To investigate these effects in more detail, we performed a separate repeated measures ANOVA for each of the sensory modalities with Stage as within-participants factor and Product as between-participants factor. These analyses showed a main Stage effect for four modalities (smell, touch, taste, and seeing, all $p < 0.01$), a main Product effect for three modalities (hearing, touch, and seeing, all $p < 0.05$) and a significant two-way interaction only for touch ($p < 0.01$). The particular tactile characteristics of the packages in the second experiment resulted in higher importance ratings for touch in the buying stage, but tended to produce lower ratings for touch for the other stages compared to the commercial packages of the first experiment. In addition, the importance ratings for hearing and seeing tended to be lower for the tactile packages of the second experiment than for the commercial packages in the first experiment in all four stages.

We now come back to the most interesting effects in the overall ANOVA: The effects of Stage and Modality. The main effects of Stage [$F(2.2, 184) = 47.3, p < 0.001, \eta^2 = 0.36$] and Modality [$F(2.4, 197) = 221.3, p < 0.001, \eta^2 = 0.73$], and the two-way Stage \times Modality interaction [$F(7.3, 604) = 59.1, p < 0.001, \eta^2 = 0.42$] were all highly significant (see Fig. 1). In the buying stage, vision was judged to be the most important sensory modality. On the basis of the packaging characteristics they saw, participants tried to predict how the product would taste (Table 1). Hence, even though participants could not taste the product in the buying stage, they rated the importance of the (imagined) taste quite high. Touch was used to feel the package and its ingredients inside. Smell was rated less important, although some participants mentioned the expected smell of the product. The sound was not found important, even if some participants mentioned the sound of the package, ingredients or the brand name.

While opening the package, smell becomes equally important as vision, because smell gives the first impression of the taste and the quality of the product. In addition, through vision you can evaluate the contents of the package (the powder, its color, ingredients) in order to check what you are going to eat. Touch is also important, because people have to open the package and make sure that there is no powder between tear-strips.

At the cooking stage smell dominates the product experience, because people find it important that the product smells appetizing. They also use olfaction to make sure the dish does not burn.

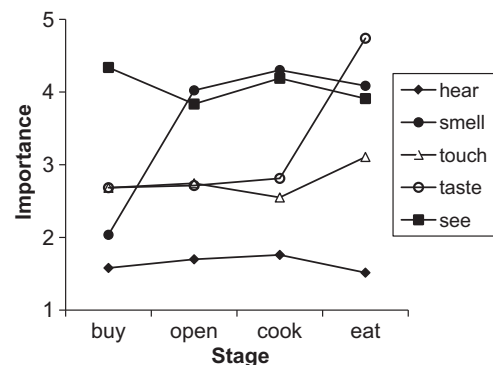


Fig. 1. Importance of sensory modalities at different stages of product usage. Standard errors of the means vary from .046 to .167.

Vision is also important at this stage, because the product should look appetizing. Some participants commented that they notice the thickness of the product through vision and touch. They use visual and auditory cues to know when the product begins to boil.

At the eating stage taste is dominant, because 'the taste is what it's really all about'. Olfactory and visual properties remain important at this stage. Participants commented that the product should look appetizing, and a good smell improves the taste. Some participants also noted that the appearance of the product on the package should match its actual appearance. Although touch was not dominant in any stage, at the time of eating its importance increases, because respondents notice the thickness of the product while stirring it and feeling it in the mouth.

Overall, the number of comments in Table 1 is consistent with the mean importance ratings in Fig. 1, in the sense that more important aspects tend to generate more comments. In addition, the nature of the comments is helpful in accounting for the differences in importance ratings.

3.2. Emotions

Repeated measures ANOVAs on the emotion ratings with Stage and Emotion as within-participant factors and Product as between-participant factor yielded a significant main effect of Emotion [F(2.7, 224) = 27.8, $p < 0.001$, $\eta^2 = 0.25$] and a Stage \times Emotion interaction [F(14.6, 1213) = 3.3, $p < 0.001$, $\eta^2 = 0.04$]. The other effects did not reach statistical significance ($p > 0.05$).

Averaged over stages, mean emotion ratings decreased from 1.85 to 1.15 in the following order: satisfaction (1.85), attraction (1.77), joy (1.56), pleasant surprise (1.56), fascination (1.41), dissatisfaction (1.37), contempt (1.34), admiration (1.34), boredom (1.32), aversion (1.31), unpleasant surprise (1.23), and sadness (1.15). Overall, the means that differed more than 0.20 were significantly different in the post hoc test with Bonferroni correction. This overview shows that positive emotions tended to occur more often than negative emotions. The only exception is the relatively low mean rating for admiration.

To investigate the two-way interaction further, we performed repeated measures ANOVAs for each emotion separately with Stage as within-participants factor and Product as between-participants factor. These analyses yielded significant Stage main effects for six emotions: satisfaction, attraction, pleasant surprise, fascination, dissatisfaction, and boredom. The variations in means over stages are given in Fig. 2.

This analysis of the emotional dynamics suggests that ratings for satisfaction and pleasant surprise tend to be higher during

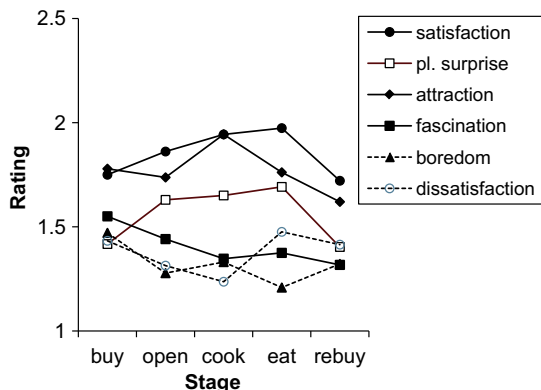


Fig. 2. Emotion dynamics at different stages of product experience. Standard errors of the means for the negative emotions vary between .051 and .067 and for the positive emotions from .057 to .084.

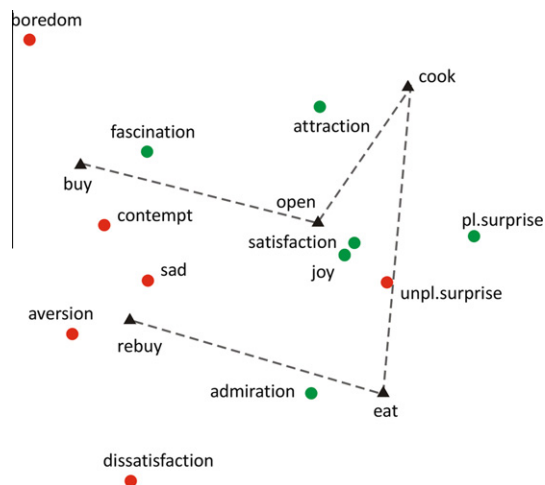


Fig. 3. Correspondence map of emotional experiences during different stages of product usage.

opening, cooking and eating than during buying. Attraction ratings tend to be the highest and dissatisfaction ratings tend to be the lowest during the cooking stage. Fascination ratings decrease gradually over the five consecutive stages of the experiment. However, this decrease does not seem to be related to changes in boredom, because boredom ratings also tend to decrease.

To obtain a graphical representation of all emotion results, a correspondence analysis (CA) was performed with two factors: Stage (5 levels; each level representing a usage stage) and Emotion (12 levels; each level representing a measured emotion). Because CA applies to categorical data, the emotion responses were transformed (1 = no correspondence; 2 = single correspondence; 3 = double correspondence). The two dimensional solution (Fig. 3) visualizes the associations between usage stages and the reported emotional responses: Stages that are plotted close to each other elicited similar emotions. The first dimension, which is represented by the horizontal axis, accounts for 60 percent of the total inertia, and the second dimension, represented by the vertical axis, accounts for 27 percent of the total inertia.

Similar to Fig. 2, this explorative analysis indicates that buying and re-buying evoke relatively more negative emotions than opening, cooking, and eating. If we follow a chronological path in Fig. 3, we see that we start out at buying with a combination of negative emotions (contempt, sadness) and fascination, which transform into positive emotions at opening (satisfaction, joy), cooking (attraction), and eating (admiration), but return to negative when a new buying decision is to be made (aversion, sadness).

Table 2 shows the number of participants who indicated that a particular emotion was the strongest for a particular stage and provides examples of comments why these emotions were prominent. The frequency counts of the strongest emotions are roughly in agreement with the mean ratings discussed above. The highest frequency counts were found for satisfaction, attraction, and pleasant surprise, but the counts for joy were considerably lower. Dissatisfaction was the negative emotion that was experienced most frequently. In line with Fig. 2, frequency counts for pleasant surprise tend to be higher during opening, cooking and eating than during buying, and both fascination and boredom counts tend to decrease over the course of the experiment.

Comments mostly reflect responses to sensory qualities (good or bad appearance, taste, smell, texture), usability aspects (easy or difficult to open package or to prepare the product), and the nature of the product. Some positive comments show that participants become

Table 2

The strongest emotions at different stages of product usage, including the number of times they were mentioned and examples of explanations.

Strongest emotion	Buy	Open	Cook	Eat	Rebuy
Admiration	1: Curious about taste and smell	2: Easy to open	2: Remarkable that powder and water together can make a food product	4: Very nice taste, no side tastes	2: So many different varieties
Satisfaction	14: Looks good; fits my taste; product is clear	15: Product meets expectations; look forward to cooking and eating	14: Product is ready; it looks and smells good; was easy to prepare	18: Good for in-between meals; fast preparation	16: Product was sufficient and filling
Pleasant surprise	6: Package looks fresh and distinctive	13: Nice smell and easy to open	19: Nice smell and texture, better than expected	17: Tastes better than expected; not bad for a powder product	4: Product was better than expected
Attraction	18: Curious about new product and about taste of instant product; lively picture; I feel like eating product	12: Feel like eating product; curious about taste	18: The look and smell make me feel like eating the product	2: I liked the product	13: I liked the taste and smell of the product; images are appetizing
Fascination	7: Package feels different	5: How do they make this? Curious about taste	3: Curious about the taste	3: Making a nice product in such short time; what are those white pieces?	2: I am curious to compare different products
Joy	2: Cheerful picture and graphics	4: Happy with product information; strong smell makes you happy	5: I can finally taste it!	2: My stomach is filled	3: I am glad that I know this product now
Contempt	9: Dislike for powder products; negative taste anticipation; too artificial	4: Bad smell; dislike for powder; deceptive package	2: Smell is not very promising	1: Hardly any taste	7: Dislike the product; deceptive package
Dissatisfaction	6: Ugly package; not much vegetable; not the best product in this store	6: Unexpected color of the powder; bad smell at opening	3: Color does not match with package	18: This soup has nothing new to offer; too salty	14: The taste was bad; did not change my dislike for powder products
Unpleasant Surprise	4: Does not look special	2: Unattractive salty smell; difficult to open	1: Smell is too strong and not really innovative	3: Not much structure	2: Artificial taste; misleading image on the package
Aversion	4: Package does not fit content; unattractive picture	4: Looks and smells chemical	6: Smells too strong; looks unnatural	3: The taste was undefined	6: Did not like the product; too thin, too creamy
Boredom	11: Nothing special; not surprising; product looks boring	4: I expected more attractive product; no surprises after opening	5: Several minutes of stirring is not the best part of cooking	1: Tastes like normal instant product	3: I want something different
Sadness	1: Makes me think of eating alone and paying no attention to my food	1: Is sticky; looks like fish feed	0	2: Tastes too watery and artificial	1: The product did not live up to its package

curious about the product characteristics, or that they are surprised that you can prepare quite a good meal out of powder and water. Negative comments typically reflect negative attitudes towards powder products, expectations that are not met, or discrepancies between the actual product and the product displayed on the package.

3.3. Overall analysis of the data

In order to investigate any possible relationships between the different types of ratings in our study, we performed a Principal Component analysis (PCA) on all responses on the 17 variables (5 sensory modalities and 12 emotions). This analysis yielded four factors with Eigenvalues larger than 1 and explained 58% of total variance. After varimax rotation, the six negative emotions loaded on the first factor (19.9%, all loadings between 0.57 and 0.81), whereas the six positive emotions loaded on the second factor (19.4%, all loadings between 0.63 and 0.77). The third factor (10.2%) was mainly determined by the smell (0.74) and taste (0.79) importance ratings, whereas the fourth factor (8.5%) was determined by the hearing (0.67) and seeing (0.72) importance ratings. The touch importance ratings loaded on both the latter factors with loadings of 0.51 (factor 3) and 0.55 (factor 4). Hence, the emotion data show a clear distinction between a negative affect factor and a positive affect factor, while the sensory modality importances show a division between the more intuitive, chemical senses and the more rational senses vision and audition, with the sense of touch taking an intermediate position.

Because the sensory importance ratings and the emotion data load on separate factors, this analysis suggests that the modality importance data are largely unrelated to the emotion intensity data. Nonetheless, we wanted to investigate the relationship between emotions and modality importance in more detail. Hence, we created two new variables: One containing the mean ratings on the six positive emotion items (Cronbach's $\alpha = 0.84$) and one containing the mean ratings on the six negative emotion items ($\alpha = 0.83$). Subsequently, we investigated to what extent the scores on these two variables could be predicted by the ratings on the five sensory importance items through regression analyses. For the positive emotion variable, none of the five importance measures proved to be a significant predictor [two-tailed t-test, all $p > 0.10$], while for the negative emotion variable only the importance attributed to vision contributed significantly [$t = 2.8$, $p < 0.01$; all other $p > 0.20$]. Participants who attributed more importance to visual aspects also tended to rate negative emotions as more intense.

4. Discussion

This research aimed at understanding how the sensory properties of a food product and emotional reactions to it evolve over the different stages of the user-product interaction. The results demonstrate that all these properties may vary depending on the stages of product usage.

At the buying stage, people pay most attention to visual properties of the product package. This result is in line with previous research (Fenko et al., 2009), which demonstrated the dominance of vision at the buying stage for a variety of industrial products. This is probably a common finding that is induced by practical restrictions in retail environments, such as the impossibility to open packages. When participants chose a product from the shelf, they paid attention to the information about the ingredients and tried to imagine how the product would taste. That is probably why taste was the second most important modality at the buying stage. During the opening of the package, participants were able to smell the contents of the package, and olfaction became equally important as vision. Smell remained important throughout cooking and eating. Furthermore, at the eating stage taste became dominant, followed by vision and smell. Even though the buying and opening stages are likely to involve a considerable number of tactile interactions with the packages (e.g., picking up, carrying, tearing, shaking) this was not reflected in the importance judgments, which are below the midpoint of the scale. The tactile properties became somewhat more important at the eating stage, because the thickness of the food constitutes one of the components of the eating experience. Hearing was not judged to be important at any stage of product usage.

The most surprising finding in regard to sensory importance dynamics was the relatively high rating of taste at the buying stage, although participants had no actual gustatory sensations. This result shows that participants interpreted the questions about their sensory experience more broadly than we expected, and included their expectation or mental image of the sensations that were not yet experienced. This suggests that questionnaire data on sensory modality importance should be used with caution: The answers may reflect not only actual sensory experiences, but also people's ideas of what they might or should experience. Furthermore, the relatively low importance ratings for touch during the buying and opening stages might reflect a tendency to disregard the perception of the packaging in order to focus more on its content. Possibly, some participants reason that only the perception of the actual food product is relevant and ignore the interaction with its packaging.

The dynamics of the emotional experience confirms our suggestion that product experience is influenced by both the actual perception of the sensory product properties, and by pre-existing attitudes and beliefs about a product. In addition, expectations about product performance can be activated during the usage episode, because each stage stimulates expectations about how the next stage will be experienced. For example, the images on the package stir expectations about the smell of the product when opening the package and the taste of the prepared product, or white pieces in the product stimulate curiosity to find out what they will be once the product is prepared.

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 the emotion of 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. Apparently, people do not change their attitudes towards foods after a single positive experience. At the buying stage, when vision is the main and sometimes the only 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 rebuy stage are similar to those found before.

We should be careful when interpreting the effects of emotional responses reported in product tests on overall product experience. These emotions may be contextualized, which means that they are experienced only in the context of the particular usage episode. Surprise is experienced when something sudden and unexpected happens, and pleasant surprise is evoked by an unexpected concern match (Scherer, 1984). People may be genuinely surprised that the taste of a powdered food product is much better than they expected, but at the same time not have a positive attitude of the product, because it does not match their main food concerns (e.g., nutrition and freshness). When someone is asked to eat muskrat-stew (a local delicacy called 'water-rabbit' in a small village in Belgium), this person can be surprised that the stew actually tastes better than expected. At the same time his general experience about (or attitude towards) eating 'water-rabbit' can be - and remain - negative, which is not dependent on the moment of surprise when he tasted the food. Hence, although pleasant surprise may be the dominant emotion when eating the dish, that does not imply that it is also the dominant emotion for the food product as such.

It may be hard to modify beliefs based on specific sensory information, because the sensory modalities may differ in the way they are related to cognitive and affective systems. Experimental data suggest that vision and audition are the two sensory modalities that are most closely connected to rational thinking (Goodale & Humphrey, 1998; Neisser, 1994; Paivio, 2006). Touch, smell, and taste, on the other hand, are more strongly associated with emotions (Hinton & Henley, 1993; Sweetser, 1990), but these experiences are difficult to verbalize and to recognize consciously (Köster, 2003). Therefore, visual exposure to the product may be more likely to update the user's cognitive attitudes and beliefs about the product, while the other senses may trigger mainly affective reactions, which are difficult to recognize and often do not surpass consciousness threshold levels (Berridge & Winkielman, 2003). Even if participants were aware of their emotions and sensory experiences during our experiment, this was not enough to change their pre-existing attitudes about the dehydrated food products. As soon as they were back in front of the supermarket shelves, their negative cognitive 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.

The present study was limited to a single, dehydrated food product and was tested within a sample of 87 consumers from a single population. Each of the four packages was evaluated by a limited number of 20–24 consumers. Although many outcomes may be specific for the experimental context of the current study, the study also shows some outcomes that are likely to apply to other foods and populations as well. For instance, we have shown that the food experience tends to be dynamic over time, showing variations in the importance of the various sensory modalities and the intensity of various positive and negative emotions. Other products are likely to produce other types of patterns, but they are all likely to display similar dynamics. In addition, findings from our innovative approach suggest that food product optimization should be performed considering packaging and food as a whole and along the entire product experience. Indeed, interactions between the two components seem to contribute to changes in emotional patterns highlighted along the participant's experience. This proof of concept may be extended to any other food product categories.

Another finding that may generalize to other research contexts concerns the relationship between the responses on the different scales. Although positive experience aspects tend to cluster

together, and negative experience aspects cluster as well, these two clusters operate independently and produce separate factors in PCA. This is in line with other studies who have noticed the independence of positive and negative affect (e.g., Watson, Clark, & Tellegen, 1988). In addition, the emotion responses seem largely unrelated to the perceived importance of the various sensory modalities. Because each sensory modality may perceive both positive and negative sources of stimulation, these dimensions are probably intrinsically independent, even though the nature of stimulation in specific experimental contexts could in some instances produce significant intercorrelations. For instance, in the present study regression analysis suggested a significant relationship between the importance of the visual modality and the intensity of negative emotions. However, we think that this relationship emerged by chance, because the importance ratings for vision were highest during the buying stage when negative emotional responses also tended to be highest. We do not expect this outcome to generalize to other studies.

In future research, it would be interesting to investigate the dynamic relationships of various sensory experiences with cognitive and affective processes more closely. This could be important both for theoretical understanding of psychological processes involved in product experience, and for the practice of product design, marketing, advertising, and retail.

Acknowledgements

We would like to thank Dirk-Jan Oudshoorn, Reinoud Valks, and Christiaan Maats for their contribution to data collection and analysis.

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