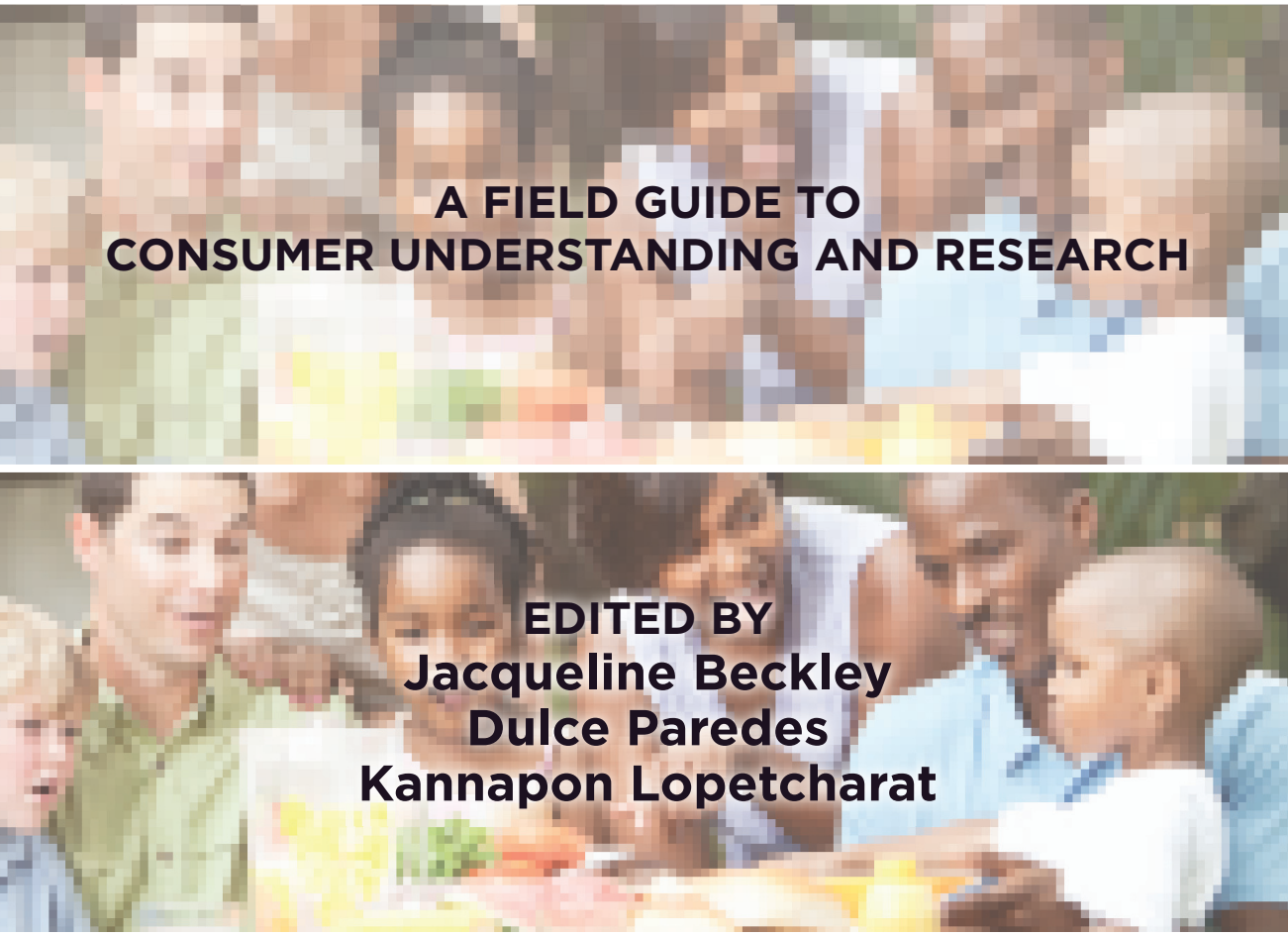
PRODUCT INNOVATION TOOLBOX

A FIELD GUIDE TO CONSUMER UNDERSTANDING AND RESEARCH



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WILEY-BLACKWELL

6.6

Emotion Research as Input for Product Design

Pieter Desmet and Hendrik Schifferstein

Key learnings

- ✓ Roles of emotion in new product development
- ✓ Measuring emotional responses
- ✓ Incorporating emotional learnings in product development

6.6.1 Putting emotion at the center: emotion-driven design

The first author recently purchased an electric water kettle. It is made of stainless steel and has a little window that enables me to observe the water while it heats to boiling temperature. When first using it, I unexpectedly experienced a little delight: as soon as the kettle was activated, the water inside turned bright blue. That is when I discovered that the manufacturer had incorporated an LED-light in the kettle's interior. Although it has no apparent function, I was delighted by this tiny magical moment of plain water suddenly turning blue. Because of my emotional response, I now appreciate the kettle more than I would have without this little surprise, even sharing the emotion by demonstrating it to friends and dinner guests.

The kettle example, illustrating the impact of emotion during product usage, is actually arbitrary because *any* product will elicit emotions, whether or not the designer intends this or is even conscious of it (Desmet, 2008). The list of examples is infinite: someone may be irritated by the non-usability of a fancy music player, disappointed by the performance of a new computer, fascinated by a multi-functional espresso machine, inspired by an innovative electric car, etc. The fact that emotion is a key aspect of the user-product relationship is generally accepted and promoted in the (design) industry: with the power to entice customers to select one particular item from a row of similar products, emotions have a considerable influence on our purchase decisions (Pham, 1998). Moreover,

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emotions are not only involved in our reasoning about what product to buy, but also have a significant effect on consumer satisfaction (Westbrook and Oliver, 1991), product attachment (Mugge et al., 2005) and general well-being (Desmet and Hassenzahl, 2011). Hence, the emotions of product consumers and users are too important to be ignored in design processes, and the ability to design products with a positive emotional impact is of great relevance to the discipline of design.

The blue light hidden in a water kettle is an example of "emotion-driven design" because it was probably intentionally installed to elicit pleasant surprise. Emotion-driven design or "design for emotion" involves a design process that intends to evoke particular user emotions. Although user emotion is taken into consideration in any given design project to some extent, in emotion-driven design the user emotion takes a *central* role: the design goal typically includes a statement about the intended emotional user effect or "target emotion". Design for emotion is driven by the aim to better understand the relationship between users and products. Because emotion-driven design requires a thorough understanding of the intended users, measuring the users' emotional responses, either to existing products or to new product ideas and concepts, is likely to contribute to the success of the resulting designs. Emotion research can serve various functions depending on the product design stage, such as helping in formulating the design goal, inspiring the design team, testing initial ideas, or selecting concepts.

The aim of this chapter is to provide ideas of how emotion research can be used as a relevant source of information in new product development projects. First, we provide a brief overview of the design process involved in new product development projects. This overview is used as a framework for sketching the requirements for emotion research in the various stages of the design process. Subsequently, we provide a brief overview of the variety of relevant research methods that are available. By means of example projects, we illustrate possibilities of using emotion research in various stages of design processes.

6.6.2 New product development and design

New product development is the term used for the complete process of conceptualizing and developing new products, materializing them and bringing them to the market. A general overview of new product development processes and the role of designers in these processes, is visualized in Figure 6.6.1. In general terms, the aim of new product development is to facilitate the movement from an existing towards a preferred state (Eekels and Roozenburg, 1991). The point of departure is the articulation of a gap between the existing and a preferred state (i.e. one determines that the current state is not optimal; top part in Figure 6.6.1). Three main stages can be identified in the new product development process that is aimed at changing the existing into the preferred state (Van Kleef et al., 2004; middle part in Figure 6.6.1). The first step is to initiate the design project. The initiation can originate from all kinds of opportunities (or threats) that are encountered or identified, such as technological developments,

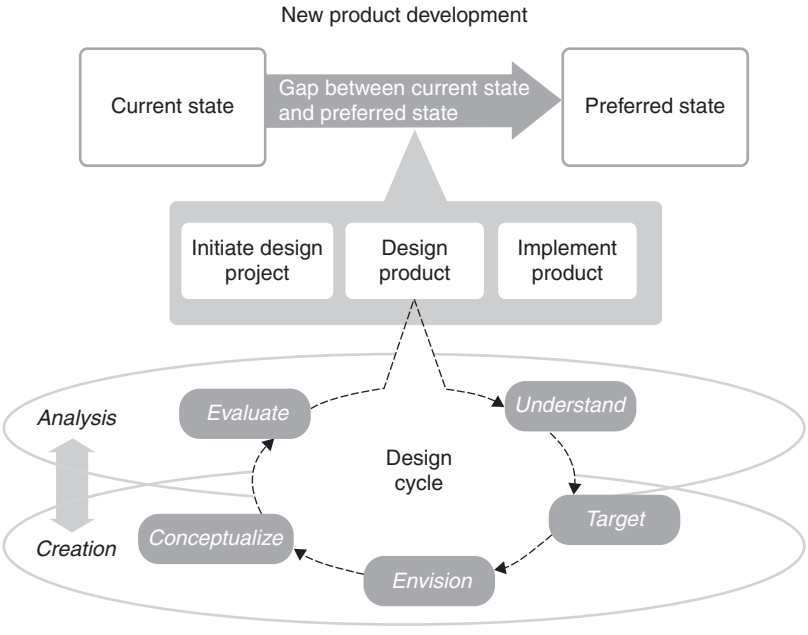

Figure 6.6.1 The role of design in new product development.

emerging markets and customer feedback. The second step is to develop a product (or service) and the third step is to implement the product by bringing it to market. Product implementation involves various activities, such as product planning, technical implementation and product launch.

Designers, or design teams, play an important role in the second stage of new product development. Their task is to conceptualize product ideas and develop design specifications that optimize the function, value and form of products for the mutual benefit for both the user and the company. Design is essentially an integrating discipline, combining knowledge from, for example, usability, ergonomics, engineering, marketing, sensory science and aesthetics to create tangible design solutions that optimize the user-product relationship. Design processes typically start with an ill-defined problem and indefinite and incomplete criteria for the intended end result. Consequently, they always involve a high level of uncertainty. To deal with this uncertainty, industrial designers use design methodologies to structure the creative and analytical activities involved in design processes. In line with Roozenburg and Eekels (1995), and Desmet and Schifferstein (2011), we identify five basic steps in design processes: understand, target, envision, conceptualize and evaluate (bottom part in Figure 6.6.1). The process is iterative, and each design project can involve multiple cycles; the cycles are followed until the design result is satisfactory. In the "understand" step, the current situation is analyzed in order to understand this situation and its determinants. In the "target" step, the intended effect of the new product (i.e. the preferred state) is formulated. In the "envision" step, the specifications

for the new product are formulated (e.g. what should be the character and purpose of the product) and in the "conceptualize" step, ideas for new products (or services) are generated (e.g. what the product does, who uses it in which situation, and how it is operated). The final step is to evaluate the new product design to determine whether it generates the intended effect on the consumer or usage situation.

The design cycle illustrates that design processes integrate analytical and creative phases: whereas the nature of the "understand" and "evaluate" steps is analytical, the nature of the "target", "envision" and "conceptualize" steps is creative. This integration is important, because it creates requirements for emotion research in order to be instrumental in new product development processes. Empirical emotion research typically takes place in the analytical phases (i.e. understanding emotions in the current state, or in response to new design ideas). In the creative phases, concepts and product ideas are generated. Here, emotion research can serve as a valuable source of inspiration, stimulating creative ideas about possible design qualities that align with the emotional intention. For the creative phases, it is also important to understand the reasons that underlie emotional responses to products. This helps designers to understand *how* they can design products that have the intended emotional effect. Before we discuss the role of emotion research in emotion-driven design projects, we will, therefore, discuss the basic variables involved in the process that evokes consumer emotions.

6.6.3 Emotional responses to consumer products

Emotions are elusive in the sense that they are subjective: different people will experience different emotions towards the same product. A given product that is admired by some, can be experienced as boring or dissatisfying by others. Apparently, the relationship between a product and the emotional responses to this product involves other variables than the product alone – variables that differ between people. As a consequence, it is not sufficient for designers only to rely on their intuition and personal sensitivities. Instead, they need to understand the emotional responses of the target consumer, knowing that these may be different from their own. To facilitate this understanding, Desmet (2002) proposed a "basic" model of product emotions that represents the key variables involved in the process that evokes emotional responses to product design (Figure 6.6.2).

The basic model of product emotions is based on contemporary emotion theory, which considers emotions to be mechanisms that signal whether events are favorable or harmful to an individual's personal well-being. The process of signaling the personal significance of an event is called an appraisal: a "direct, non-reflective, non-intellectual automatic judgment of the meaning of a situation" (Arnold, 1960, p. 170). In appraising events, people's personal concerns serve as points of reference. Following Arnold, Frijda (1986) argues that when we appraise a stimulus as beneficial to our concerns, we will experience positive emotions and try to approach this particular stimulus. Likewise, when we

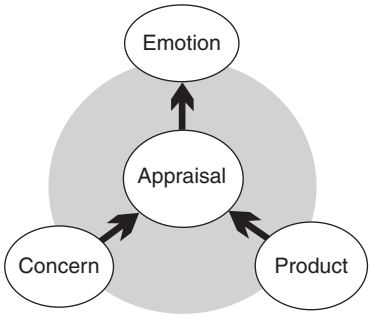

Figure 6.6.2 A basic model of product emotions (Desmet, 2002).

appraise a stimulus as colliding with our concerns, we will experience negative emotions and try to avoid it.

Concerns are more or less stable personal preferences for certain states of the world (Frijda, 1986). This explains why people differ with respect to their emotional reaction to a given product. Compare, for example, the response of a sailing enthusiast with the response of an environmentalist aiming to preserve coral wildlife to the same sailing yacht. The first will probably experience a pleasant emotion (e.g. hope) given the concern for enjoying sailing trips, whereas the second will more likely experience an unpleasant emotion (e.g. fear), given the concern of avoiding coral damage caused by sailing yachts. Several design cases have shown that understanding the concerns of the user is key to successful emotion-driven design (e.g. Desmet and Dijkhuis, 2003; Desmet et al., 2007).

Ortony et al. (1988) developed a typology of human concerns in which three types of emotional concerns are distinguished: goals, standards and attitudes. Desmet and Hekkert (2007) found these three types of concerns to be particularly valuable for understanding product emotions. Goals are event-related concerns. These represent what one wants to get done and what one wants to see happen. Goals are often assumed to be structured in a hierarchy ranging between abstract goals or aspirations, like the goal to have a successful life, to goals as concrete and immediate as the goal to catch a train. Many goals are directly and indirectly activated in the human–product relationship (see Demir, 2010). For example, one buys, owns and uses products because one believes they can help to achieve things (a digital agenda helps to organize our life), or because they fulfill a need (a bicycle fulfills the need for transportation).

Standards are our beliefs, norms or conventions of how we think things should behave. Whereas goals refer to the state of affairs we want to obtain, standards are the states of affairs we believe ought to be (Ortony et al., 1988). For example, many believe that they should respect their parents, and eat more fruit and vegetables. Most standards are socially learned and indicate which moral evaluations are made. Whereas goals are relevant for our personal

well-being, standards are relevant for the preservation of our social structures (and thus indirectly also for our personal well-being). We approve of things that comply with standards and disapprove of things that conflict with them. We not only have standards regarding human (inter)action, but also regarding products. With respect to products, our values represent our beliefs of how a product (or a person associated with the product) should behave or function. For instance, we expect a new car to start without effort, and we expect a vase to be water resistant.

Attitudes are our concerns that are related to objects. They represent our dispositional likings or dislikings (taste) for particular (attributes of) objects. We have attitudes towards product types ("I don't like guns"), aspects or features of products ("I like red cars"), towards style ("I like Italian design"), towards quality of interaction ("I like cars that have a firm drive"), and towards context-related consequences of products ("I like feeling relaxed after drinking a beer"; see Desmet, 2010). Some people like red cars, others like black cars. Some people like Italian furniture style, whereas others prefer the Scandinavian style. Emotional responses related to attitudes are focused on the moment of the experience and not on the (anticipated) consequence of usage or on the (expected) behavior or functioning. In the latter cases, the emotional responses will be related to the expectations that can represent goals or standards.

6.6.4 Methods for emotion research in new product development

Figure 6.6.3 shows three main types of emotion research in new product development projects. The first and second type focus on assessing emotions (either to (a) existing or to (b) new product designs) and the third type (c) focuses on assessing concerns. Measuring emotions can help understanding the emotional impact of products, and assessing concerns can help understanding the causes of these emotions.

The measurement of emotion and the assessment of concerns require different approaches. For both approaches, various methods are available. The next

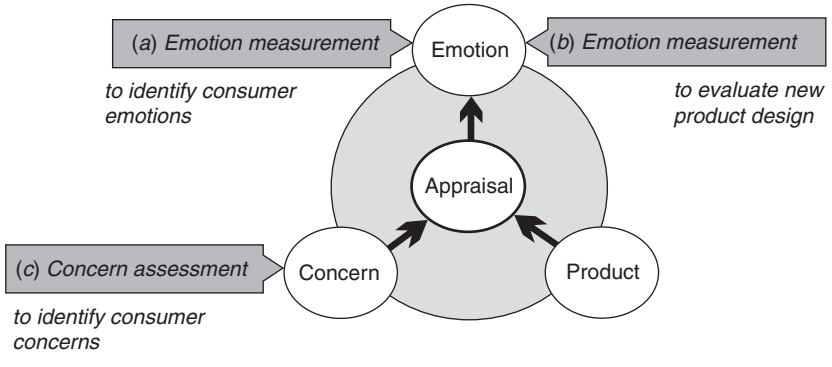

Figure 6.6.3 Emotion research for new product development.

sections give a brief overview of research methods in general emotion research. Only some will be elaborated on further, because some methods are more suitable for application in design-oriented research than others.

6.6.4.1 Emotion measurement

Emotions are often conceptualized as multi-componential phenomena (Scherer, 2005), including behavioral reactions, expressive reactions, physiological reactions and subjective experiences. Behavioral reactions are the actions or behaviors one engages in when experiencing an emotion, such as running or seeking contact. Emotions initiate behavioral tendencies like approach, inaction, avoidance and attack (Frijda, 1986). Fear makes one want to run, love makes one want to approach or caress, and so one. Expressive reactions are the facial, vocal and postural expressions that are part of the emotion. Each emotion is associated with a particular pattern of expressions (Ekman, 1994). Anger, for example, comes with fixed stare, contracted eyebrows, compressed lips, vigorous and brisk movements, and, usually, a raised voice, almost shouting (Ekman and Friesen, 1978). Physiological reactions are the changes of activity in the autonomic nervous system that are part of the emotion, such as pupil dilatation, increase in heart rate, and sweat production. The subjective experience is the feeling, the conscious awareness of the emotional state one is in, such as feeling happy or angry. Most available instruments focus on the assessment of the expressive, physiological, or the feeling component of the emotion.

Traditionally, most attempts to measure emotions have been done in the field of psychology and sociology. More recently (i.e. the last 20 years), acknowledging the important role of emotions in their field of research, consumer and marketing researchers have developed instruments which measure emotional responses to advertisements and consumption experiences. Even more recently (i.e. the last 10 years), and as a result of the rapid invasion of computers into our daily lives, computer science has also become a player in the field of measurement of emotions. The overview below is partly based on Laurans et al. (2009).

- *Emotional expression* The notion that each emotion is characterized by a unique (facial) expression, resulted in the development of systematic observation tools such as the facial action coding system (FACS; Ekman and Friesen, 1978). Facial action coding system is a system that deconstructs facial expressions into visual facial muscle activities. The system can be used for manually coding facial expressions of participants. These tools are, however, seldom used in design-oriented research. One reason is that coding methods demand a considerable investment in time and expertise (the manual is over 1000 pages long), while their usefulness for the measurement of the typically mild emotions elicited by product interactions remains to be established. Software packages are now beginning to appear that are based on techniques for the automatic recognition of expression, often within the framework of affective computing (Den Uyl and van Kuilenburg, 2005). For the time being, these packages mostly rely on posed expressions. Although they are able to detect differences in basic valence, they have

difficulties in detecting subtle differences between similarly valenced emotions. Nevertheless, they may become interesting for future design-oriented research.

- *Physiological activation* Techniques that measure physiological activation have some practical advantages: they yield continuous measures that do not demand the user's attention. The "objective" nature of the measurement is also appealing, as they avoid some of the biases influencing self-reports. One obstacle in applying these techniques for design-oriented research is the need for specific expertise and complex equipment, and the relative obtrusiveness of sensors, reducing the freedom of movement of the participants. A more fundamental problem is the relatively low coherence between physiological activation and other components of emotion (Bonanno and Keltner, 2004; Mauss et al., 2005), which requires a careful consideration when applying these techniques in design-oriented research. As of today, it remains very difficult to use physiological data for assessing users' emotions in response to products (Laurans and Desmet, 2008). As a consequence, the bulk of published research using these techniques is supplemented with self-report data.
- *Emotional experience* The techniques that are used most often rely on the self-report of the subjective experience component of emotion. These techniques do not require complex or expensive equipment. Various standardized scales and questionnaires are available, reflecting different views on the structure of emotional experience. Reviews of these self-report instruments are reported by Laurans et al. (2009) and Poels and de Witte (2006). A broad distinction can be made between questionnaires based on descriptors of discrete emotions and questionnaires developed to assess the main dimensions of feelings. An example of the first type is the Geneva Emotion Wheel (Scherer, 2005), which is a verbal self-report instrument that measures 20 distinct emotions. An example of the second type is the PANAS scale, which measures two independent dimensions: one for positive affect (PA) and the other for negative affect (NA), each representing a basic dimension of feelings (Tellegen, 1985).

Although most questionnaires are verbal, some do not rely on words. Non-verbal scales use cartoon characters to represent emotions, which makes them easier to use across cultures. One is the self-assessment manikin (SAM, see Bradley and Lang, 1994), which measures three basic dimensions of emotions: valence (positive versus negative), arousal (calm versus excited) and dominance (or feeling of control regarding the situation). With only one item per scale, the SAM is quick and easy to administer for product testing. PrEmo (Desmet, 2003) is a non-verbal measurement tool developed specifically for design-oriented research consisting of 10–14 animations that each represent a different emotion. Each animation shows a cartoon character that expresses an emotion through facial expression, body movement, and sound (see Desmet and Dijkhuis, 2003; Desmet et al., 2005).

6.6.4.2 Measuring emotions for product design

The main disadvantage of dimensional instruments for design-oriented research (either based on expression, physiology or self-report), especially in the early phases of the design process, is that they tend to lack inspirational value.

Assessments of existing products with self-report instruments based on categorical emotions are usually much more effective in informing further design efforts (Laurans et al., 2009). These instruments are able to uncover rich emotion profiles that provide nuanced information – and for designers these nuances form the sources of inspirational value. However, a drawback of many instruments that are based on categorical emotions is that they have the tendency to over-represent negative emotions, whereas emotional responses to products more often tend to be positive than negative. This was shown for industrial product design (Desmet, 2002), and for food design (Desmet and Schifferstein, 2008). Measurement instruments used in product development processes should therefore not over-represent negative emotions.

There are additional characteristics of emotions elicited by product design that should be taken into consideration (see Desmet, 2008). First, most emotions that are experienced in the user-product relationship are felt at low intensities. Products, for example, tend to elicit frustration more readily than fury, and joy more readily than ecstasy. Second, rather than eliciting one single emotion, products may elicit multiple (mixed) emotions simultaneously, with each different product aspect (e.g. general appearance, particular details, implicit and explicit expectations, and associated, remembered and imagined meanings) having an emotional impact. A person can, for example, be proud of a new pair of shoes and happy with the reaction of his or her partner, and at the same time be irritated by the lack of comfort and afraid of damaging the delicate leather. Given the subtle and mixed nature of emotions experienced by product consumers, self-report instruments that measure distinct emotions, such as the Geneva emotion wheel and PrEmo are most appropriate for design-oriented emotion research.

6.6.4.3 Concern assessment

Concerns, values or expectations, are generally assessed with various types of questionnaires or interviews. Standardized concern questionnaires are based on general concern taxonomies. Several taxonomies of general life concerns are available, with associated measurement scales. An often used example is the taxonomy and questionnaire developed by Sheldon et al. (2001), which consists of ten motive types with three distinct motives for each type (Table 6.6.1).

The Sheldon questionnaire can be used to identify the concerns that were involved in remembered emotional events. First, respondents are asked to imagine a remembered recent life event in which they experienced an emotion. Given this event, respondents use five-point scales to express to what extent each motive was attained in the case of a positive emotion or blocked in the case of a negative emotion. Analogously, respondents may be asked to remember events in which emotions were experienced in response to a particular product. The general concerns thus generated can be used as main directions in the design process, (e.g. to design for autonomy, to design for relatedness, etc.).

In many cases, using general concern taxonomies may not be feasible, because particular product emotions may be determined by specific product features or situational characteristics. These cases call for open interview techniques. Laddering is an interview technique that can be used to determine the concerns that underlie people's (dis)likes for specific product features and

Table 6.6.1 Sheldon concern taxonomy (created from data from Sheldon et al., 2001).

Autonomy	That my choices were based on my true interests and values. Free to do things my own way. That my choices expressed my "true self."
Competence	That I was successfully completing difficult tasks and projects. That I was taking on and mastering hard challenges. Very capable in what I did.
Relatedness	A sense of contact with people who care for me, and whom I care for. Close and connected with other people who are important to me. A strong sense of intimacy with the people I spent time with.
Self-Actualization / Meaning	That I was "becoming who I really am." A sense of deeper purpose in life. A deeper understanding of myself and my place in the universe.
Physical thriving	That I got enough exercise and was in excellent physical condition. That my body was getting just what it needed. A strong sense of physical well-being.
Pleasure-stimulation	That I was experiencing new sensations and activities. Intense physical pleasure and enjoyment. That I had found new sources and types of stimulation for myself.
Money-luxury	Able to buy most of the things I want. That I had nice things and possessions. That I got plenty of money.
Security	That my life was structured and predictable. Glad that I have a comfortable set of routines and habits. Safe from threats and uncertainties.
Self-esteem	That I had many positive qualities. Quite satisfied with who I am. A strong sense of self-respect.
Popularity-influence	That I was a person whose advice others seek out and follow. That I strongly influenced others' beliefs and behavior. That I had strong impact on what other people did.

qualities (Reynolds and Gutman, 1988). Laddering was originally developed to determine means-end chains. By repeatedly asking the question: "Why is this important to you?" the researcher is able to infer which concerns underlie particular product preferences. The session starts with asking the respondent to select the most preferred product from a set of products. Respondents are asked to explain what product qualities or features they base their selection on. They are then asked to explain why the particular quality or feature is important to them. Whatever they mention, the interviewer will ask again why they think this is important to them. This eventually leads to the concerns that underlie their preferences. The session continues until the researcher has a full overview of all concerns that the respondent has in relation to the given product.

6.6.5 Emotion research in new product development

In this section, we discuss opportunities for emotion research in the different steps of the design cycle in emotion-driven design projects. Three design cases are used to illustrate application possibilities: a telephone case, in which a mobile phone was designed with the aim to evoke a "wow!" experience; a breakfast case, in which a tray-served airplane breakfast was designed with the general aim to improve the emotional impact of the current breakfast; and a fabric conditioner case, in which a fragrance for a fabric conditioner was developed with the aim to strengthen the emotional consistency of the product. Details of the case studies (including measurement procedures and data analysis) have been reported by Desmet et al. (2007) and Desmet (2010). Here, we only discuss them to illustrate the design-oriented emotion research.

6.6.5.1 Measuring emotions in the "understand" stage

The first purpose of emotion research is to understand the emotions of consumers in the current situation. The most straightforward approach is to measure emotions that are evoked by existing products. One can, for example, measure the emotional impact of existing products in the portfolio of the client and/or the client's competitors. Alternatively, these can be emotions experienced in a particular domain that is relevant for the client, such as visitors of museums, patients in hospitals, or travelers at airports. The results of these measurements can be used in several ways in the "target" step to formulate a statement about the intended emotional response of the users or consumers to the new product. For instance, the research can be used to identify possibilities to reduce negative emotions, to introduce positive emotions, or to improve emotional consistency in the design.

6.6.5.1.1 Identify possibilities to reduce negative emotions

Emotion measurement can identify unwanted negative emotions. For example, measurements can indicate that users are dissatisfied about particular product features or properties, or irritated by unclear requirements. In those cases, the design goal is to reduce these negative emotions. An example is a manufacturer

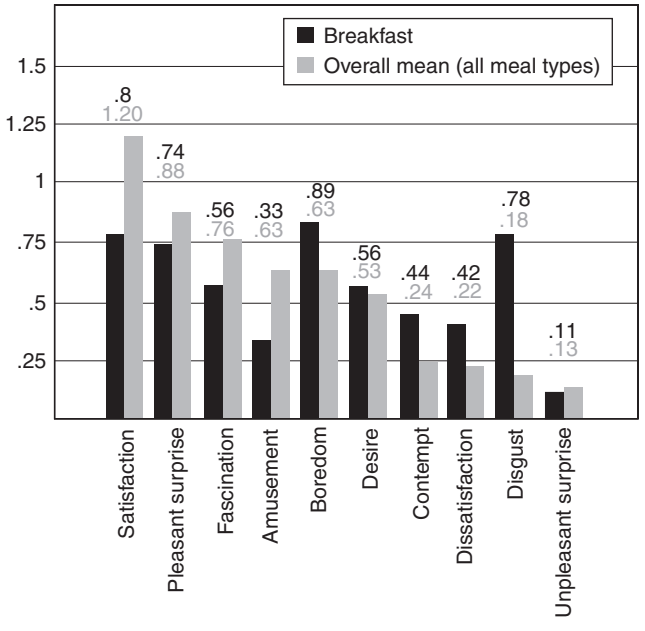

Figure 6.6.4 Emotions elicited by all meal types and by a breakfast tray.

of office seats, who discovers that users are frustrated because of a difficult-to-adjust armrest (current state) and starts a product development process to resolve the frustration by improving the ease of use of the armrests (preferred state).

Example: Airplane meal

An airline company had decided to invest in redeveloping the meals they served during flights with the aim to improve their emotional impact. It was decided to reduce negative emotions experienced by passengers in response to the existing meals. The first step in the project was to use PrEmo to assess the emotions elicited by the company's current airplane meals during flight. The meals included breakfast trays, breakfast boxes, lunches, dinners and snack services. The graph in Figure 6.6.4 shows the average emotional impact. The black bars represent the emotional impact of the breakfast tray (overall mean ratings for a three-point scale). The grey bars represent the average emotional impact of all five meal types.

The graph indicates that the breakfast tray rates bad on the negative emotions boredom and disgust when compared with the other meal types. On the basis of this study, it was decided to target the redesign efforts on the breakfast tray, with the aim to reduce the experience of disgust and boredom.

6.6.5.1.2 Identify possibilities to introduce positive emotions

An emotion measurement can also identify opportunities to introduce desirable, but not yet experienced positive emotions. For example, benchmark research can indicate that there is a market for a product that evokes fascination, or consumer feedback can indicate that there is a possibility for increasing the

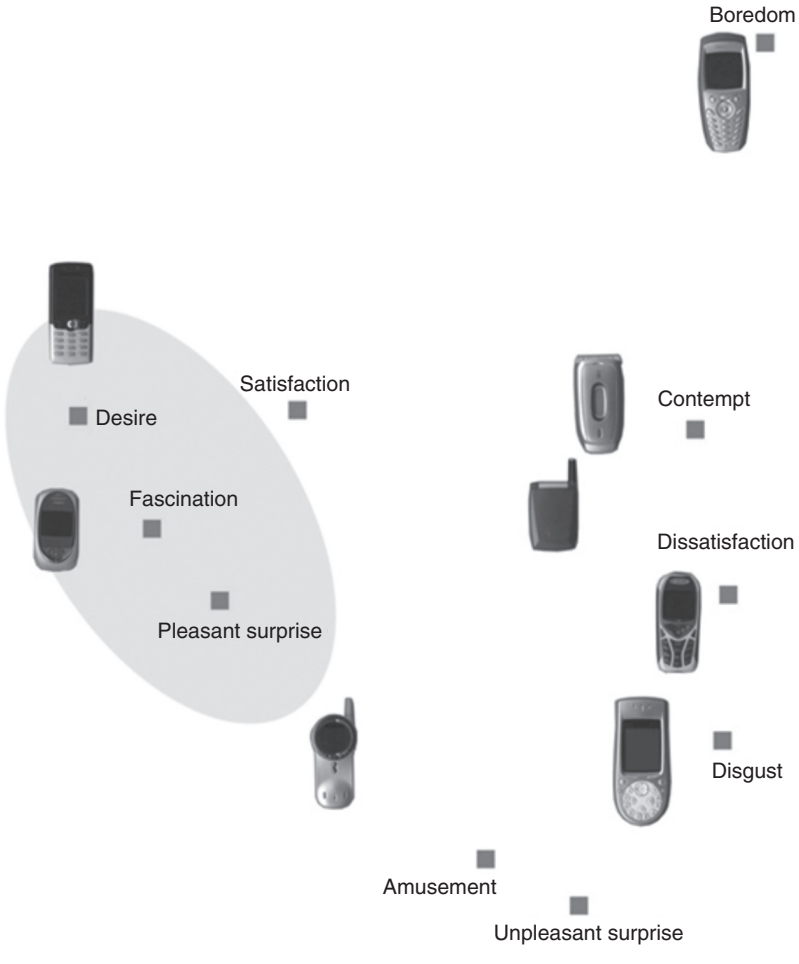

Figure 6.6.5 Emotional impact of existing mobile phones.

joy of use. In those cases, the design goal is to introduce positive emotions. An example is a wine producer who discovers that there is a market for wine that evokes amusement and starts the development of an amusing wine.

Example: Wow telephone

The client was a telecom company who had decided to develop a mobile phone that evokes a "wow!" feeling for the target consumers. Emotion measurement was used to better understand this general experience. The main aim of the study was to have an impression of what emotions are involved in a "wow!" experience, and to determine which existing phone designs evoked the intended "wow!" experience. The emotional responses elicited by eight existing mobile phones were measured (with 35 target consumers, each respondent responding to all models). The models were selected to represent substantial design variation and to include those models that the client believed would evoke the intended "wow!" experience (Figure 6.6.5).

	B	*A*	*H*	*D*	*E*	*F*	*C*	*G*
								
Surprise	1.54	1.23	1.37	.86	.89	.66	.66	.46
Desire	1.03	1.20	.57	.57	.40	.46	.29	.26
Fascination	1.14	1.06	.86	.63	.51	.51	.40	.29
Overall	1.32	1.16	.93	.69	.60	.54	.45	.34

Figure 6.6.6 Measured wow-impact in pre-study.

The graphical representation in Figure 6.6.5 is the result of a correspondence analysis. It visualizes the variance in the data, in which distances between items are based on how often a particular emotion was experienced in response to a particular stimulus. Given this visualization, the design team proposed to select the "wow!" experience to consist of the three emotions desire, fascination and pleasant surprise (shown in the gray area that was added by the researcher). Figure 6.6.6 shows the mean ratings of all telephone models on these three wow-emotions (on a three-point scale, ranging between 0 and 2).

The last row, the "wow index", shows the overall mean rating on these three emotions. The telephones are ordered in accordance with their "wow!" impact. Three models elicit a higher level of "wow!" experience than the other five: models A, B and H. This ranking served as the emotional benchmark for the project, and the project aim was to develop a mobile phone that evoked at least as much "wow!" as these three models.

6.6.5.1.3 Identify possibilities to strengthen emotional coherence

Emotion measurement can help create coherence between the emotional fingerprint of a brand and the emotional impact of the product design.

Example: Fabric conditioner

The aim of the project was to optimize the emotional consistency of a fabric conditioner product. The client had recently redesigned the product packaging, and wanted to develop a fragrance that, in terms of emotional impact, fitted with the package design. An initial measurement was performed to identify the "emotional fingerprint" of the new package design. The general aim of product design is to evoke positive emotions. There are, however, many different types of positive emotions, and the concept of emotional fingerprint was introduced to denote the specific positive emotion type that is typically elicited by a product. The emotional impact of the old and new package was measured with PrEmo. A third product (a green package) was included in the study to serve as point of reference. Figure 6.6.7 shows the correspondence map that visualizes the emotional impact of the new design in comparison to the old design.

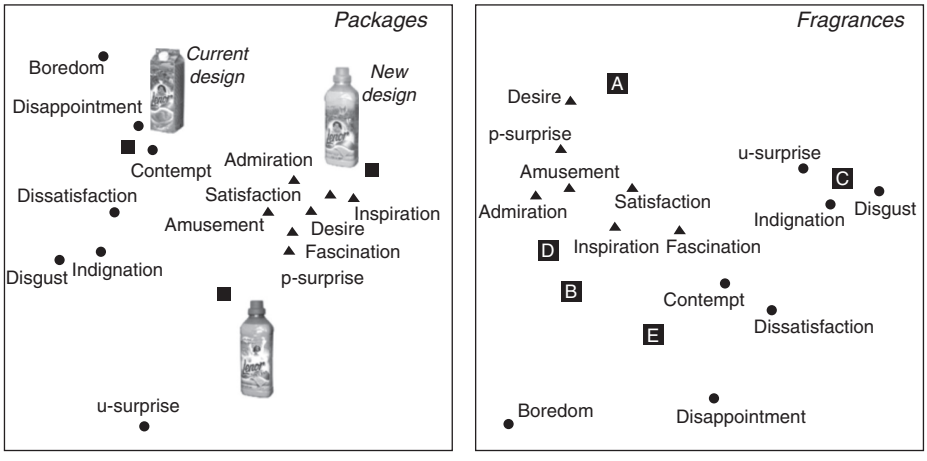

Figure 6.6.7 Emotions elicited by fabric conditioner packages and fragrances (p-surprise = pleasant surprise; u-surprise = unpleasant surprise).

On the basis of these results, the client decided to select the emotion "inspiration" as the key emotional target for the product, because it is evoked by the new package design and fits with the brand identity of this particular product. The emotional target for developing an appropriate fragrance was therefore to develop a "blue fabric conditioner fragrance" that evokes inspiration. The right side of Figure 6.6.7 shows a second emotion measurement. Each letter represents a fragrance that was developed by the client's fragrance supplier to fit with a blue fabric conditioner. Note that the configurations of emotions differ between the two maps in Figure 6.6.7, because the analysis aims to make an optimal visualization for each specific stimulus set. On the basis of this measurement, fragrance D was selected and implemented in the product.

6.6.5.2 Assessing concerns in the "understand" stage

The second purpose of emotion research is to identify the concerns that consumers have with respect to given products or with respect to a given situation. Emotion measurement focuses on the "what" question, and concern assessment focuses on the "why" question. Assessing concerns enables the design team to understand why consumers experience particular emotions to a given product or situation.

6.6.5.2.1 Identify concerns given a particular product

Concern assessment can identify the goals, standards and attitudes of consumers that underlie their emotional responses to a given product (type). Laddering interview techniques can be used to investigate existing products, and value taxonomies can be used to structure the results (see Chapter 6.1).

Example: Wow telephone

A concern study was performed to generate insights in the concerns that underlie the wow-experience of the target user with respect to mobile phones. Two group discussions (five respondents each) with target consumers were conducted. The same mobile phones as in the emotion measurement were used, together with the correspondence map in Figure 6.6.5. The group members first discussed the emotional impact of each of the eight mobile telephones. The models were placed randomly on the table, and the moderator invited participants to express their affective responses. Subsequently, the moderator introduced and explained the mobile telephone and emotion map. The group members were stimulated to discuss to what degree they "agreed with" the map, that is to what degree the map represented their emotional responses. The group was stimulated to discuss the underlying reasons why the models and emotions were placed in that particular configuration. By using this approach that was loosely based on laddering, the moderator was able to direct the discussion towards the abstract level of underlying concerns. All comments made by any of the participants that referred to concerns were recorded and subsequently categorized in terms of the three concern types: goals, standards and attitudes. Table 6.6.2 gives an overview of the categorized concerns. The first column shows the concern type, the second shows examples of mentioned concerns, and the third column shows concern themes that were formulated to represent the concern examples.

6.6.5.2.2 Identify concerns given a situation

Concerns underlying emotional responses to products are context-dependent. For example, someone has other concerns when using a laptop in the train than when using the laptop in an office environment. It can, therefore, be important to take the context of use into consideration when doing a concern analysis. The analysis should take place in a context that is as realistic as possible.

Example: Airplane meal

In order to identify how the breakfast tray could be redesigned to decrease disgust and boredom, a concern analysis was made by interviewing passengers during intercontinental flights. Respondents were shown the current product, and asked to respond, using a laddering technique to enable the interviewer to discuss underlying concerns. Identified concerns were categorized in three classes – concerns with respect to: (1) The meal, (2) The presentation and (3) Eating the meal. Four pairs of seemingly conflicting concerns were identified as inspirational for the design team:

(1) Meal: The meal should show variety/the meal should show balance.
(2) Meal: I want to be refreshed/I want to be relaxed.
(3) Presentation: I want to be distracted/I want things that are easy to use.
(4) Eating the meal: I like familiarity/I like surprises.

Table 6.6.2 Concern profile related to wow-experiences.

Concern types	Concern examples	Concern themes
GOALS I want a telephone that	fits my hand (not too small or too big); is convenient to store; does not have awkward folding mechanisms.	Manageable
	has clear and unambiguous buttons; has buttons that are easy to operate; can be operated with uncomplicated interaction protocols.	Practical
	does not have parts that can break off; is not sensitive to damage; has a protected screen; has sturdy buttons; is always reliable.	Reliable
VALUES A telephone should	have a solid cover; not be too light; have a clear click if it has a folding mechanism; not have the tactile quality of plastic; not make cracking sounds when held in the hand.	Quality
	be recognizable as telephone; have a design that emphasizes the telephone function; should be functional; have a no-nonsense expression; not have 'design-frills'.	Logical
ATTITUDES I like telephones that	are consistent in general shape, color and buttons; are shaped geometrically; have balanced shapes; are made of 'real' materials like metal and rubber.	Consistent
	are not boring; have powerful shapes; show distinctive features; have an innovative design; have an exciting design; are stylish; are elegant; are unique.	Unique
	have classy design; are made of beautiful materials; are well-detailed and finished; do not look childish; do not look cheap; show perfection in design and fabrication.	Luxurious

6.6.5.3 Stimulating creativity in the "envision" stage

The "target" stage may result in an emotional design direction, either in terms of what emotion to design for, or in terms of what emotion to reduce or prevent. For instance, in the fabric conditioner case, the company wanted to design an inspiring fragrance that fitted the accompanying package. We also described the case of the airline, who wanted to reduce the disgust and boredom evoked

by their breakfast trays. Knowing which emotions to evoke or to avoid provides a target that can be used to determine the appropriateness of design concepts, but it may not provide direct inspiration for generating new designs. Emotion research and emotion theory can be of use for stimulating creativity when envisioning design directions, and for formulating design qualities or characters.

6.6.5.3.1 Envision solution space

General knowledge available in the literature on emotions and concerns can be used as a source of inspiration. Because of the general nature, it can open up interesting opportunities for the creative process. We may use existing lists providing overviews of emotions (Frijda, 1986; Scherer, 2005), appraisals (Lazarus, 1991; Scherer, Ortony et al., 1988;), or concerns (Ford and Nichols, 1987; Sheldon et al., 2001) as inspirational materials for developing innovative ideas. For instance, starting out from Sheldon's list of concerns (Table 6.6.1), we can ask participants of a creative session to pick a concern from the list at random, and to try to relate it to the target product. Imagine a situation with a user who has this concern, and explain how the product helps him or her in reaching this particular goal, meets or conflicts with a certain standard, or relates to this attitude. Analogously, starting out with an elaborate list of positive or negative emotions, the participants may be asked to develop a usage scenario in which the product evokes that particular emotion. The unusual product-emotion combinations that occur will open up the mind for new situations, uses and product concepts.

6.6.5.3.2 Generating product quality or character

Another activity in the "envision" stage of the design process that can help in making the transition from target to concept is to create a product character. A product character represents the designer's vision on how to align the product with the concern profile. A character is a specification of the quality and personality of the product. This can reflect both the quality of the interaction and the physical product, such as, stimulating, inviting, seductive, forceful, natural or colorful. The product character can be used as a reference in all stages of the design process in order to safeguard the emotional fittingness of the final design.

Example: Wow telephone

Some of the concerns in Table 6.6.2 appear to be inconsistent or even conflicting. These apparently conflicting concerns proved to be particularly inspiring for generating a product character. For example, the telephone should be innovative, surprising and stimulating, and at the same time it should be no-nonsense and harmonious. Or, the appearance should be simple and balanced, and at the same time distinctive and unique. These paradoxical concerns are interesting, because they represent combinations that are not yet fulfilled by existing products, and therefore stimulate novel design solutions. On the basis of the conflicting concerns, a character triangle was created that represents the eight concern themes. Figure 6.6.8 shows the character triangle in words and pictures.

Figure 6.6.8 Product character that represents eight concern themes.

This product character implies three successive layers: the first impression is impetuous and self-willed; then the character becomes sincere and balanced; and finally it becomes beneficent and sophisticated.

6.6.5.4 Generating concepts in the "conceptualize" stage

The next step in the design process is to conceptualize products that fit with the concern profile and product character. The envision stage does not yet formulate product ideas, but qualities or characters of the product that will be designed. In the conceptualization step, ideas for new products (or services) are generated that intend to have this defined character. This includes determining, for example, what the product does, what it will look like, what technology is used, who uses it in which situation, and how it is operated.

Example: Wow telephone

In the process of sketching product ideas, the designer aimed to create a product concept that fitted the three-layered character. To prevent a "wow!" response that has only a short existence, it was decided to focus on the overall (holistic) concept rather than on feature-based concepts. Sketches explored the possibilities to create a layered response in which each character domain represents one layer of experience: an initial impact at first sight; a second impact; and a long-term impact.

Figure 6.6.9 Design Wow telephone.

The final design has three functional layers. Each layer is built from three material layers (Figure 6.6.9). When closed, the product looks like a photo camera, and when opened it looks like a small computer, or like a simple mobile phone, depending on how it is opened. The parts that are touched (by the finger when interacting with the product or by the face when using the telephone function) are made of white soft rubber. The exterior is made out of cool metal (aluminum anodized in the color gold). The design has an impulsive spirit; the basic shape is clear, but the lines are playful. The layered character is applied in all the details of the product in order to create a subtle and sophisticated design experience. The first impression is that the product is impetuous and self-willed because of the contrasts in colors and material between the inside and outside of the phone, and because it can open in two ways (which was a unique feature at that time). When using the phone, the character is sincere and balanced because the way in which it is opened clearly communicates the main function. Moreover, dividing the functions in two enabled the design of a simple and straightforward interface. After a period of using the product, one will experience its sophistication in the details of the design. For example, the buttons are engineered in a way that prevents them from getting dirty; the rubber material gives a smooth and beneficent feeling when touching the ear.

Example: Airplane meal

In the airline breakfast project, the overall product character was formulated as "the charger; like a morning walk in the park". This metaphor, which expresses the dynamics of the breakfast character during breakfast consumption, was the leading theme for the design process (Figure 6.6.10). A morning walk in the park is a refreshing activity in which the person is in control of what path to follow, and of how fast she or he wants to be refreshed. This combination of refreshment and relaxation, and of control and surprises was envisioned to reconcile the seemingly conflicting concerns that were found in the concern analysis. The metaphor was used to formulate three key elements of the product character: engaging (explorative for the food and accessible for the package), dedicated (fresh for the food and bright for the packaging) and invigorating (nutritious for the food and embracing for the packaging).

Figure 6.6.10 Breakfast character (by KVD Amsterdam).

Figure 6.6.11 Product concept (design by KVD Amsterdam).

The concept was titled "morning tapas": a balanced union of distinct breakfasts (Figure 6.6.11). It balances between a heavy and a light breakfast, between a warm and a cold breakfast, and between a sweet and a savory breakfast. A duo of a warm and a cooled beverage take a prominent place in the meal. The cold and warm meal elements are selected for the combination with the beverages (like tapas). The packaging also consists of several contrasting elements. The tray is made of recycled paper, and the lid is made of transparent plastic. This combination creates the intended bright, open and embracing character. Inside, there are several cups with the warm and cold elements. The top left element is warm savory (e.g. omelet); the top right element is cold

savory (e.g. cheeses); the bottom left element is warm sweet (e.g. sweet rice); the bottom right element is cold sweet (e.g. fruit yogurt). The smaller cups in the middle contain "condiments" (such as nuts and honey) that can be used to personalize the other meal elements. This allows for combining elements in a non-ambiguous manner, generating the nutritious, explorative and fresh character. This is enhanced by the cooled herbal tea in the first (transparent) cup that enables passenger to "awaken the taste buds" before opening the package to start the breakfast.

6.6.5.5 Testing products in the "evaluate" stage

In various stages of the design project, the emotional impact of design ideas, concepts and prototypes can be tested as a means for evaluating the emotional impact of the design in comparison to the emotional intentions of the designer. The emotional impact of initial ideas can be measured by using renderings and/or verbal descriptions of the ideas as stimuli in emotion measurements. In a later stage of the design process, prototypes or mockups can be used as stimuli in emotion measurements. These studies can be used to investigate the effects of design decisions on the emotional responses of target users.

Example: Airplane meal

The emotional impact of the new breakfast concept was tested in a real-life situation, on board of the airplane during flight. The breakfast was served on an intercontinental flight, and 26 randomly selected passengers used PrEmo to report their emotional responses after being served the breakfast. Five positive and five negative emotions were measured (see Figure 6.6.4). The data were compared with an identical test that was performed with a conventional breakfast. The study indicated that the new concept elicited significantly less disgust (0.78 compared to 0.27) and boredom (0.89 compared to 0.27) than the original concept. It was therefore concluded that the new concept was successful in generating the intended emotional effect, which was to reduce the levels of boredom and disgust. Given this conclusion, the breakfast was implemented and served during all intercontinental flights between Europe and Asia for a period of three years.

Example: Wow telephone

An evaluation study was performed to assess if the new telephone design elicited the intended "wow!" experience. A prototype was built, which did not function as a telephone, but was functional in terms of basic interactions (opening and closing the telephone and computer function). The first study was repeated with the new prototype as an additional stimulus. Figure 6.6.12 shows the mean ratings of all stimuli on the three "wow!" emotions (on a three-point scale rating). In addition, the last row shows the "wow index," that is, the overall mean "wow!" rating.

In Figure 6.6.12, the models are ordered in accordance with their "wow!" impact. The new model in the second column (model G) had the highest "wow!" impact, whereas the model in the ninth column (model E) had the lowest "wow!" impact. Differences between the "wow!" rating of model G and all other

	G	*B*	*D*	*H*	*C*	*F*	*A*	*E*
								
Surprise	1.57	1.40	1.07	.97	.80	.57	.37	.53
Desire	1.03	.97	1.17	.83	.27	.50	.50	.40
Fascination	.87	1.17	1.93	.83	.37	.47	.40	.37
Overall	1.16	1.15	1.06	.88	.48	.51	.42	.43

Figure 6.6.12 Measured wow-impact of existing and new telephone designs.

models except model B were significant, indicating that both models G and B elicited higher levels of "wow!" experience than all other stimuli. On the basis of these findings it was concluded that the new design did evoke the intended "wow!" experience, and it was subsequently used as the basis for the development of a production model.

6.6.6 Summary and future of emotional research

In this chapter we have sketched possibilities of emotion research as input for product design, using example cases to illustrate opportunities. In spite of the potential value of emotion research in design projects, we have observed that design teams are often not able to make good use of emotion research in the creative stages of the design process. This could be caused by a general mismatch between the scientific frame of mind of the researcher who studies emotions, and the creative frame of mind of the designer who generates ideas (for a discussion, see Eekels and Roozenburg, 1991). Although research and design are strongly interwoven and mutually dependent on each other, there are three essential differences that should be understood before we can discuss how emotion research can be useful for design processes: (1) Whereas design is possibility-driven, research is reality-driven; (2) Whereas design aspires to create, research aspires to understand; (3) Whereas design focuses on totality, research focuses on aspects.

Scientific research focuses on the existing, real and factual world as it is. The central aim is to bring about a change in the realm of the mind: to generate new knowledge that explains present and past phenomena, and predicts future phenomena. Given this focus, scientific research requires goal oriented observation, eventually supported by experiments. Moreover, research never focuses on the reality in its totality, but on selected aspects of reality. In contrast, design focuses on worlds that do not (yet) exist, but are, it is hoped, realizable. Whereas there is only one real, factual world, there are limitless non-existing, yet possible worlds. The central aim of design is to bring about a change in the material world: a design that intervenes with or changes the world as it is. Design cannot solely rely on observation (i.e. the world to observe does not yet exist), but requires envisioning, imagining and conceiving possible futures.

Moreover, design is a holistic activity that involves the totality of the entity to be designed, simultaneously aiming to optimize all product aspects, such as usability, aesthetic appeal, safety and production costs.

The methods that are available for measuring and understanding emotions are mostly developed within a scientific frame of thought. They are particularly suitable for developing an understanding of the existing world. However, in order to enable design teams to make good use of emotion measurement data, researchers need to be sensitive to the design frame of thought: designers focus on integrated possibilities of various future worlds, in which values like originality and creativity overshadow the typical scientific values like validity and reliability. Hence, data should be represented in a holistic (rather than reductionist) fashion. Although this may be inadequate for scientific purposes, because holistic data do not necessarily enable researchers to determine relationships between design features and emotions, for designers this is inspiring because it is the holistic design, including all details, that determines user emotions. Moreover, data should be represented and communicated in a descriptive instead of prescriptive way. Creativity can be supported better with a visual (or sensory) rather than a numerical data representation. Typically, designers tend to prefer holistic, in-depth descriptions of a few interesting personal cases in the form of personas, interaction scenarios, or story boards (see Sleeswijk Visser, 2009) to an overview of population means, which give general trends but tend to level out all interesting individual variations.

Emotion-driven design projects require emotion research that is inspirational:

- For design-oriented emotion research, the nuances in experienced emotions count. Products typically do not evoke basic emotions such as fear and anger, but more subtle emotions such as boredom and admiration. Emotion research in a design context should therefore use methods that measure these subtle emotions.
- Designers are inspired by combinations of insights in what emotions current products evoke and what the underlying human concerns are that drive these emotions.
- It is not ideal to separate the research activities from the design cycle; the data will be more inspiring when the design team is also involved in the "understand" step of the design cycle.
- Data representations are crucial; rich, holistic, multisensory data presentations stimulate discussion and creativity.
- Emotion measurement can have an important communication function in teamwork: it enables the team to develop a mutual language of and view on the emotional impact of the design they are working on.

There are stages in the design process, where emotion measurement does not play a direct role. These are the creative stages, which rely on the ability of the design team to envision and conceptualize products that are both original and appropriate for the given emotional target. In those stages, general emotion theory can be useful for both stimulating and directing creativity. The universal principles proposed by emotion theorists can be used, for example, to challenge designers to explore non-conventional design directions. It is our experience

that this combination of using emotion measurement in the "understand", "target" and "evaluate" stages, and of using emotion theory in the "envision" and "conceptualize" stages, is most likely to generate successful results.

Emotion is only one aspect of user experience. Other kinds of experiences, such as aesthetic experience and experience of meaning (see Desmet and Hekkert, 2007; Schifferstein and Hekkert, 2008), are also interesting to take into consideration during the design process. Future research can explore the possibilities of incorporating these other kinds of experiences in design-oriented research (e.g. Desmet and Schifferstein, 2011). Another opportunity is to investigate how the dynamics of human–product interaction can be included in the measurement. Emotions experienced by product users unfold in time, depending on the course of the interactions and the events occurring during the interaction. A single outcome measure of the overall experience provides little insight in these dynamics. Continuous measurement of user experience could help designers identify the key episodes in the interaction and the time points they can act on to impact the user experience (Laurans et al., 2009). Emotion may be only one aspect of user experience, but it is a pivotal one. All the thoughts and experiences that users have in relation to their products affect their emotions. Hence, when a product evokes positive emotions, it fits with the user's concerns on many levels – functional, aesthetic and symbolic. When it does not fit with the concerns on all levels, it will also evoke negative emotions. In that sense, "design for emotion" enables and stimulates designers to do what they do best: to work with a holistic perspective, focusing on the totality of the product to be designed, integrating all aspects into an envisioned possible future – one that evokes emotions like hope, desire, pride and inspiration.

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