



# Appraisal Patterns of Emotions in Human-Product Interaction

Erdem Demir\*, Pieter M. A. Desmet, and Paul Hekkert

*Department of Industrial Design, Delft University of Technology, Delft, The Netherlands*

Emotional design, i.e., designing with an intention to evoke or to prevent a particular emotion, can be facilitated by understanding the processes underlying emotions. A promising approach to understanding these processes in the current psychological literature is appraisal theory. Appraisal theory can support this understanding because it explains how different emotions are elicited by different underlying appraisals. This paper reports a study that aimed to identify and specify appraisals that elicit emotions of product users for four emotion groups: happiness/joy, satisfaction/contentment, anger/irritation, and disappointment/dissatisfaction. The study started with a sensitizing task to make participants familiar with reporting their emotional experiences. With a combination of experience sampling and in-depth interviews, the emotions experienced when interacting with products and the causes of these emotions were captured. The results indicated that the appraisal patterns as proposed in general appraisal theory can also be traced in human-product interaction for all four emotion groups. On the basis of the results, an initial specification of those appraisals and design directions are proposed.

**Keywords** - Appraisal Components, Human-Product Interaction, Designing for Emotions.

**Relevance to Design Practice** - Insights gained in this study can support emotional design as they contribute to providing a structure for emotional design activities. Emotional design can be reformulated as design with the intention to activate or to prevent activation of appraisals of the intended emotions.

**Citation:** Demir, E., Desmet, P. M. A., & Hekkert, P. (2009). Appraisal patterns of emotions in human-product interaction. *International Journal of Design*, 3(2), 41-51.

## Introduction

Emotional design, which is designing products with the intention to evoke or to prevent elicitation of certain emotions, can be facilitated by an understanding of emotional processes. In the design literature, several models and frameworks that aim to contribute to this understanding have been proposed (Jordan, 1999; Desmet, 2002; Norman, 2004). Jordan (1999) investigated different sources of product pleasures: physiological, psychological, sociological, and ideological. Physiological pleasures involve bodily sensations; psychological pleasures are about achievements of the self; sociological pleasures are the pleasures of social interaction; and ideological pleasures are about intellectual stimulation. A product can be designed to enhance each of these pleasure sources. Desmet (2002) investigated how product appearance evokes emotions and proposed that appraisal theory can be used to explain how products elicit emotions. A product appraisal is an automatic assessment of the effect of a product on one's well-being. Desmet proposed four main types of product appraisals: the relation of a product to one's goals, the sensorial appeal of the product, the legitimacy of an action represented by the product, and the novelty of the product. Norman (2004) also focused on the mental processing that gives rise to affective responses. He identified three levels of processing: a visceral level governing responses through direct perception, a behavioral level involving learnt but automatic affective responses, and a reflective level involving affective responses due to conscious thinking. In line with those levels, Norman proposed three design strategies: design for appearance (visceral design), for ease of use (behavioral design), and for reflective meaning (reflective design).

Because the appraisal perspective is more abstract than the other two, it may not be as easy to apply in design practice. However, an advantage is that it combines the main propositions that underlie the other two perspectives. This means that the pleasure and processing perspectives can be explained in terms of the appraisal framework. The pleasure types that Jordan (1999) proposes basically correspond to different types of motive consistency, a particular appraisal type. Moreover, different levels of mental processing, as identified by Norman (2004), coincide with different levels of appraisals. Smith and Kirby (2001) identified three levels of processing in appraisals: appraisals that involve (1) direct perceptions (such as pain sensations) that do not require the activation of mental representations (visceral level), (2) automatic associative processes that activate memories of previous experiences outside of the consciousness (behavioral level), and (3) conscious reasoning (reflective level). The comprehensiveness of appraisal theory renders it a prominent perspective in psychology. However, like other psychological theories, it does not focus on our relationships with products. In this paper, we explore and investigate ways to conceptualize and operationalize appraisals for the domain of product design. In

Received March 28, 2009; Accepted July 4, 2009; Published August 31, 2009

**Copyright:** © 2009 Demir, Desmet, and Hekkert. Copyright for this article is retained by the authors, with first publication rights granted to the *International Journal of Design*. All journal content, except where otherwise noted, is licensed under a *Creative Commons Attribution-NonCommercial-NoDerivs 2.5 License*. By virtue of their appearance in this open-access journal, articles are free to use, with proper attribution, in educational and other non-commercial settings.

\*Corresponding Author: e.demir@tudelft.nl

doing so, we hope to assist those who want to use appraisal theory for understanding or explaining emotions experienced in human-product interactions.

## Perspectives on Appraisal

An appraisal, in the cognitive tradition of emotion psychology, is defined as a quick evaluation of a situation with respect to one's well-being (Frijda, 1986; Lazarus, 1991). Although appraisals are mostly automatic and nonverbal, just to simplify the concept, and without claiming theoretical tenability, we can think of an appraisal as an answer to the question, "What does this situation mean for my well-being?" If the answer given to this question is positive (beneficial to my well-being), a pleasant emotion occurs. In contrast, a negative answer (harmful to my well-being) evokes an unpleasant emotion. For instance, in a frustrating situation, such as when a word processor does not respond while one is trying to finish a document before a tight deadline, the answer to this question is most likely to be negative, and a negative emotion such as anger or worry is likely to occur.

Appraisal literature reports two prominent approaches in describing and differentiating between appraisals: thematic and componential. In the first approach, appraisals are described in terms of summary statements that reflect the overall personal meaning of a situation, known as appraisal themes. Each discrete emotion involves a distinct overall personal meaning. For instance, for sadness the overall meaning is an irrevocable loss, whereas for

joy it is a progress towards realization of a goal (Lazarus, 1991). When a situation is appraised as an irrevocable loss, be it the end of a romantic relationship or the loss of a cherished object, sadness is the resulting emotion. In the second approach, appraisals are not described in terms of a single and basic question, but in terms of several questions, each focusing on a different aspect of the situation: "How does this situation relate to my motives?", "To what extent was this situation expected?", "Who or what is responsible for this situation?", among others. The answers given to each of these questions are named as appraisal components and each discrete emotion involves a particular pattern of those components (Roseman, 2001; Scherer, 2001). For instance, pride involves appraising a situation as consistent with one's motives and caused by one's own person (Roseman, 2001). Both approaches can be useful in understanding and designing for emotions. The thematic approach provides more than the sum of the components and may provide a holistic understanding of the intended emotion. However, it may be difficult for designers to relate commonly reported themes like "irrevocable loss" or "demeaning offense" to emotional experiences with products. For that reason, in this paper, we have adopted the componential approach for describing appraisals. Although less holistic, this approach can be useful for writing clear design briefs because it facilitates a more systematic and fine-grained analysis of emotions.

Appraisal theory asserts a causal relationship between appraisals and emotions, meaning that activation of a particular appraisal pattern results in the corresponding emotion. This implies that attempts to design for a particular emotion may be facilitated by an understanding of the appraisal pattern that elicits this emotion. In order to achieve this understanding, two main challenges have to be met. The first is to identify the appraisal components that are involved in the process that elicits emotions in human-product interactions. A complexity in this challenge is that appraisal patterns proposed by different theoreticians show minor differences in terms of involved components. As design researchers, we are not sure which of these components are most suitable for explaining emotions in human-product interactions. The second challenge is that the available appraisal components should be made more tangible because they are too abstract to be useful for design purposes. Say for instance, someone wants to design a telephone that elicits joy. According to appraisal theory, joy is experienced in response to an event that is consistent with one's motives. Hence, the design should be consistent with the motives of the users. Given its general nature, this condition most probably does not provide the designer with additional insights. In this paper, both challenges are addressed with a three-phased explorative experience sampling study. The goals were (1) to identify the appraisal components of particular emotions in human-product interaction, and (2) to specify the identified components to make them more tangible for application in the design domain. Participants reported their emotional responses to products whenever they were prompted to do so by an SMS. In total, 170 emotion records were collected and elaborated on in a subsequent in-depth interview stage. These reports covered 29 different emotions, and the number of reports per emotion varied among different emotions. Given the variety in number of

**Erdem Demir** is a Ph.D. candidate in the Faculty of Industrial Design Engineering at Delft University of Technology. He received his M.Sc. degree from the Industrial Design department of the Middle East Technical University with a thesis focusing on user satisfaction and the underlying design-related dimensions. He also holds a M.Sc. degree from the Industrial Engineering department of the same university, with a thesis on genetic algorithms and their applications in logistics problems. His main research aim is to develop theory that can assist the designer in designing products that evoke intended emotions. The perspective of this project is based on cognitive emotion psychology, and his aim is to identify appraisals that are related to emotions elicited during user-product interaction. Based on the prospective model of interaction appraisals, he aims to develop, test, and apply 'design for emotion' strategies.

**Pieter Desmet** is an associate professor of form theory in the Faculty of Industrial Design Engineering at Delft University of Technology. He has a background in industrial design, and in 2002 he obtained his Ph.D. for research on emotional product experience. His main research interest is in the field of design, emotion, and subjective well-being. In cooperation with several international companies, he studies why and how consumer products evoke emotions. In addition, he develops tools and methods that can facilitate emotion-driven design. Desmet has published his research in several journals, and presented his work at international platforms. He is a co-founder and executive board member of the International Design for Emotion Society, and scientific advisor for SusaGroup, an organization that facilitates design for meaningful experience processes.

**Paul Hekkert** is a full professor of form theory in the Faculty of Industrial Design Engineering at Delft University of Technology. There he chairs the design aesthetics section and supervises a research group that carries out innovative research on our sense perception and (emotional) experience of products. Much of this research is done in cooperation with industrial partners. Paul has published numerous articles on product experience and aesthetics in major international journals and is co-editor of "Design and Emotion: The experience of everyday things" [2004] and "Product experience" [2008]. Together with a colleague/designer, he also developed an interaction-centred design approach, called Vision in Product design (ViP), which is widely applied in both education and industry. He and his colleague are presently finishing a book in which this approach is laid out [publication in 2010]. Paul is founder and chairman of the Design and Emotion Society [www.designandemotion.org] and serves as a member of the editorial boards for The Design Journal, Empirical Studies of the Arts, and International Journal of Design.

reports for those 29 emotions, we focused on the most frequently reported negative and positive emotions, as they allowed a richer analysis: happiness/joy (20), contentment/satisfaction (18), anger/irritation (28), and disappointment/dissatisfaction (9). The diary reports and decoded interview accounts for these emotions were analyzed for the involved appraisal components. The following section briefly reviews the appraisal components and patterns that have been proposed for these four emotions.

## Appraisal Components

Although componential appraisal models proposed by the various theorists differ in terms of approach and methodology, many of them introduce similar components. For the current study, the models of Smith and Ellsworth (1985), Frijda (1986), Ortony, Clore, and Collins (1988), Lazarus (1991), Roseman (2001), and Scherer (2001) were reviewed. From these models, a set of seven components was assembled. In order to devise a comprehensive yet manageable set, only components included in at least two of these models were selected, resulting in the following list: motive consistency, intrinsic pleasantness, expectation confirmation, standard conformance, agency, coping potential, and certainty.

### Motive Consistency Component

The motive consistency component is basically represented by the question, “How does this situation relate to what I want (i.e., my motives)?” In an emotional experience, the situation may be appraised as either consistent or inconsistent with what one wants. When a situation is appraised as consistent, a pleasant emotion is evoked. For example, talking to a distant loved one through a cellular phone may evoke joy because it is consistent with the motive of affection. In contrast, situations appraised as conflicting with what one wants, or motive inconsistent, will evoke an unpleasant emotion. Although this component is capable of informing why a particular situation triggers a positive or a negative emotion (because the situation matches/conflicts with the motives), it is too general to be of help in identifying the particular aspects that bring up the emotion. Specifying the type of motive that is involved in that situation may deepen this understanding. The motives, as discussed in appraisal literature, may be as abstract as universal human needs or human concerns (Frijda, 2007), such as belonging, or as concrete as particular goals (Lazarus, 1991), such as completing a project document or purchasing an expensive car. Motivation literature presents different classification schemes that may be of help in identifying types of abstract motives (Maslow, 1970; Ford, 1992). Currently, it is not clear how these abstract motives are translated into more concrete ones in our interactions with products. This is another issue that we looked into in this study.

### Intrinsic Pleasantness Component

The intrinsic pleasantness component deals with the sensorial pleasantness of an object, such as the sweetness of a candy bar. The associated question is: “To what extent is this object

pleasant?” The outcome can be either pleasant (in attraction emotions like desire), or unpleasant (in repulsion emotions like disgust). To many, finding something pleasant is a disinterested experience, meaning that it does not require any personal motive, such as the pleasantness of a sweet taste (Scherer, 2001; Hekkert & Leder, 2008). Yet, others argue that finding something pleasant is inherently related to motives, in particular related to the main motive of survival (Moors, De Houwer, & Eelen, 2004; Johnston, 2003). In that sense, intrinsic pleasantness can be considered as a particular type of a motive consistency appraisal, which is related to the main motive of survival and which does not require any mental representation of that particular motive during the appraisal, meaning that it is a direct perception level appraisal. However, in order to have a more specific and detailed account of appraisal components, we adopt the perspective of Ortony, Clore, and Collins (1988) and Scherer (2001), and treat the pleasantness appraisal as a separate component.

### Expectation Confirmation Component

One may have explicit expectations about the outcome of an event. The expectation confirmation component is about whether the actual outcome of an event confirms or violates those expectations (Scherer, 2001). In relation to products, one may have different expectations, varying from an expectation about an unexplored aspect of a product (e.g., performance prior to usage), to an expectation about the consequence of a user action (e.g., pushing a button to go to the menu of a cellular phone). One can experience satisfaction or disappointment when the outcomes respectively confirm or disconfirm these expectations.

### Agency Component

The agency component is represented by the question of who (or what) is responsible for a given situation. The possible answers to this question are oneself, another person or thing, or the general circumstances. If one believes that he or she caused a pleasing or disturbing event—i.e., self agency—then self-conscious emotions such as pride or shame are likely to occur. For instance, a skater who succeeds in making a difficult move may experience pride because he attributes the success to his effort and skill. In emotions like anger or admiration, other people or objects are found responsible for bringing up the evocative situation. For some other emotions, the event cannot be attributed to any particular person or object and is attributed to circumstances, such as being happy about finding the “perfect” pair of shoes in the market by chance.

### Standards Conformance Component

The question that represents the standards conformance component is, “How does this situation relate to social norms and standards?” A situation can be appraised as violating standards or as confirming or surpassing standards. For emotions like anger or guilt, the situation is appraised to violate a standard, and, in contrast, emotions like pride or admiration involve appraising a situation as

conforming to or surpassing a standard. For instance, one may appraise the eco-friendly material used in a chair as confirming the standard of ‘caring for the environment’ and therefore admire the thoughtfulness of the producer. This component is similar to the expectation component, as each standard can trigger a corresponding expectation. To exemplify, one who believes that a car should not break down after a single year of usage, as a standard, will also expect a new car to be free of problems in the first year of ownership. Note however, some expectations may have little dependence on social standards or norms. For example, an expectation that a particular chair structure can carry a certain amount of weight is not shaped by social standards but by our personal experience with that particular structure or material.

### Coping Potential Component

Coping potential is about whether one can handle and/or change the actual or expected harmful aspects of a situation. As a result of this appraisal, one can appraise oneself as powerful enough to influence the situation, which may be manifested by overt behavior in the direction of desired influence. Anger, for instance, involves such an appraisal of high coping potential. The manifestation of this appraisal, in the case of anger, usually involves aggressive behavior towards the person or the object that is found responsible for the unpleasant situation, in an attempt to change the unpleasant aspects of the situation or to restore the social respect. In contrast, emotions such as fear or anxiety involve low coping potential, meaning that one appraises oneself as having little control or power to change the situation, which results in a moving away from the situation. For example, computer anxiety, in literature, is usually associated with an appraisal of finding oneself powerless to manipulate and control the computer (Busch, 1995).

### Certainty Component

The question that characterizes the certainty component is, “Am I certain about this event?” For some emotions, like fear and hope, the answer to this question is uncertain. One thinks that something (either pleasing or disturbing) may happen in the future but is not certain about it. For some other emotions, such as happiness and sadness, harms and benefits are for certain. Someone may be afraid that she has lost her valuable necklace when she notices that it is not in the usual place. She may feel afraid while she is uncertain about the loss. With the hope of finding it, she may go on searching, still uncertain about the loss. Only when the loss is certain or the necklace is found, the emotion may change to sadness or relief.

## Appraisal Patterns of Emotions

As mentioned before, particular emotions have distinct patterns of involved appraisal components. The appraisal patterns of the emotions that are addressed in the current study are summarized in Table 1. Components that are included in the patterns proposed by more than one reference are shown in black. Components that are debatable are shown in blue.

### Happiness / Joy

The central component for the appraisal pattern of happiness/joy is motive consistency. Most appraisal theorists agree that happiness/joy involves high motive consistency, i.e., the attainment of a motive (Scherer, 2001; Ellsworth & Smith, 1988; Ortony et al. 1988; Roseman 2001). However, there is also some inconsistency among these models. For instance, Scherer (2001) considered another component, intrinsic pleasantness, to be a part of the appraisal pattern of happiness/joy. The inclusion of intrinsic pleasantness as a basic appraisal component enabled Scherer (2001) to differentiate happiness from joy: happiness involves an intrinsic pleasantness appraisal, whereas joy does not. In addition, the motive consistency for happiness is not as high as motive consistency for joy, according to this model. The other theoreticians did not explicitly discuss the role of sensorial pleasantness in happiness/joy and explained joy/happiness with the appraisal of attainment of motives in general. Given this difference of perspective in literature, a particular issue to be investigated in this study is whether motive consistency and/or intrinsic pleasantness underlie joy/happiness evoked in our interactions with products.

Besides motive consistency, Roseman (2001) considered that happiness/joy involves circumstance agency: no particular person or object is responsible for the motive consistent situation. In addition, Ellsworth and Smith (1988) proposed that happiness/joy involves a certainty appraisal, meaning that the goals are attained for sure. Otherwise, the experienced emotion will be hope instead of happiness/joy.

### Contentment / Satisfaction

As with all pleasant emotions, contentment/satisfaction involves appraising a situation to be motive consistent. The main appraisal component that differentiates this emotion from other pleasant emotions like happiness/joy is the expectation confirmation component. Ortony et al. (1988) stated that contentment/satisfaction involves an expectation about a particular pleasing outcome. For one to experience contentment/satisfaction these expectations should be met.

**Table 1. Summary of appraisal patterns of emotion**

Emotion	Motive Consist.	Pleasant.	Expectation Confirm.	Agency	Standard Conform.	Coping Potential	Certainty
Happiness Joy	Consistent	Pleasant		Circumstance			Certain
Contentment Satisfaction	Consistent		Confirmed				
Anger Irritation	Inconsistent			Other	Violation	High	
Disappointment Dissatisfaction	Inconsistent		Disconfirmed	Circumstance Other		Low	Certain



## Anger / Irritation

Anger/irritation involves high motive inconsistency: one tends to be frustrated in one way or another to feel or express anger. In addition to motive inconsistency, most authors agree that anger/irritation involves attributing the frustration to another person or even an inanimate object, i.e., other agency (Scherer, 2001). On top of motive inconsistency and other agency, Roseman (2001), referring to the attack tendency in the experience of anger, includes high coping potential in the pattern of anger/irritation. Scherer (2001) and Ortony et al. (1988), on the other hand, stated that standard violation is part of the appraisal pattern of anger/irritation. According to them, in an anger episode, one experiences the situation as a violation of social standards and norms.

## Disappointment / Dissatisfaction

The appraisal pattern of disappointment/dissatisfaction is based on motive inconsistency, and a disconfirmed pleasing expectation (Frijda, 1986; Ortony et al., 1988). Apart from these components, Frijda, Kuipers, and Ter Schure (1989) showed that disappointment also involves appraisals of certainty (the expectations are not met for sure), low coping potential (nothing can be done to change the situation), and agency of some other person or thing. Van Dijk and Zeelenberg (2002), on the other hand, stated that one can also experience disappointment/dissatisfaction without attributing it to a particular person or an object but to circumstances in general.

## Experience Sampling Study and Interviews

In psychology, three main approaches are used to capture and elicit emotional experiences. In the first approach, stimuli are used to elicit emotional experiences in controlled environments. This approach is often criticized for lacking ecological validity, because effects observed in the lab environment may not reflect real life experiences (Schorr, 2001). The second approach, asking people to recall their emotional experiences, partly overcomes this problem. However, this approach also comes with problems related to affective memory biases. In other words, reporting emotional experiences that happened a while ago may result in changed or incomplete data (Schorr, 2001). The third approach, the naturalistic approach, was selected for the current study because it minimizes both of these previous problems. In this approach, participants are asked to report their emotional experiences (or their emotional expressions are observed) while they engage in their daily activities.

There are two approaches for identifying appraisals: capturing individuals' subjective evaluations (subjective approach), and capturing physiological or expressive correlates of appraisals (objective approach). In this study, the subjective approach was adopted because the objective approach is not sensitive enough to differentiate between components (e.g., electrodermal activity in Pecchinenda, 2001, or facial expressions in Keiser and Wherle, 2001). In addition, some objective indicators of appraisals that are used to measure appraisals in interpersonal communication may not be observed in human

product interaction (e.g., vocal expression in speech in Johnstone, Van Reekum, and Scherer, 2001).

The current study involved three phases: sensitizing, capturing and identifying. The goal of the sensitizing phase was to familiarize the participants with emotional introspection and reporting. In the second phase, an adaptation of a naturalistic method, the experience sampling method (ESM; Hektner, Schmidt, & Csikszentmihalyi, 2007), was used to capture participants' emotional experiences with products. In the third phase, participants were interviewed about the details of their emotional experiences and the underlying appraisals. The 29 participants, all master's students at the Industrial Design Engineering Department of Delft University of Technology, were paid for their participation.

In the sensitization phase, participants used a questionnaire to report emotional experiences in their daily lives. Each participant received a set of 10 emotions that were randomly selected from a basic list of 33 emotions developed by Scherer (2005). Participants were asked to recall and report events in which they had experienced one of these ten emotions. For each report, they were also asked to describe what had happened, and to explain why they experienced that particular emotion.

In the capturing phase, participants used a booklet to answer some diary questions whenever they were prompted to do so by an SMS. The basic idea was to report the last emotion experienced while interacting with a product. To overcome the difficulties in labeling and communicating emotional experiences, the complete list of emotions of Scherer (2005), composed of 33 emotion terms, was used in the second phase. Participants either picked one of the listed emotions or reported an additional emotion that was not included on the list. Then, they were asked to report the product that had been involved in the experience, describe the events that took place, and provide a causal explanation for the emotional activation. Participants were also asked to take a photo of the product that they reported.

The second phase was carried out in two ways. For the first 19 participants, the study lasted for three days. Each of these participants received one to three SMS's at random moments of the day, totaling up to six for the entire study period. The reports of these respondents showed a disproportionately high number of cases of irritation and anger. To ensure variability, the remaining participants were asked not to report examples of anger and irritation. Based on the low return rate for the first 19 participants (average return rate was 4.36 out of 6), the signaling schedule was changed to cover ten days, and only one SMS was sent per day. The signaling times were randomized over participants and days, in an attempt to cover a variety of different daily activities that may take place throughout the day.

The third step was an interview that was designed to identify the participants' appraisals of the situation. After an explanation of the procedure, participants first read their own reports to recall their experiences. Then the interviewer asked several questions that aimed to disclose the details of each experience, such as the activity the participant was involved in when experiencing the emotion, the responses of the product, and the presence or absence of other people. During the session, the photographs

of the products were shown, which facilitated recalling the experience and communicating the details of the experience with the interviewer. An average interview session lasted for 45 minutes. All phases of the study were conducted in English.

## Results

A total of 170 emotion reports were collected. Of these reports, 75 dealt with the two most frequently reported positive emotions (20 for happiness/joy, and 18 for contentment/satisfaction) and the two most frequently reported negative emotions (28 for anger/irritation, and 9 for disappointment/dissatisfaction). Each report consisted of a transcribed interview text and a diary booklet text. The reports were analyzed for involved appraisal components. Statements referring to the relevant components summarized in Table 1 were identified for each emotion. Table 2 provides exemplary statements for each of the appraisal components. After this initial analysis, the coding scheme and procedure was discussed and finalized. The entire data set was then re-analyzed based on this final coding scheme.

The results showed that the most central appraisal component, which was identified in almost all emotion reports (68 out of 75), was motive consistency. In order to specify this component, the motives that were attained or blocked in those experiences were examined. This examination resulted in the identification of three basic levels of motives: general motives, contextualized motives, and interaction goals. General motives are universal goals and needs; those shared by all humans, such as

the need for social belonging. The results indicated that emotional experiences with products may result from the attainment of these general motives, e.g., being beautiful with a necklace and therefore more easily accepted socially. Contextualized motives are situation-dependent specifications of the general motives, as with exercising on a treadmill to keep fit. Interaction goals are related to the operation, maintenance or upkeep of products, e.g., being able to operate a coffee maker.

The number of times that a hypothesized appraisal component was identified in the reports and the details about the motives that were identified are provided for each emotion.

### Appraisal Pattern of Happiness / Joy

Most records (17 out of 20) for happiness/joy included at least one motive consistent aspect. Sixteen of these reports were about attainment of general motives. Only one report was about attainment of a contextualized motive, such as finishing the set up of a tent, which marks the start of vacation time. The particular motive types and specific motives related to each case that were identified are presented in Table 3.

In 8 out of 20 reports, at least one statement referred to sensorial pleasantness appraisals. That is to say, in 4 out of 20 reports there was a pleasantness appraisal and not a motive related aspect. The types of pleasantness involved and related examples are given in Table 4.

In all cases, participants reported external attributions. The cases involving sensorial pleasantness and most of the general

**Table 2. Examples of statements referring to different appraisal components**

Appraisal component	Outcome	Example
Motive consistency	Consistent	"...Every time I use this toothbrush I feel like I'm taking good care of myself... and this time I felt the same..." (Electronic toothbrush, Happiness/Joy)
	Inconsistent	"...I realized that I missed the class... I really wanted to make it... I can't believe I could turn the alarm off in my sleep..." (Cellular phone, Anger/Irritation)
Pleasantness	Pleasant	"...When I pulled the string of the curtain blind it opened, making a very nice, cheerful wweeuww sound..." (Curtain blind, Joy/Happiness)
	Unpleasant	"...I was trying to open a wine bottle with this shabby corkscrew... and the glass broke and I cut my hand..." (Corkscrew, Anger/Irritation)
Expectation confirmation	Confirmed	"...the wax was just what I wanted... I could shape it exactly in the way that I had in mind..." (Hair wax, Contentment)
	Disconfirmed	"...I was hoping to start the day with a nice shower... and I wasn't expecting that the heater would make any tricks..." (Water heater, Disappointment/dissatisfaction)
Agency	Other (Product)	"...I pushed a wrong button... that's stupid...I mean there is no reason whatsoever to make this pad a touch pad..." (Cellular phone, Anger/Irritation)
	Circumstances	"...It took so long to lock my bike...I don't know if it was me or the product... but during that time I didn't think about the product...I wasn't blaming it or something...It was just bad luck..." (Bike lock, Anger/Irritation)
Standard conformance	Violated	"...this bike light is supposed to be simple, and it should be simple, but I have to put in so much effort to make it work." (Bike lights, Anger/Irritation)
Coping potential	High	- (No statements were coded for high coping potential)
	Low	"...I did not know what to do, I clicked on the mouse, waited a bit, but it didn't do anything." (Computer software, Anger/Irritation)
Certainty	Certain	"...I was taking a shower with this new watermelon scented sponge and it smelled so nice..." (Sponge, Happiness/Joy)

**Table 3. The motive types and examples for happiness/joy**

Level of motive	Type of motive	Examples
<b>General motive</b> (16 out of 20)	Social belonging (3 out of 16)	Chatting with family abroad through a web-cam
	Social interaction (4 out of 16)	Receiving a pleasant SMS
	Physical challenge (2 out of 16)	Playing with a hula-hoop
	Taking good care of self (2 out of 16)	Brushing the teeth with an electronic toothbrush
	Intellectual stimulation (2 out of 16)	Magical working mechanism of a coffee percolator
	Being independent and powerful (1 out of 16)	Owning a Jeep
	Feeling familiar and safe (1 out of 16)	Being able to open the lock of a new apartment
	Being beautiful (1 out of 16)	The consequences of putting on false eyelashes
<b>Contextualized motive</b> (1 out of 20)	Installation goal	Finishing the set up of a tent as a marker of the start of leisure time

**Table 4. The type of pleasantness and examples for happiness/joy**

Type of pleasantness	Example
<b>Visual pleasantness</b> (1 out of 8)	A beautiful nail clipper
<b>Auditory pleasantness</b> (2 out of 8)	Window blind makes a pleasant sound when opened
<b>Olfactory pleasantness</b> (1 out of 8)	Taking a shower with a shower sponge smelling like watermelon
<b>Tactual pleasantness</b> (1 out of 8)	Pleasant “bubbly” feeling of an electronic toothbrush
<b>Gustatory pleasantness</b> (1 out of 8)	Eating a tasty hamburger
<b>Kinesthetic pleasantness</b> (2 out of 8)	Stapling the documents with a mini-stapler

personal goal attainment cases were particularly attributed to particular qualities of products, e.g., the “supersonic” quality of an electronic toothbrush (14 out of 20). Almost all cases (19 out of 20) involved high levels of certainty of experienced pleasantness or goal attainment. Only one case involved a long-term benefit (taking good care of teeth); however, this case was also accompanied by a pleasant tactual feeling of the toothbrush.

### Appraisal Pattern of Contentment / Satisfaction

The findings supported the contribution of the motive consistency component for contentment/satisfaction (16 out of 18). The type of motives and examples are provided in Table 5.

In two other cases, contentment was due to pleasantness (e.g., a beautiful fork, and a nice-feeling drawing paper). In 16 out of 18 reports, there was a previous expectation about the attainment of the goal. In 5 out of 18 cases, the expectations were about a reward in return for product usage, or a phase completion in product usage. Drinking coffee made with a coffee machine, or completing the arrangement of songs according to their genres

in a music player software program are examples of those types of situations. In other cases (13 out of 18), the expectations were about the particular usage episode and/or the product qualities that influence those usage episodes. Even when the intrinsic pleasantness of the product evokes the emotion, the pleasant aspect was already expected.

### Appraisal Pattern of Anger / Irritation

In most reports, (25 out of 28) there was a motive inconsistent aspect that was reported as a cause of the anger/irritation. The types of obstructed motives and examples are provided in Table 6.

In another 5 out of 28 reports, unpleasantness was reported. The types of unpleasantness and examples are provided in Table 7.

As suggested in the literature, in some accounts (12 out of 28), participants stated that the encountered situation should not have taken place, which can be regarded as violation of a general standard. In some other cases (11 out of 28), participants explicitly mentioned other, more specific, standards pointing to some problematic product aspects.

**Table 5. The types of motives and examples for contentment/satisfaction**

Level of motive	Type of motive	Examples	
<b>General motive</b> (1 out of 18)	Intellectual stimulation (1 out of 18)	A tape dispenser with smart material selection and mechanism solution	
<b>Contextualized motive</b> (3 out of 18)	Attainment of a consumption goal (2 out of 18)	Drinking the coffee prepared by the coffee maker after a hard day's work	
	Attainment of a purchase goal (1 out of 18)	Finding the perfect present for a friend at the market	
<b>Interaction goal</b> (14 out of 18)	Upkeep goal (1 out of 18)	Arranging songs according to genre in music player software	
	Preparation goal (1 out of 18)	Finding the remote control in order to change the TV channel	
	Usage goal (12 out of 18)	Goal of easy and efficient use (6)	Easy-to-use handbag with proper number of specialized sections
		Goal of performing well (4)	A hair wax that works just right for the user's type of hair

**Table 6: The types of motives and examples for anger/irritation**

Level of motive	Type of motive	Examples
<b>Contextualized motive</b> (10 out of 28)	Work/study related goals (5)	Missing class because of mistakenly turning off the alarm
	Social activities related goals (3)	Being late to a party because of not being able to wrap the present properly
	Personal care related goals (1)	Getting awakened by the alarm clock
	Environmental care related goals (1)	Spilling coffee on the table
<b>Interaction goal</b> (Blocked) (15 out of 28)	Effective usage goal (10)	A remote control that does not respond A coffee vendor that gives only a half cup of coffee
	Efficient usage goal (5)	A software that responds very slowly A washing machine tap that waits too long before letting the door open

**Table 7: The type of unpleasantness types and examples for anger/irritation**

Type of unpleasantness	Example
Pain (3 out of 28)	Cutting hand while trying to open bottle with a corkscrew
Comfort (2 out of 28)	Getting wet in the rain due to the breakdown of an umbrella

In most cases (22 out of 28), the product was found to be responsible for the unpleasant event. However, the results indicated that other people or circumstances can also be found responsible in anger/irritation in human-product interaction (5 out of 28). For example, a participant reported a case of irritation caused by spilling hot tea on the table while trying to fill a cup. In this account, although the user did not attribute any responsibility to the carafe that is used to fill the cup (because the lid on the carafe was not fastened tightly), the situation was still irritating. In 2 out of 28 reports, the anger/irritation was directed at the product even though the product had no apparent responsibility in the situation, e.g., blaming the computer for not being able to find a piece of information on the Internet.

None of the participants explicitly stated a perceived high coping potential in response to angering situations. In most cases, the harm was already experienced and there was nothing to reverse it, for example, having an accident while using a corkscrew. In contrast, most reports for anger/irritation involved low coping potential appraisals, such as not being able to open a drawer or the cap on a water bottle. In our view, this implies that the high control potential is inherent in a typical human-product interaction episode. Although a user cannot reverse motive-inconsistent aspects, such as hurting oneself with a corkscrew, he or she is still capable of coping with the motive-inconsistent aspects of the product, such as eliminating further problems by getting the product that is not functioning repaired, using the product with more care, or even by replacing the product with another one or a similar substitute.

### Appraisal Pattern of Disappointment / Dissatisfaction

In 8 of the 9 disappointment/dissatisfaction cases, the participants reported a motive inconsistent aspect. The types are given in Table 8. All of these accounts involved a previous expectation. Six cases involved expectations about particular qualities and features of the product (e.g., “the new model of this camera does not provide really new features...”), and three cases involved expectations about the outcome of interaction (e.g., “I was expecting to find the laundry dry already”). When the expectations were merely about outcomes of interaction and not about particular product qualities, the motive inconsistency was attributed to the circumstances. In 6 other cases, where the expectation focus was on the product, product agency was observed.

For disappointment/dissatisfaction, no comments were made that indicate an appraisal of low coping potential. In these cases, although the participants could not reverse the unpleasant events, they felt like they could overcome the problematic consequences of the event by some other secondary actions, like restarting the computer that freezes, or using a sponge instead of a dishwashing brush that does not clean properly.

### Discussion

The main goal of the study was to identify the appraisal components underlying emotions in human-product interactions and to specify the identified appraisals. In this study, we focused on four emotions that were reported most frequently by the participants: happiness/joy, contentment/satisfaction, anger/irritation, disappointment/dissatisfaction. The results indicated that happiness/joy involved appraising an interaction with a product as motive consistent and/or as intrinsically pleasant, and being certain about this motive consistency and/or pleasantness. The results, in contrast, did not support the involvement of circumstance agency, that is to say in some cases, the product was found responsible for the experience of joy/happiness. This, however, might be caused by the method

**Table 8: Types of motives and examples for disappointment/dissatisfaction**

Level of motive	Type of motive	Examples
<b>Contextualized Motive</b> (2 out of 9)	Personal care related goals (2)	A hair dryer that does not help in straightening unruly hair
<b>Interaction goal</b> (6 out of 9)	Effective usage goal (4)	A dishwashing brush that does not clean effectively
	Efficient usage goal (2)	A laptop with its USB socket in the back, causing inefficient usage



used. In the study, participants were asked to focus on the last product that they used and felt something about.

An interesting finding about happiness/joy was that some happiness/joy cases were caused by a mere appraisal of intrinsic pleasantness. This finding basically conflicts with some of the appraisal models that include motive consistency but not intrinsic pleasantness in the appraisal pattern of happiness/joy (Roseman, 2001). This finding can be interpreted in two ways. Firstly, it may imply that the reports of this study include two different types of happiness/joy: a prototypical joy emotion as characterized by a goal attainment (Lazarus, 1991), and an aesthetic pleasure (sensorial experiences are also seen as a separate source of emotions in interaction with products, see Desmet & Hekkert, 2007). Secondly, it may support the proposition that the pleasantness appraisal is a particular type of the motive consistency appraisal. Scherer (2001) treated the pleasantness appraisal as a separate component because, in his approach, sensorial pleasure is motive-independent. However, what we find pleasing is usually determined by our motives. According to by-product hypothesis, even the objects that humans innately find sensorially pleasurable (e.g., sweet and fatty food) are pleasurable because they are functional regarding survival, the main motive of humans (Hekkert & Leder, 2008). Depending on the scope of the term of “motive,” one can also see pleasantness as a particular type of motive consistency appraisal.

The appraisal pattern of contentment/satisfaction is quite similar to the pattern of joy/happiness in the sense that both emotions are evoked by a motive consistency appraisal. The main difference is that contentment/satisfaction also involves an expectation confirmation component. That is, the pleasing aspects of the human-product interaction are expected aspects in contentment/satisfaction cases.

In human-product interaction, an anger experience involves appraising the situation as a blockage of a motive, for example, not being able to push the correct button on a product (resulting in a sense of unpleasantness). This motive inconsistent situation evokes anger only if it is appraised as violating a standard (such as, the buttons of a phone shouldn't be too small). In anger experiences, an external person or an object is held responsible. In some cases, it can be the product itself and in other cases it can be about another person, such as a co-user of a product.

Disappointment/dissatisfaction differs from anger/irritation in the sense that it involves an expectation that is not as strong as a standard. The motive inconsistencies in these experiences can be attributed to the products and can also be attributed to the circumstances. This finding complies with the conceptualization of Van Dijk and Zeelenberg (2002), implying the existence of two different types of disappointment.

In this study, we only discussed appraisal patterns of the four emotions that were most frequently reported by participants. Although we think that frequency is a logical criterion to determine the relevance of a particular emotion to our relationships with products, it is not the only criterion. Another one, for instance, may be the effect of particular emotions on the overall attitude towards the product. There are other emotions—such as pride, contempt, admiration, and gratitude, to name just a few—that may

not be frequently experienced but still have a powerful influence on how we relate to products and how we accept or reject products in our lives. Fortunately, appraisal theory explains a wide variety of emotions and can be used to provide an understanding of those other emotions within the human-product domain. In the future, we aim to study the appraisal patterns of some of those emotions as well.

An initial step towards an in-depth understanding of product appraisals was taken by identifying various levels of motives involved in the motive consistency component. Three main motive levels can be involved in a motive consistency appraisal in human-product interactions: general motives, contextualized motives and interaction goals. The overall motive structure may be represented by a hierarchical model, as proposed by Ortony et al. (1988). In this hierarchy, attainment of a lower level goal or motive marks progress towards a higher level motive. For instance, to be successful in working life (general goal) one must be in the office on time (contextualized condition), in a proper condition (contextualized goal), and one should fulfill her responsibilities on time (contextualized goal). Furthermore, to reach a contextualized goal, one has to interact with various products. For instance, on a typical work day morning, in order to be at work on time and in a proper condition, one may need a cup of coffee to get ready for the working day, and this calls for an interaction with a coffee machine. The relationship between these goals is illustrated in Figure 1.

In addition to the three above-mentioned motive levels, various motive types were identified—among them, social belonging, personal care, intellectual stimulation, and being independent. Although insightful, this list of motive types is far from exhaustive. Future research focusing on the different types of motives in human-product interaction is needed. A possible approach to this research topic can be to compile types of general human motives from motivational literature (Maslow, 1970; Ford, 1992; Chulef, Read, & Walsh, 2001) and then to investigate how these different types of motives manifest themselves in different contexts (i.e., contextual goals), and how they are translated to specific interaction goals.

A limiting aspect of the study was the method used to identify appraisals. In this study, we could identify only the conscious appraisals. As mentioned briefly in the introduction section, there are three levels of appraisals: (1) direct appraisals, (2) automatic associative appraisals, and (3) conscious reasoning-based appraisals. Only the first two levels, which operate outside consciousness, have causal roles in emotion elicitation; that is to say, an emotion may be experienced without any conscious appraisal of the situation (Kappas, 2006). Therefore, a robust theory of appraisal should address those automatic and direct appraisals. However, given the need for an explorative first step in the domain of appraisals in human-product interactions, only conscious appraisals were investigated in this study. Although this choice can be supported to some extent by views of some theorists (Roseman & Evdokas, 2004) stating that conscious appraisals may accurately reflect automatic and direct appraisals, in order to develop a robust theory of appraisals in human-product interactions, future work should focus on automatic appraisals.

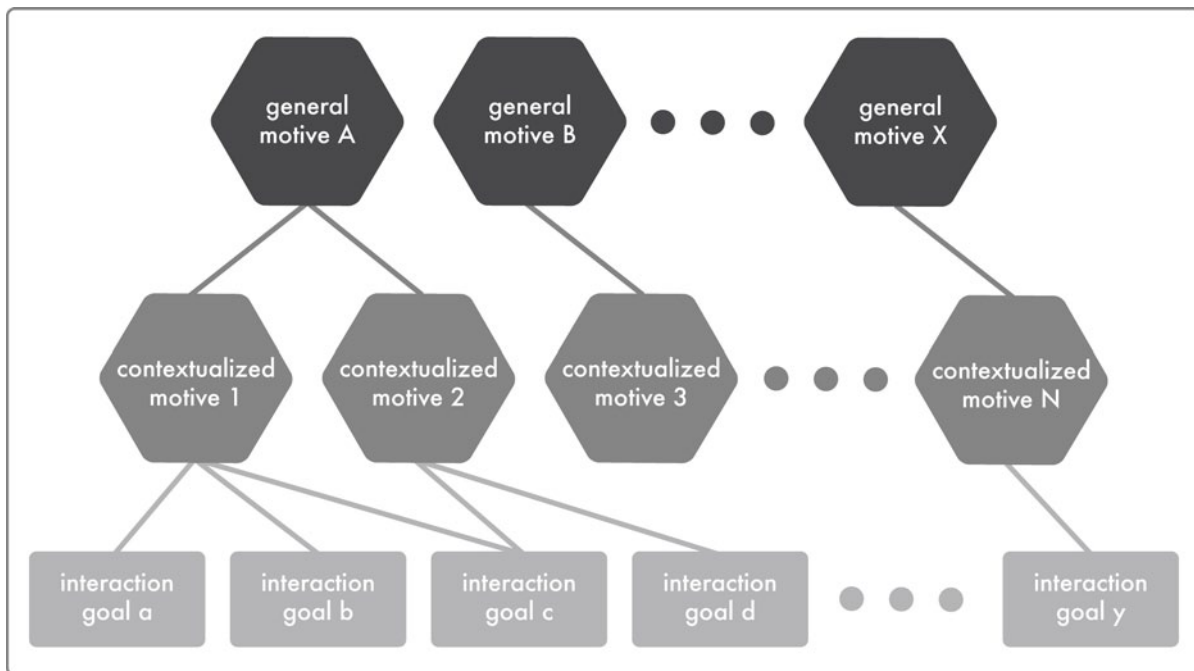


Figure 1. Motive hierarchy in human-product interaction.

Insights into conscious appraisals patterns that underlie emotions experienced in human-product interaction can be used to reformulate design goals. Specifically, design for emotion can be reformulated in terms of design with the intention to activate or prevent activation of appraisals. For example, designing with the goal to elicit joy is designing for motive consistency and certainty. Designing with the goal to prevent anger is designing to prevent motive inconsistency, standard violation and external agency. Although this can be a first step in formulating a more tangible design goal, it is still abstract. It can be made more concrete if it is possible to specify what sort of motive consistency to evoke or what sort of standard violation to prevent. For this, we have to identify those particular motives, standards, and expectations that are involved in emotional experiences with products. We are currently developing and testing tools, such as online questionnaires, that can be used to identify those particular motives, standards and expectations. With the help of these tools and structured procedures that we aim to develop in the future, support of this perspective on emotional design can be fully actualized.

## References

1. Busch, T. (1995). Gender differences in self-efficacy and attitudes toward computers. *Journal of Educational Computing Research*, 12(2), 147-158.
2. Chulef, S., Read, S. J., & Walsh, A. (2001). A hierarchical taxonomy of human goals. *Motivation and Emotion*, 25(3), 191-232.
3. Desmet, P. M. A. (2002). *Designing emotions*. Unpublished doctoral dissertation, Delft University of Technology, Delft, The Netherlands.
4. Desmet, P. M. A., & Hekkert, P. (2007). Framework of product experience. *International Journal of Design*, 1(1), 57-66.
5. Ellsworth, P. C., & Smith, C. A. (1988). Shades of joy: Patterns of appraisal differentiating positive emotions. *Cognition and Emotion*, 2(4), 301-331.
6. Ford, M. (1992). *Motivating humans: Goals, emotions, and personal agency beliefs*. Newbury Park, CA: Sage.
7. Frijda, N. H. (1986). *The emotions*. Cambridge, UK: Cambridge University Press.
8. Frijda, N. H. (2007). *The laws of emotions*. London: Lawrence Erlbaum Publishers.
9. Frijda, N. H., Kuipers, P., & Ter Schure, E. (1989). Relations among emotion, appraisal, and emotional action readiness. *Journal of Personality and Social Psychology*, 57(2), 212-228.
10. Hekkert, P., & Leder, H. (2008). Product aesthetics. In H. N. J. Schifferstein & P. Hekkert (Eds.), *Product experience* (pp. 259-285). San Diego: Elsevier.
11. Hektner, J. M., Schmidt, J. A., & Csikszentmihalyi, M., (2007). *Experience sampling method: Measuring the quality of everyday life*. Thousand Oaks, CA: Sage.
12. Johnston, S. V. (2003). The origin and function of pleasure. *Cognition and Emotion*, 17(2), 167-179.
13. Johnstone T., Van Reekum, C. M., & Scherer, K. R. (2001). Vocal expression correlates of appraisal processes. In K. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal processes in emotion: Theory, methods, research* (pp. 271-284). New York: Oxford University Press.
14. Jordan, P. W. (1999). Pleasure with products: Human factors for body, mind and soul. In W. S. Green & P. W. Jordan

- (Eds.), *Human factors in product design: Current practice and future trends* (pp. 206-217). London: Taylor & Francis.
15. Kappas, A. (2006). Appraisals are direct, immediate, intuitive, and unwitting...and some are reflective... *Cognition and Emotion*, 20(7), 952-975.
  16. Keiser, S., & Wherle T. (2001). Facial expressions as indicators of appraisal processes. In K. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal processes in emotion: Theory, methods, research* (pp. 285-300). New York: Oxford University Press.
  17. Lazarus, R. S. (1991). *Emotion and adaptation*. Oxford: Oxford University Press.
  18. Maslow, A. H. (1970). *Motivation and personality*. New York: Harper & Row.
  19. Moors, A., De Houwer, J., & Eelen, P. (2004). Automatic stimulus-goal comparisons: Support from motivational affective priming studies. *Cognition and Emotion*, 18(1), 29-54.
  20. Norman, D. (2004). *Emotional design: Why we love (or hate) everyday things*. New York: Basic Books.
  21. Ortony, A., Clore, G. L., & Collins, A. (1988). *The cognitive structure of emotions*. New York: Cambridge University Press.
  22. Pecchinenda, A. (2001). The psychophysiology of appraisals. In K. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal processes in emotion: Theory, methods, research* (pp. 301-315). New York: Oxford University Press.
  23. Roseman, I. J. (2001). A model of appraisal in the emotion system: Integrating theory, research, and applications. In K. Scherer, A. Schorr & T. Johnstone (Eds.), *Appraisal processes in emotion: Theory, methods, research* (pp. 68-91). New York: Oxford University Press.
  24. Roseman, I. J., & Evdokas A. (2004). Appraisals cause experienced emotions: Experimental evidence. *Cognition and Emotion*, 18(1), 1-28.
  25. Scherer, K. R. (2001). Appraisals considered as a process of multilevel sequential checking. In K. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal processes in emotion: Theory, methods, research* (pp. 92-120). New York: Oxford University Press.
  26. Scherer, K. R. (2005). What are emotions? And how can they be measured? *Social Science Information*, 44(4), 695-729.
  27. Schorr, A. (2001). Subjective measurement in appraisal research. In K. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal processes in emotion: Theory, methods, research* (pp. 331-349). New York: Oxford University Press.
  28. Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology*, 43(4), 813-838.
  29. Smith, C. A., & Kirby, L. D. (2001). Towards delivering on the promise of appraisal theory. In K. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal processes in emotion: Theory, methods, research* (pp. 121-138). New York: Oxford University Press.
  30. Van Dijk, W. W., & Zeelenberg, M. (2002). What do we talk about when we talk about disappointment? Distinguishing outcome-related disappointment from person-related disappointment. *Cognition and Emotion*, 16(6), 787-807.