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Needs, affect, and interactive products – Facets of user experience

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ABSTRACT

Subsumed under the umbrella of *User Experience* (UX), practitioners and academics of Human–Computer Interaction look for ways to broaden their understanding of what constitutes “pleasurable experiences” with technology. The present study considered the fulfilment of universal psychological needs, such as competence, relatedness, popularity, stimulation, meaning, security, or autonomy, to be the major source of positive experience with interactive technologies. To explore this, we collected over 500 positive experiences with interactive products (e.g., mobile phones, computers). As expected, we found a clear relationship between need fulfilment and positive affect, with stimulation, relatedness, competence and popularity being especially salient needs. Experiences could be further categorized by the primary need they fulfil, with apparent qualitative differences among some of the categories in terms of the emotions involved. Need fulfilment was clearly linked to hedonic quality perceptions, but not as strongly to pragmatic quality (i.e., perceived usability), which supports the notion of hedonic quality as “motivator” and pragmatic quality as “hygiene factor.” Whether hedonic quality ratings reflected need fulfilment depended on the belief that the product was responsible for the experience (i.e., attribution).

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1. Introduction

“I positively remember my first attempt to use arc-welding equipment – an almost martial experience, which rekindled my interest in mechanical engineering studies.”

“I was on a short trip to Dublin. In the early hours, my mobile phone woke me up. My boyfriend, who stayed at home, had just texted a sweet ‘I love you.’”

“It is just fantastic to see how our two little cats play and care for each other. We captured this experience with our digital camera to watch and relive it.”

The almost martial feeling of welding, the sweetness of a caring wake-up message, the lasting memories of two beloved cats playing – these are all experiences mediated by technologies, such as arc-welding equipment, mobile phones and digital cameras. Experience is a stream of feelings, thoughts and action; a continuous commentary on our current state of affairs (Kahneman, 1999, p. 7). Experience is ubiquitous, mostly unconscious, but still accessible to the person experiencing. The simple question of “How do you feel?” prompts probing and reflection. Beyond these single

moments, people are able to summarize and memorize particularly outstanding, rich, or touching experiences – just as first-time arc-welding, being woken up by a love message, or observing beloved cats.

Recently, the field of Human–Computer Interaction (HCI) has witnessed a growing interest in an experiential perspective on the design and evaluation of interactive products (see Hassenzahl (2010) and Hassenzahl and Tractinsky (2006) for an overview). Subsumed under the umbrella of *User experience* (UX), practitioners and academics are looking for new approaches to the design of interactive products, which accommodate experiential qualities of technology use rather than product qualities. Even though far from settled, many agree that UX is a dynamic, highly context-dependent, and subjective account of human–technology interaction (Law et al., 2009). In addition, the experiential stresses affect and emotions. Emotions have a multitude of functions in the context of interaction, ranging from shaping the interaction itself to the evaluation and communication about product use (Forlizzi and Battarbee, 2004). And also Kahneman's (1999) notion of a “continuous commentary” refers to the pleasure and pain felt in any given moment, which influences whether we go on with our current activity, whether we cancel it or whether we will ever do it again.

In their book on experience, McCarthy and Wright (2004) emphasize, too, the “emotional thread” of experience, and they note that emotion and experience are inseparable. They suggest that all our actions are “shot through with values, needs, desires,

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and goals” (p. 85). The connection of action with values and needs colours our experience, sets its emotional tone. Referring to the three introductory examples, one can easily “see” the emotionality through the descriptions of the experiences – feeling bold, strong, loved, thrilled, or amused.

With their emphasis on “values, needs, desires and goals,” McCarthy and Wright (2004) are in line with accepted psychological theories (see Carver and Scheier, 1989), which understand action as being permanently shaped not only by the context and conditions on an operational level, but also driven by overarching, universal psychological needs. The question at hand, however, is what these “values, needs, desires” are. In fact, McCarthy and Wright (2004) seem to explicitly avoid any commentary on the content of “needs.” This is due to a critical view of attempts to reduce, what they call “felt experience”, to a set of generalized concepts. Due to experiences’ highly situated, unique and inseparable character – their “perpetual novelty” as Schmitt (1999, p. 61) calls it – they lend themselves to description, but not to any type of categorization or reduction to a set of underlying principles. “Perpetual novelty” implies that experiences can be described in retrospect. However, in the moment of description, they are gone and will never occur again. This actually would be the end of story for experience in HCI, because designing for bygone and unrepeatable experiences is futile.

In contrast to McCarthy and Wright (2004), the present paper argues that although two experiences may never be alike, we may nevertheless be able to categorize them. Schmitt (1999, p. 61) suggested a categorization “in terms of their [experiences’] generic emerging properties.” He proposed processes (e.g., think, feel, relate, etc.); however, we suggest categorizing experiences on the basis of the psychological needs they fulfil. To give an example: the positive experience from arc-welding is a consequence of challenge, skills and mastery – in short: competence. This competence experience differs clearly from the experience of a sweet “I love you”-message. Here the positive experience stems from feeling related to other people and, thus, maybe thought of as relatedness experience.

The paper’s objective is twofold: it establishes need fulfilment as a major source of positive (emotional) experiences with technology (see Hassenzahl, 2010) and clarifies the links between needs, affect, and product perception. In addition, it looks at the notion of a categorization of experiences based on the primary need it fulfils and explores qualitative differences between experiences. By that, we offer a structural model of positive experience, which differentiates experience based on the psychological needs fulfilled through technology use. In addition, we gain first insights into the process, which links experience to product perception, and we provide an alternative approach to the measurement of experience: from the indirect quantification of user experience through product perception and evaluation to the direct quantification of experience beyond the mere affective.

We first describe and discuss a set of potential psychological needs. Based on this, we present an online questionnaire study of positive experiences with technology, and we analyse the structure of need fulfilment, links between needs, affect and product and differences between categories of experience. We conclude with the implications of the study for user experience, its measurement and design.

2. Needs, affect and interactive products

Universal human needs are an ever-present topic in psychology. One of the theories best known outside psychology is certainly Maslow’s (1954) *Theory of Personality*, which lists five universal needs: physical health, security, self-esteem, belongingness, and self-actualization. Other authors compiled further lists such as Rokeach

(1973) or Reiss (Reiss and Havercamp, 1998). A prominent contemporary theory is Ryan and Deci’s (2000) *Self-Determination Theory*, which restricts itself to a “big three”: autonomy, relatedness and competence. Based on a review of the available theories, Sheldon and colleagues (2001) compiled a concise list of the top 10 psychological needs (see Table 1 for an overview).

In a series of studies, Sheldon and colleagues (2001) explored the relationship between those 10 needs and affect. Specifically, they asked people to report on a recent, satisfying life event, and to rate the affect (positive, negative) and feelings of need fulfilment experienced during this event. Affect was measured with the *Positive Affect Negative Affect Schedule* (PANAS, Watson et al., 1988) a widely used and validated questionnaire, consisting of 20 affect adjectives, such as *proud, excited, scared* or *hostile*; 10 for positive affect and 10 for negative. Need fulfilment was assessed by items such as “During this event I felt that I was successfully completing difficult tasks and projects” (competence) or “During this event I felt close and connected with other people who are important to me” (relatedness). The results (from the analysis of three independent data sets) provided a number of insights into needs and their relation to affect. First of all, the degree of need fulfilment was positively related to the intensity of positive affect. Except for luxury, all needs showed correlations with positive affect in the range from .20 to .50. Second, a principle component analysis showed the needs to be relatively independent from each other. Hence, satisfying experiences are marked by particular needs and, thus, can be classified accordingly. Third, needs differed in their salencies: autonomy, competence, and relatedness were especially noticeable in the reported positive life events.

In a pilot study, Hassenzahl (2008) asked participants ($N = 52$) to think of a recent, positive and satisfactory experience with an interactive technology. A slightly adapted version of Sheldon and colleagues’ questionnaire was used to measure the occurrence of autonomy, competence, and relatedness in those experiences. In addition, an abridged version of PANAS (Watson et al., 1988; German version, Krohne et al., 1996) was used to assess affect. The results not only lent support to the notion of distinct experiences based on the particular need fulfilled, but also revealed a clear link between needs and affect.

To summarize, the fulfilment of particular psychological needs can be understood as a source of positive experience. Note, however, that the implied causality is an assumption only. Positive experiences can be distinguished based on the primary need fulfilled.

The assumption that need fulfilment leads to a positive experience is apparent in a number of models of user experience in the context of HCI. Jordan (2000), for example, suggested four distinct “needs” (he called it “pleasures”) based on work by Tiger (1992): physio (e.g., touch, taste, smell), socio (e.g., relationship with others, status), psycho (e.g., cognitive and emotional reactions) and ideo needs (e.g., aesthetics, embodied values). Gaver and Martin (2000) compiled a list of needs, such as novelty, surprise, diversion, to influence the environment, to extend knowledge and control, intimacy, to understand and change one’s self, and mystery. Hassenzahl (2003) suggested manipulation, stimulation, identification, and evocation as important needs in the context of interactive technologies.

Table 1 presents a rough mapping of those constructs to Sheldon and colleagues’ (2001) 10 needs. Although those three models use different terminologies, they all address the themes of competence, relatedness, popularity, stimulation, and meaning. The needs, thus, unify different models and further clarify the psychological basis of the assumed pleasures, needs or values. In addition, Sheldon and colleagues’ (2001) work established a clear link between positive experience and need fulfilment in the context of satisfying events, and Hassenzahl’s (2008) pilot study suggests that those results are generalisable to positive experiences with technology.

Table 1
Ten human needs (descriptions are taken from Sheldon et al., 2001, appendix) and models of User experience addressing those needs.

Need	Description	Jordan (2000)	Gaver and Martin (2000)	Hassenzahl (2003)
Autonomy–Independence	Feeling like you are the cause of your own actions rather than feeling that external forces or pressure are the cause of your action			
Competence–effectance	Feeling that you are very capable and effective in your actions rather than feeling incompetent or ineffective	Psycho-pleasure	To extend knowledge and control; to influence the environment	Manipulation
Relatedness–belongingness	Feeling that you have regular intimate contact with people who care about you rather than feeling lonely and uncared of	Socio-pleasure	Intimacy	
Influence–popularity	Feeling that you are liked, respected, and have influence over others rather than feeling like a person whose advice or opinion nobody is interested in	Socio-pleasure		Identification
Pleasure–stimulation	Feeling that you get plenty of enjoyment and pleasure rather than feeling bored and understimulated by life	Psycho-pleasure	Novelty, surprise, diversion, mystery	Stimulation
Security–control	Feeling safe and in control of your life rather than feeling uncertain and threatened by your circumstances			
Physical thriving–bodily	Feeling that your body is healthy and well-taken care of rather than feeling out of shape and unhealthy	Physio-pleasure		
Self-actualizing–meaning	Feeling that you are developing your best potentials and making life meaningful rather than feeling stagnant and that life does not have much meaning	Ideo-pleasure		
Self-esteem–self-respect	Feeling that you are a worthy person who is as good as anyone else rather than feeling like a “loser”		To understand and change one's self,	Evocation
Money–luxury	Feeling that you have plenty of money to buy most of what you want rather than feeling like a poor person who has no nice possessions			

The present study seeks to further explore the role of need fulfilment for the user's experience. We selected 7 out of the 10 needs that we considered the most important in the context of experiences with technology, namely competence, relatedness, popularity, stimulation, meaning, security and autonomy. The first five are the ones that have been addressed already – at least implicitly – by other models of user experience. We further added security, due to its seemingly obvious link to usability issues, and autonomy, due to its central character in *Self-Determination Theory* (Ryan and Deci, 2000). Luxury was excluded, due to its marginal role even in Sheldon et al.'s studies. Self-esteem, although a distinct need in Sheldon and colleagues' (2001) list, was excluded, because it could be understood rather as an outcome of need fulfilment than a need in itself (in line with Sheldon et al.'s own discussion, p. 336). For example, self-esteem can *result* from fulfilled competence. Finally, physical thriving was excluded due to its seemingly weak connection to interactive technologies in general and its failure to emerge as a distinct need in Sheldon and colleagues' study (2001). Note, however, that our set of needs is not meant as a definitive selection; rather we were aiming at a streamlined list, covering most of experiences without being overly complex. Following Sheldon and colleagues' (2001) and our own pilot study (Hassenzahl, 2008) we asked people to report a recent positive experience. We then asked them to rate need fulfilment and affect, as well as product perceptions and evaluations in order to explore the links between these different constructs. Note that due to our focus on positive experiences only, results and according generalisations are limited.

3. Method

3.1. Participants and procedure

The questionnaire study was carried out online with Survey-Monkey (www.surveymonkey.com). A link to the study was distributed via the WiSo-panel (www.wisopanel.uni-erlangen.de, Göritz, 2007) and various email lists. All in all, 548 of the 668 (82%) participants (62% female, 35% male, 3% not specified) completed the questionnaire on the majority of the crucial measures. We allowed for some missing values per participant, which led to slight variations in sample size, depending on the measures involved. A response rate could not be computed, due to the way we distributed the survey. The sample's median age was 32 (Minimum = 17, Maximum = 90).

The questionnaire consisted of four parts: introduction, report of a positive experience, needs, affect, product perception/evaluation scales, and demographic details. All materials were in German. In the introduction, we stated our interest in the experience of situations, in which technology (e.g., gaming, watching, listening to music, communication) plays a role. Participants were then asked to think of and write down a recent, outstanding, positive experience with technology. They were asked to relive the experience and to rate it on a series of scales: need fulfilment, experienced affect, attribution, product perception and evaluation (for a detailed description see below). Finally, participants provided some demographic information (gender, age, occupation), were thanked and given an email address for further inquiries.

3.2. Need fulfilment

The experienced fulfilment of the seven needs (competence, relatedness, popularity, stimulation, meaning, security, and autonomy) was measured with a questionnaire adapted from Sheldon and colleagues (2001). Each need was captured with

three items (21 items in total). Participants responded on a five-point scale ranging from *not at all* to *extremely*.

We performed a random split of the overall sample. On one half, we carried out a principal component analysis (varimax rotation) with an explicit extraction of seven components. Four of the 21 items were problematic, having loadings on at least two components higher than .30 without any clear primary component. In addition, autonomy and meaning items largely loaded on the same component, with the three meaning items being more coherent. Based on this, we excluded the four items with strong crossloadings and the entire autonomy scale (seven items in total). To test the stability of this solution, we performed another principal component analysis (varimax rotation, six components extracted) on the remaining half of the sample. The results were satisfactory.

Table 2 shows the final set of items and the results of a principal component analysis on the whole sample (varimax rotation, six components extracted). This solution explained 86% of the variance. All primary component loadings were high (.75–.93), with only two crossloadings slightly greater than .30.

We computed mean scale values (Cronbach's alpha from .79 [Popularity] to .88 [Meaning]; scale inter-correlations from .14 to .57) for each need by averaging the respective items for each participant. In addition, we computed a *General* saliency of needs by averaging all items. This score captures the extent to which need fulfilment took place, regardless of the actual type of need.

3.3. Affect

Affective experience was assessed with the *Positive Affect Negative Affect Schedule* (PANAS, Watson et al., 1988; German version Krohne et al., 1996). It consists of 20 verbal descriptors of different affective experiences, namely *afraid, scared, nervous, jittery, irritable, hostile, guilty, ashamed, upset, and distressed* for negative affect and *active, alert, attentive, determined, enthusiastic, excited, inspired, proud, strong* and *interested* for positive affect. Participants indi-

cated how much they experienced the particular affect on a five-point scale ranging from *not at all* to *extremely*. PANAS assumes a hierarchical structure (Watson and Tellegen, 1985), with two broad factors capturing the valence of the experienced affect (positive, negative). Each descriptor itself captures the specific content of the affect and, thus, expresses qualitative differences in experience.

In the present study, we calculated a positive affect (PA) and a negative affect (NA) scale value by averaging the responses to the 10 affect descriptors for each valence. Internal consistency for PA and NA was good (Cronbach's alpha of .83 for PA and .87 for NA), and the scale inter-correlation small ($r = .07, p > .05$). Both findings lend credit to the reliability of the distinction between PA and NA.

Besides the two general valence factors, recent work (Egloff et al., 2003) implies that positive affect can be further partitioned into joy (*excited, proud, enthusiastic*), interest (*interested, strong, determined*), and activation (*active, inspired, alert, attentive*). Based on this, we calculated scale values for joy, interest, and activation by averaging the respective descriptors. Internal consistency of joy was satisfactory (Cronbach's alpha = .79), but not of interest (Cronbach's alpha = .67) and activation (Cronbach's alpha = .54). The scale inter-correlations were in all cases substantial (ranging from .45 to .67). An exploratory principal component analysis (varimax rotation, Eigenvalue > 1) of the 10 positive affect descriptors suggested a three factor structure, however, with an alternative grouping of descriptors: *active, strong, proud, determined, and alert* formed one component (Eigenvalue = 2.77, 28% variance explained), *excited, enthusiastic, and interested* a second (Eigenvalue = 2.56, 16% variance explained) and *inspired and attentive* a third one (Eigenvalue = 1.30, 13% variance explained). Although this grouping differed from Egloff et al.'s (2003), we kept it for further analyses because it reflected the given data.

A further principal component analysis (varimax rotation, Eigenvalue > 1) of the negative affect descriptors revealed two components, one (Eigenvalue = 5.25, 53% variance explained) with loadings of 9 out of the 10 descriptors and a second (Eigenvalue = 1.23, 12% variance explained) with a very high loading of

Table 2
Principal component analysis (varimax rotation) of the whole sample.

Scale/Item	Component					
	1	2	3	4	5	6
I felt ...						
<i>Relatedness</i>						
... a sense of contact with people who care for me, and whom I care for	.92					
... close and connected with other people who are important to me	.93					
... a strong sense of intimacy with the people I spent time with	.90					
<i>Meaning</i>						
... that I was "becoming who I really am"		.81				
... a sense of deeper purpose		.78				
... a deeper understanding of myself+		.81				
<i>Stimulation</i>						
... that I was experiencing new sensation and activities			.88			
... that I had found new sources and types of stimulation for myself			.87			
<i>Competence</i>						
... that I was successfully completing difficult tasks and projects				.86		
... that I was taking on and mastering hard challenges				.84		
<i>Security</i>						
... that my life was structured+					.85	
... glad that I have a comfortable set of routines and habits		.31			.83	
<i>Popularity</i>						
... that I was a person whose advice others seek out and follow	.32					.75
... that I'm someone, others take as a guidance+						.81
Eigenvalue	2.79	2.42	1.77	1.76	1.72	1.53
% variance explained	20	17	13	13	12	11

Notes: All items were originally in German; component loadings <.30 are suppressed; +) these items slightly differ from Sheldon et al. (2001).

afraid (.94) and a secondary loading of *ashamed* (.49). However, this did not justify a further partitioning of the negative affect descriptors.

3.4. Product perception and evaluation

Hassenzahl and colleagues (Hassenzahl et al., 2000; Hassenzahl, 2001, 2003) argued that the perceived qualities of an interactive product can be divided into instrumental, pragmatic and non-instrumental, self-referential, hedonic aspects (see also Batra and Ahtola, 1990). *Pragmatic quality* refers to a judgment of a product's potential to support particular "do-goals" (e.g., to make a telephone call) and is akin to a broad understanding of usability as "quality in use." *Hedonic quality* is a judgment with regard to a product's potential to support pleasure in use and ownership, that is, the fulfilment of so-called "be-goals" (e.g., to be admired, to be stimulated).

The present study used an abridged version of the AttrakDiff2 questionnaire (see Hassenzahl and Monk, in press) to measure product perceptions and evaluation. It consists of 10 seven-point semantic differential items, four to measure pragmatic quality (*confusing–structured*, *impractical–practical*, *unpredictable–predictable*, *complicated–simple*), four to measure hedonic quality (*dull–captivating*, *tacky–stylish*, *cheap–premium*, *unimaginative–creative*) and *good–bad* and *beautiful–ugly* as measures of general product evaluation. Hassenzahl and Monk (in press) already used the abridged version of the questionnaire on four, heterogeneous samples (number of participants = 607, number of products = 110). In those study, internal consistency (Cronbach's alpha) for the composite scales was good (ranging from .79 to .95), while scale inter-correlation remained low (ranging from .00 to .52, with an average of .24), suggesting good discriminant validity.

In the study at hand, internal consistency (Cronbach's alpha) of the pragmatic and hedonic quality scale was satisfactory (.70 and .75, respectively). Scale inter-correlation was significant, due to the large sample size, but clearly smaller than the internal consistencies ($r = .38$, $p < .01$). A principal component analysis (varimax rotation) with two components to be extracted revealed a satisfactory solution, with *cheap–premium* as the only problematic item, loading on both components. This suggests *cheap–premium* to be close to the general evaluation of the product – its "goodness." We nevertheless kept the scales in their original form to facilitate comparison with previous studies.

3.5. Attribution

Need fulfilment and affect are direct enquiries into experience, whereas product perception and evaluation are rather indirect. The former is felt in a particular situation (e.g., "I felt ... that I had found new sources and types of stimulation for myself"), whereas the latter is expressed through product attributes (e.g., "captivating", "creative"). An attribute is the consequence of an *attribution process* that relates an experience to a particular object and establishes it as the cause of this experience. This is akin to affect attribution (see Russell, 2003), where felt arousal and negative valence is, for example, attributed to a bear ("I'm afraid of the bear"), which will in turn become an attribute of the object itself ("The bear is frightening", which actually means "the bear is able to cause fear"). Accordingly, experiences should only be mirrored in product perceptions and evaluation if the product was seen as – at least partial – cause of the experience. In view of that, we asked participants to assess the extent to which the product caused the experience on a five-point scale ranging from *very small* to *very large*.

4. Results and discussion

4.1. Experiences

Participants reported a wide variety of experiences, involving many different interactive products and activities. Frequent examples of interactive technologies mentioned were computers/laptops, mobile phones, digital cameras, Internet chat, email and instant messaging, software, television and DVD, mp3-players, game consoles or navigation devices. The majority of the reported experiences (72%) referred to one of those technologies, either directly or indirectly by describing a particular activity (e.g., "taking photos"). More uncommon examples were coffee machines, an arc-welding device, a helicopter, bicycles or a vibrator (11%). For the remaining 17% of the reported experiences, the technology referred to was either not stated or described too vaguely. The activities mentioned in the experience reports ranged from utilitarian (e.g., installing a software, information search, problem solving) to hedonic (e.g., exploring, communicating with friends, watching movies). Overall, the sample covered a wide variety of experiences and is, thus, appropriate for further analysis.

Similar to Sheldon and colleagues (2001), we were not successful in further classifying the content of experiences. The descriptions were just too different in length, style and depth. However, we classified experiences as being *social*, depending on whether it mentioned other people explicitly. All remaining experiences were classified as *non-social*. This resulted in 204 (of 548, 37%) *social* experiences.

4.2. Saliency of needs

Table 3 shows the salience of each need expressed as the mean experienced intensity, the standard deviation of this mean, and the 95% confidence interval.

Relatedness, stimulation and competence were the most salient needs in the sample of positive experiences, followed by popularity, security and finally meaning. In other words, if people experienced technology as positive, it facilitated closeness and communication between people, provided new stimulating insights and opportunities for mastery.

A relation is plausible between certain products or activities (e.g., TV, family TV watching) and particular types of experience (e.g., relatedness experience). Unfortunately, the variety of activities and products in the sample did not allow for a further, product- or activity-specific analysis due to difficulties in achieving the necessary fine-grained categorizations from the reported experiences. However, the classification of social versus non-social experiences provided the opportunity to check the content validity of the measurement, because social situations should result in a higher saliency of relatedness and popularity (i.e., social needs).

In Table 3, the column "social" presents the point-biserial correlation coefficients of the classification of situation (non-social, social) with each need. As expected, relatedness was significantly more salient in social compared to non-social situations (as indicated by the positive correlation). The other social need, popularity, was also positively, but not significantly more salient in social situations. The remaining individual needs were negatively correlated (all significantly except stimulation). These results suggest that the fulfilment of one need in a particular class of situations (here relatedness in social situations) inhibits the fulfilment of other needs (see Kruglanski et al., 2002)."

4.3. Affect, needs, product perception and evaluation

Table 4 shows the bivariate correlations between affect, needs, product perception and evaluation. Remember that the mean scale

Table 3

Mean experienced intensity of needs (standard deviation, 95% confidence interval) and their correlation with whether the situation was social.

Need	Mean (SD)	95% CI		Social (0 = No, 1 = Yes)
		Lower	Upper	
Relatedness	3.26 (1.40)	3.14	3.37	.38**
Stimulation	3.25 (1.26)	3.14	3.36	-.08
Competence	3.09 (1.27)	2.99	3.20	-.16**
Popularity	2.69 (1.17)	2.59	2.79	.08
Security	2.63 (1.24)	2.52	2.73	-.17**
Meaning	2.40 (1.19)	2.30	2.50	-.14**
General	2.89 (0.90)	2.81	2.96	

* $p < .05$.

** $p < .01$.

values of the six needs as well as of pragmatic and hedonic quality (PQ, HQ) were correlated (see Sections 3.2 and 3.4). To facilitate the interpretation of the following correlational analyses, we computed a component score (i.e., factor score) by regression for each need as well as pragmatic and hedonic quality. In contrast to scale values, component scores have the advantage of being uncorrelated. Thus, each bivariate correlation reported represents the unique variance shared by the two constructs. We also computed a component score to obtain a value for each facet of positive affect (see Table 4, below row “Positive”). For positive and negative affect we used the scale values, because they were nearly uncorrelated (see Section 3.3).

All needs were significantly correlated to positive affect, ranging from a low .12 (security) to a high .44 (stimulation) coefficient. Indeed, the rank order of correlations – stimulation, competence, relatedness, popularity, meaning and security – mirrors the salience of needs reported in Table 3. Security and meaning were the two needs least related to positive affect. Security can be understood as a “deficiency need”, i.e., a need that creates negative affect if blocked, but not necessarily strong positive feelings if fulfilled. This is in line with the notion that usability or pragmatic quality is rather concerned with the instrumentality of a product, but not a source of pleasure in itself. This is also apparent in the correlations between positive affect, and product perceptions (i.e., pragmatic and hedonic quality) and evaluation (i.e., goodness). Hedonic quality was more strongly related to positive affect than pragmatic quality. Finally, the correlation between positive affect and goodness emphasizes the role of experienced affect in the evaluation of a product. In fact, one may think of product evaluation as a form of attributed positive affect. Being confronted with the necessity to evaluate a product on a “good–bad”-dimension, people may probe their experienced positive affect and then base

their judgment on the result of this probe. The correlations of negative affect with product perception and evaluation were small, but nevertheless significant. Experienced negative affect was associated with a less favourable overall evaluation and reduced pragmatic quality. At first glance, the positive correlation between negative affect and hedonic quality seemed puzzling. However, taking into account the close association of need fulfilment with hedonic quality (as a form of attributed need fulfilment, see Section 4.4), this can be viewed as a consequence of the apparent positive correlation between negative affect, meaning, and competence. In fact, for meaning, the correlation with negative affect was stronger than with positive affect, that is, the more meaning the more negative affect. One explanation for this is that meaning might just not be important or even inappropriate in the context of experiences with interactive products. For example, “to feel a sense of deeper purpose” is surely an important aspect of life events, however, to imagine situations in which a contemporary mobile phone or a computer game creates such an experience seems difficult. Another explanation would be that meaning is predominantly created through negative experiences, in the sense of an outcome of going through something emotionally difficult. The relation between competence and negative affect seems more straightforward, emphasizing the “bitter-sweetness” of competence experiences. Other than stimulation or relatedness, competence pleasure is derived from taking up challenges and their subsequent mastery. This implies a certain risk of failure as an integral part of the experience and a potential source of negative affect. Again, this emphasizes the qualitative differences between categories of experience. The general need fulfilment was substantially correlated with negative affect (.24). This is in large part due to meaning. Given meaning was removed from the general need fulfilment, the correlation dropped to a low .12.

The further analysis of the facets of affect revealed a remarkable qualitative difference. Affective experience as measured with PANAS can be (1) *active, strong, proud, determined and alert* or (2) *excited, enthusiastic and interested*. The former was most closely associated with competence needs, that is, action, challenge and the successful attainment of do-goals. The latter was more closely associated with stimulation and relatedness needs, that is, novelty, curiosity and social relationships. This indicates an important qualitative difference in the experience of need fulfilment. Although competence was definitely a source of pleasure, the resulting pleasure differed from the type of pleasure caused by stimulation or relatedness. Thus, one may understand experiences as clusters of particular situations, actions and feelings, revolving around a particular need, which “colours” the entire experience. The third facet, *inspired and attentive*, was not strongly linked to need fulfilment.

Table 4

Bivariate correlations between affect (positive, negative), needs and product perception and evaluation (pragmatic quality [PQ], hedonic quality [HQ], goodness [GOOD, bad–good]).

Affect	Needs							Product perception and evaluation		
	Stimulation	Competence	Relatedness	Popularity	Meaning	Security	General	HQ	PQ	GOOD
Positive	.44***	.29***	.26***	.24***	.17***	.12**	.62***	.46***	.28***	.45***
Active, strong, proud, determined and alert	.21***	.45***	.01	.24***	.24***	.23***	.57***	.33***	.21***	.31***
Excited, enthusiastic and interested	.47***	-.08	.33***	.06	-.02	-.02	.31***	.34***	.23***	.41***
Inspired and attentive	-.01	.03	.14**	.07	.07	-.12**	.07	.06	-.02	-.03
Positive	.03	.12**	.02	.08	.32***	.09*	.24***	.12**	-.09*	-.16***

* $p < .05$.

** $p < .01$.

*** $p < .001$.

This is also supported by the missing links between this facet and any measure of product perception and evaluation.

To summarize: need fulfilment was related to positive affect; it might be understood as a source of pleasure. Here, stimulation, relatedness, competence and popularity play a prominent role. Our results further demonstrated qualitative differences between experiences, which support the notion of different categories of experience, each revolving around a particular need as well as providing a particular set of emotions attached to specific situation and actions (e.g., the bitter-sweet experience of competence, strongly tied to goal-oriented behaviour and challenge). Finally, product perceptions and evaluation are clearly related to the experience of affect, highlighting the integral nature of emotions in the context of product use and experience. As expected, hedonic quality was more related to positive affect than to pragmatic quality. This supports the idea of hedonic quality as a “motivator”, capturing the product’s ability to create positive experience and pragmatic quality as a “hygiene factor”, enabling the fulfilment of needs through removing barriers and, thus, dampening negative affect but not being a source of positive experience in itself. The following section further expands on the connection between

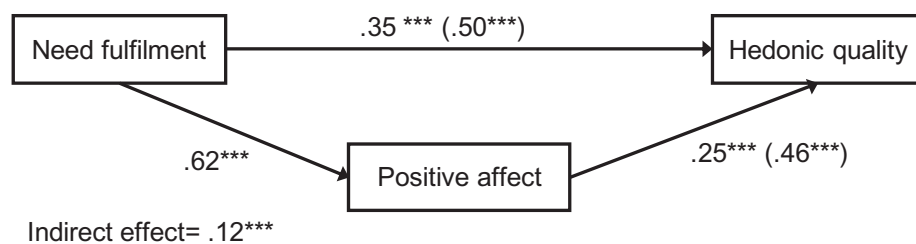
needs and affect on the one hand, and product perception on the other hand.

4.4. Linking needs and affect to product perception

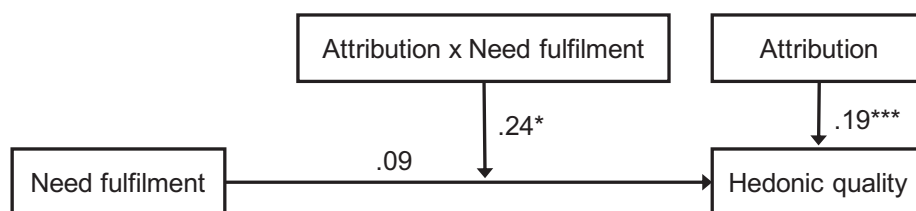
Hassenzahl (see Hassenzahl, 2003, 2008) understands hedonic quality as a product perception directly related to fulfilment of needs, that is, hedonic quality subsumes product attributes that signal potential need fulfilment. In fact, the bivariate correlation between the general saliency of needs and hedonic quality was strong ($r = .50, p < .001$). Hedonic quality was also positively related to positive affect ($r = .46, p < .001$) (see Fig. 1a, coefficients in brackets).

A question at hand is whether the effect of need fulfilment is mediated by positive affect or whether there is a direct link between need fulfilment and hedonic quality. The mediation model implies that need fulfilment leads to positive affect, which in turn impacts hedonic quality. The direct model implies that people are matching experienced fulfilment of needs with their product perception, that is, they attribute a certain ability to fulfil needs to the product directly in the form of particular product attributes

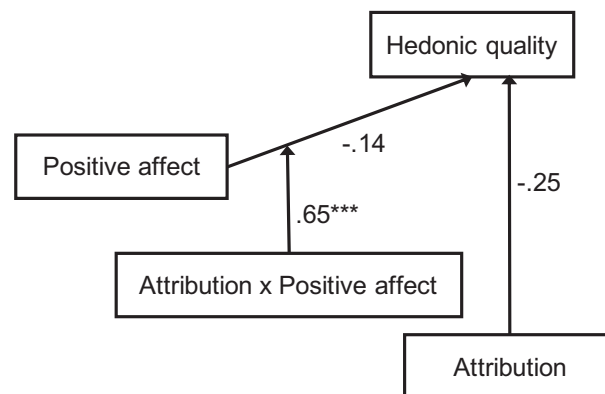
(a) Hedonic quality — Mediation



(b) Hedonic quality — Moderation (Positive affect controlled)



(c) Hedonic quality — Moderated mediation (Need fulfilment controlled)



Notes: In brackets are bivariate correlations, all remaining coefficients are β -weights.

Fig. 1. (a) Mediation, (b) moderation, and (c) moderated mediation analyses for general need fulfilment, positive affect and hedonic quality.

(e.g., “I had a stimulating experience” – “the product is novel, creative”). Note that all subsequent analyses are correlational in nature. The suggested flow from need fulfilment and affect to product attributes, and the thereby implied causality, is solely based on theoretical considerations. In general, however, we refrain from any strong notions of causality and assume a rather flexible, even bi-directional configuration (see Hassenzahl and Monk, *in press*), where experience (needs fulfilment, affect), for example, form product attributes, which in turn impact future experience.

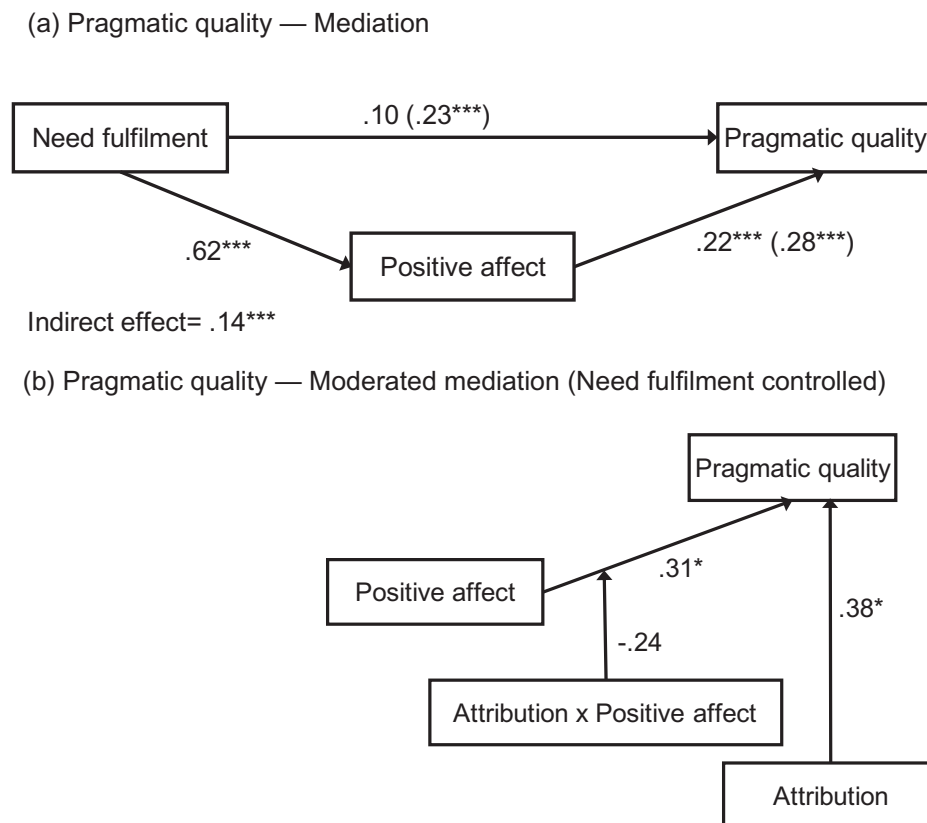
A mediation analysis with a regression of general needs and positive affect on hedonic quality (Fig. 1a) revealed a partial mediation, with a significant direct effect of general needs on hedonic quality ($\beta = .35$, $b = .85$, $SE = .12$, $t = 7.25$, $p < .001$) and a significant indirect effect via positive affect (indirect effect = .12, Sobel's $Z = 4.73$, $p < .001$; positive affect: $\beta = .25$, $b = .31$, $SE = .06$, $t = 4.93$, $p < .001$). A further analysis of the direct effect with attribution as moderator (controlling for positive affect, see Fig. 1b) showed a significant moderation effect (general needs \times attribution: $\beta = .24$, $b = .16$, $SE = .07$, $t = 2.23$, $p < .05$), a significant effect of attribution ($\beta = .19$, $b = .17$, $SE = .04$, $t = 4.84$, $p < .001$) but not of general needs on hedonic quality ($\beta = .09$, $b = .23$, $SE = .28$, $t = 0.82$, $p > .05$). In other words, the relation between fulfilment of needs and hedonic quality perceptions is direct but depends on whether the participants attributed the experience to the product. This is a first glimpse on the processes linking product experience to product perception and evaluation.

A similar analysis was performed for the indirect effect (Fig. 1c), which is a case of a so-called moderated mediation (Preacher et al., 2007). We used the MODMED-Macro for SPSS (Preacher et al., 2007) to determine whether a conditional indirect effect of general

needs on hedonic quality via positive affect exists. Indeed, controlling for general needs, positive affect \times attribution was the sole remaining significant predictor for hedonic quality ($\beta = .65$, $b = .13$, $SE = .04$, $t = 3.64$, $p < .001$; positive affect: $\beta = -.14$, $b = -.17$, $SE = .14$, $t = -1.36$, $p > .05$; attribution: $\beta = -.25$, $b = -.22$, $SE = .12$, $t = -1.90$, $p > .05$). In other words, the more people believe the product to be important for their experience, the more they let their experienced positive affect impact their judgment of hedonic quality. In sum, whether people perceived a product as hedonic depended on the extent of need fulfilment and positive affect during the experience and the belief that the product accounts for this experience.

General salience of needs was related to pragmatic quality ($r = .23$, $p < .001$) and positive affect ($r = .62$, $p < .001$). Positive affect was related to pragmatic quality ($r = .28$, $p < .001$) (see Fig. 2a, coefficients in brackets). As expected, a mediation analysis (Fig. 2a) showed that the direct link between general needs and pragmatic quality was spurious ($\beta = .10$, $b = .24$, $SE = .13$, $t = 1.83$, $p > .05$), whereas the indirect effect via positive affect remained significant (indirect effect = .14, Sobel's $Z = 3.89$, $p < .001$; positive affect: $\beta = .22$, $b = .28$, $SE = .04$, $t = 4.00$, $p < .001$). A further moderation analysis of the direct effect is unnecessary because of its insignificance. The link between positive affect and pragmatic quality was not moderated by attribution (controlled for general needs, see Fig. 2b) (positive affect \times attribution: $\beta = -.24$, $b = -.05$, $SE = .04$, $t = -1.16$, $p > .05$; positive affect: $\beta = .31$, $b = .41$, $SE = .16$, $t = 2.59$, $p < .05$; attribution: $\beta = .38$, $b = .34$, $SE = .14$, $t = 2.54$, $p < .05$).

All in all, these results lent support to Hassenzahl's model (see Hassenzahl, 2003, 2008). First, as expected, a direct relation be-



Notes: In brackets are bivariate correlations, all remaining coefficients are β -weights.

Fig. 2. (a) Mediation and (b) moderated mediation analyses for general need fulfilment, positive affect and pragmatic quality.

tween needs and product perception existed for hedonic quality only. This link between need fulfilment and hedonic quality was moderated by the extent to which the product was perceived as responsible for the need fulfilment (i.e., attribution). Thus, hedonic quality is need fulfilment attributed to the product. Second, indirect effects of need fulfilment on hedonic and pragmatic quality via positive affect existed (a type of “halo-effect”, see Thorndike (1920) and Hassenzahl and Monk (in press), for a discussion in the context of HCI). One may view this as a spill-over from positive affect to the underlying processes governing product perception. However, for hedonic quality the indirect effect was moderated by attribution in such a way that the more the product was perceived as responsible, the stronger the indirect effect. Positive affect may be understood as a core outcome of needs fulfilment and, thus, as a legitimate predictor of hedonic quality.

5. Conclusion

In analogy to Sheldon and colleagues' (2001) work on satisfying life events, the present study explored the idea of the fulfilment of basic needs as a source of positive experience with interactive products and technologies (e.g., mobile phones, mp3-players, navigation devices). We selected 7 out of the 10 suggested needs that we found especially appropriate and promising in the context of interactive technologies. The present study's results suggest that experiences can indeed be categorized by the primary need they fulfil. Our study further revealed a clear relationship between need fulfilment and positive affect, with stimulation, relatedness, competence and popularity being the salient and contributing needs. Moreover, the results hint at qualitative differences at least between competence and stimulation or relatedness experiences. The actual need was also reflected in the particularities of the affective experience, with stimulation and relatedness having been accompanied by positive excitement and interest, whereas competence was accompanied by strength, activity and a mixed (positive, negative) affective experience. Our final analysis of the link between need fulfilment, affect and product perception provided an insight into the underlying processes that transform experiences into product perceptions. As expected, need fulfilment was related to hedonic and not to pragmatic quality perceptions. Whether experienced need fulfilment was subsequently reflected in hedonic quality perceptions depended on the belief that the product was – at least to a certain extent – responsible for the experience (i.e., attribution). The evident, but small correlation between general need fulfilment and pragmatic quality was entirely mediated by positive affect – in other words a “halo”-effect.

5.1. Implications

The present study has a number of implications. First, it provides a first structural model of positive experiences – based on sound psychological research – which can be used to describe and classify experiences with interactive technologies. This model focuses on the communality, the core, of experiences. Although we acknowledge the huge variety in individual experiences, we argue that they can be classified nevertheless by focusing on the primary basic human need fulfilled through the experience. This approach unifies existing approaches and replaces them with a tried and tested, and essential collection of independent experience categories.

Second, the ability to describe particular categories of experience is an important step towards experience design. Future work will relate specific requirements and design resources to each category of experience. To give an example: “flow” (Csikszentmihalyi, 1975) can be understood as a variant of a competence experience,

highlighting the importance of a match between the challenge afforded by the task and the skills of the individual. In the same vein, randomness as a design resource or the notion of “serendipity” (e.g., Leong et al., 2008) might be central to stimulation experiences, whereas emotional expressiveness might be associated with relatedness experiences (e.g., Vetere et al., 2005). The category system we developed bears the opportunity to integrate scattered knowledge about experiences and ways to integrate them into a coherent model.

Third, the present study showed that experiences can be described and evaluated with the employed questionnaires. We believe this to be a promising strategy for HCI, away from the usual product-centred evaluation towards an experiential evaluation. This strategy has a number of potential advantages. First of all, it might be easier for people to describe their experiences with a product compared to describing the product itself. The former is a personal, highly subjective task, whereas product-oriented evaluation often raises the question on behalf of the participant, whether she or he has the competence or right to judge the product. In other words, it might be easier to answer the question of whether “I experienced something new while interacting with a product” than the question of whether a product is “novel.” In addition, experiences are *per se* personally meaningful, whereas product perceptions and evaluations always require a process, which transforms anticipated or experienced need fulfilment into product attributes. Moreover, experiential evaluation might enable us to compare the results of empirical evaluations of different products or even product genres, due to the universal nature of experiences. Finally, the finding that experience is only reflected by relevant product attributes, if an attribution process took place, that is, if people believe the product to be responsible for their experience, highlights the necessity to consider both, product-oriented and experiential evaluation. Otherwise, we might miss all the cases where a product creates an experience, but people nevertheless dismiss it, because of a missing link between experience and product.

Fourth, the present study lent further support to the idea of hedonic quality being a “motivator”, capturing the product's perceived ability to create positive experiences through need fulfilment and pragmatic quality being a “hygiene factor”, enabling the fulfilment of needs through removing barriers but not being a source of positive experience in itself. This evidence defies any model that assigns value to pragmatic quality or usability in itself. One might argue that security experiences are the true objective of all attempts making a product pragmatic. Note, however, that security is only weakly related to positive affect. This is in line with Sheldon and colleagues' (2001, Study 3) results, which showed that the absence of security played an important role when asking people explicitly about *negative* experiences (which was not done in the present study), but did not contribute largely to positive experiences. In fact, security can be viewed as a “deficiency need” (Maslow, 1954), that is, a need which creates a negative feeling if not fulfilled, but does not contribute much to a positive feeling. This is the essence of a “hygiene factor” as explained above.

5.2. Limitations and future work

There are at least three limitations of the present study, which require some discussion. Obviously, the present results strongly depend on the obtained sample of experiences. Although we used multiple ways of distributing the study to reach diverse people, worked with a sufficiently large sample and captured a wide variety of different experiences (and embedded technologies), it cannot be ruled out that future studies will produce different results. Note that this holds true only for the rank order of needs according to their saliency. All correlational analyses, such as the principal

components analysis on the needs questionnaire, the general link of need fulfilment to positive affect and the way need fulfilment is transformed into product perceptions should be reproducible. The saliency of needs, however, clearly depends on the sample of experiences. However, it rather reflects the distribution of experiences provided by currently available technology and should not be confused with a ranking of importance. Basically, all needs are important and meaningful to people and it is the task of designers to create interactive products that provide the full range of possible experiences.

Admittedly, the selection of needs explored in the present study was based on our preconceptions. It would be premature to declare stimulation, relatedness, competence and popularity as the definite set of possible positive experiences with interactive products. Physical striving, for example, may become more and more important (see “physio-pleasure”, Jordan, 2000), given the proliferation of interaction technologies, such as *Nintendo's Wii* or *Apple's iPhone*. In addition, other authors provided differing lists of needs, which may capture experiences not covered by the present study, such as a competition experiences or the experience of collecting and preserving meaningful things (see Reiss and Havercamp, 1998). We are looking for future studies on further needs, leading to a comprehensive set of experiences meaningful to people.

Similar to Sheldon and colleagues (2001), we found that the descriptions of experiences provided by the participants were too heterogeneous in length, style and depth to further classify them. However, product-, situation- or activity-specific profiles would have been an interesting outcome. They could be used, for example, as a validation of the need questionnaire, to better understand broad differences in product genres or to reflect upon certain product features from an experiential perspective. One step into this direction was our attempt to distinguish between social and non-social situations and the reassuring finding that social situations are especially marked by salient relatedness experiences. Future studies should employ a more structured way of having participants describe the experience, for example, by asking explicitly for a product category or the number of people involved. This will enable us to understand situations, activities and product features in terms of the experience they provide.

User experience as a discipline is just in its infancy. Some of its key assumptions, such as its subjective nature, context-dependency and temporality are already widely accepted (e.g., Law et al., 2009). It also seems self-evident that people concerned with the design of interactive products ultimately aim at providing positive experiences. What is needed now is a better understanding of the particularities of positive experience, that is, sources for and types of pleasures and techniques to evoke and to shape those experiences. We hope the present study to be a step towards this goal, by providing a framework to organize knowledge about User experience in a psychologically meaningful way.

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