

Leisure and Work, Good and Bad: The Role of Activity Domain and Valence in Modeling User Experience

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Recent research suggests that psychological needs such as competence and relatedness are involved in users' experience with technology and are related to the perception of a product's hedonic and pragmatic quality. This line of research, however, predominately focuses on positive leisure experiences and it is unclear whether need fulfillment plays a similar role in negative experiences or in other activity domains such as work. Therefore, this study investigates need fulfillment in positive and negative experiences, and in work and leisure experiences in two separate studies by analyzing almost 600 users' experiences with technology along with ratings on need fulfillment, affect, and perceived product quality. Results suggest that work and leisure experiences as well as positive and negative experiences differ in terms of need fulfillment. Hence, both activity domain and valence of experiences are important factors that should be taken in account when modeling user experience.

Categories and Subject Descriptors: Human-centered computing, Human-computer interaction (HCI)

General Terms: Experimentation, Human Factors

Additional Key Words and Phrases: User experience, work and leisure, positive affect, negative affect, need fulfillment

1 INTRODUCTION

User experience (UX) research aims to understand the determinants and processes involved in users' experiences with interactive technology and to use this understanding for designing better experiences. It has been shown that user experience is shaped in different ways by hedonic and pragmatic quality [Hassenzahl et al. 2003], types of pleasure [Jordan 2000], and valence of emotion [Mahlke and Thüring 2007]. Yet, our understanding of what constitutes users' experience still evolves, and further research that empirically investigates the determinants of user experience and their interplay is called for by many researchers [e.g., Law and van Schaik 2010].

Our understanding of user experience has recently been advanced by models derived from narratives of user experience. Narratives are typically user-generated descriptions of experiences such as

My great grandson was born in <month> of <year> and was born in <place>. I live in <another place> and within fifteen minutes I was talking to my granddaughter (the new mother) and seeing my great grandson! I was blown away and from there I have been able to watch him grow and now he knows who Ome' is.

or

I wrote an 850-word essay on a stock-trading website. I had it about three quarters up to word count when my electricity blinked out. I know I am supposed to save often, but I didn't. Anyway, since it was still pretty rough, I was able to remember most of it when my power came back on, but just when I was putting the finishing touches on it, the electricity went out again. It was storming. I did have a rougher

version saved but it was much harder to get the words just right again. When using a pen and paper that never happens.

These narratives are usually obtained by asking users to describe an outstanding/memorable experience with technology and subsequently rate the experience on various scales [Hassenzahl et al. 2010; Obrist et al. 2014; Olsson and Salo 2012; Partala and Kallinen 2012; Tuch et al. 2013; Tuch and Hornbæk 2015]. The ratings associated with narratives are used to develop models of need fulfillment, which have emerged as a way to explain the determinants and processes in user experience.

Modeling has suggested that psychological needs (i.e., fundamental qualities of experience that all humans seek to thrive such as experiencing competence and relatedness) are involved in user experience [e.g., Hassenzahl, et al. 2010]. Recent research has related such needs to the content of narratives and the rating of the technologies in those narratives. For instance, Hassenzahl et al. [2010] developed a model that illustrates how need fulfillment, in conjunction with affect, influences users' perception of the technology's hedonic quality and pragmatic quality¹. They showed that need fulfillment (e.g., the feeling of being related as described in the first narrative above) was associated with ratings of higher affect. Likewise, need fulfillment was related to higher ratings of hedonic quality, but not of pragmatic quality.

Existing work on modeling has two substantial limitations in the types of experience on which they are based. Most narratives on user experience stem from the leisure domain; Bargas-Avila and Hornbæk [2011] noted a general bias towards the leisure domain in UX research. The importance of studying user experience in work has also been stressed by Lindgaard [2012]; and Bødker [2006] argued for embracing people's whole lives, including both work and leisure, to advance user experience research. Whereas leisure is an important use context, we do not know if need satisfaction plays a similar role in an activity domain like work as in leisure; indeed, earlier work suggests that the motives driving behavior in leisure may differ from those driving work [Tinsley et al. 1993]. Another limitation of existing work is that the valence of the experiences studied is almost always positive. Although a few studies have investigated the content of narratives about negative user experiences [Partala and Kallinen 2012; Tuch et al. 2013], the role of need fulfillment in negative experiences has not been tested in modeling work.

In this paper we study the role of need fulfillment across different types of user experience (positive vs. negative) and activity domains (work vs. leisure). We directly test Hassenzahl et al.'s [2010] model of need fulfillment for each type of experience and activity domain. Thereby we attempt to replicate and extend previous findings on the relation between need fulfillment, affect, and product perception. In doing so, we respond to the need to replicate results of earlier studies and extend them to other contexts, which is crucial for the advancement of any research field (Hornbæk, Sander, Bargas-Avila, and Simonsen [2014] made a case for more replications in human-computer interaction; see also Wilson et al. [2012]). Further, we aim to address the lack of UX research in the work domain by contrasting user-generated descriptions of experiences with technology used in work with those in leisure.

¹ Hedonic quality refers to a product's ability to provide stimulation (e.g., novelty and challenge) and identification (users can express themselves through the product), whereas pragmatic quality refers to a product's ability to allow effective and efficient goal-achievement (e.g., utility and usability).

Table 1.

Conceptual Definitions of Sheldon's et al. (2001) 10 Psychological Needs (adopted from Sheldon et al. 2001)

Need	Definition
Autonomy	Feeling like you are the cause of your own actions rather than feeling that external forces or pressures are the cause of your actions.
Competence	Feeling that you are very capable and effective in your actions rather than feeling incompetent or ineffective.
Relatedness	Feeling that you have regular intimate contact with people who care about you rather than feeling lonely and uncared for.
Self-actualization	Feeling that you are developing your best potentials and making life meaningful rather than feeling stagnant and that life does not have much meaning.
Security	Feeling safe and in control of your life rather than feeling uncertain and threatened by your circumstances.
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.

2 THEORETICAL BACKGROUND

2.1 Need fulfillment in UX

The fulfillment of psychological needs, such as relatedness (i.e., feeling connected with other people) and competence (i.e., feeling capable and effective in one's actions), has recently been discussed as a factor influencing users' experience with technology [Burmeister et al. 2010; Hassenzahl et al. 2010; Wiklund-Engblom et al. 2009]. According to Sheldon et al. [2001] psychological needs are fundamental qualities of experience that all humans seek to thrive. Based on a literature review on the need concept, Sheldon et al. [2001] compiled a list of the top 10 psychological needs (see Table 1) and developed a questionnaire measuring to what extent each of these needs have been satisfied. The 10 needs and the questionnaire were validated by means of a series of three studies in which participants had to describe a recent satisfying event in their life and indicate the experienced level of need fulfillment during that event. In addition to satisfying events, Sheldon et al. examined the role of needs in unsatisfying events. They argued that psychological needs should not only be considered from an enhancement perspective (i.e., qualities that, if present, contribute to well-being), but also from a deficit perspective (i.e., qualities that, if lacking, contribute to ill-being). It seems plausible that the absence of a positive quality does not equal the presence of a negative quality. Although their results revealed that the same needs (i.e., autonomy, competence, relatedness, and self-esteem) are of primary importance in both satisfying and unsatisfying events, there are also important differences between the two types of event. For instance, the absence of security is perceived as one of the most important reasons for unsatisfying events and is highly correlated with the experience of negative affect, whereas the presence of security is much less important in satisfying events and is only moderately correlated to the experience of positive affect.

Drawing upon Sheldon's work, Hassenzahl et al. [2010] were the first to investigate the role of need fulfillment in UX on a large scale. In an online study, Hassenzahl et al. asked over 500 participants to describe a recent, outstanding, positive experience with an interactive product and to evaluate it in terms of need fulfillment and affect, and rate how they perceived the product's pragmatic and hedonic quality during the experience. On this basis, they modeled how need

fulfillment and experienced positive affect influence the users' perception of a product's hedonic and pragmatic quality. As illustrated in Figure 1 the model makes three central claims ²:

- (1) the relation between need fulfillment and hedonic quality is partially mediated by positive affect. This means that there is a direct connection between need fulfillment and hedonic quality, but at the same time need fulfillment also leads to positive affect, which in turn positively affects hedonic quality.
- (2) For pragmatic quality the model suggests a different pattern: Need fulfillment does not directly affect perception of pragmatic quality. Instead, the effect is fully mediated by positive affect. Moreover, attribution has no impact on the relation between positive affect and pragmatic quality.
- (3) The model further suggests that the effect of need fulfillment on hedonic quality is moderated by attribution. Attribution refers to the extent to which a user believes that the product was responsible for the experience. In other words, the more users' think that a product was responsible for the experiences the stronger is the impact of need fulfillment on users' perception of hedonic quality, directly as well as mediated by positive affect.

² These claims are derived from the statistical models presented in Hassenzahl et al. [2010]. In the present paper we make the assumption that all claims are central and have to be given equal weight when evaluating Hassenzahl's et al. model.

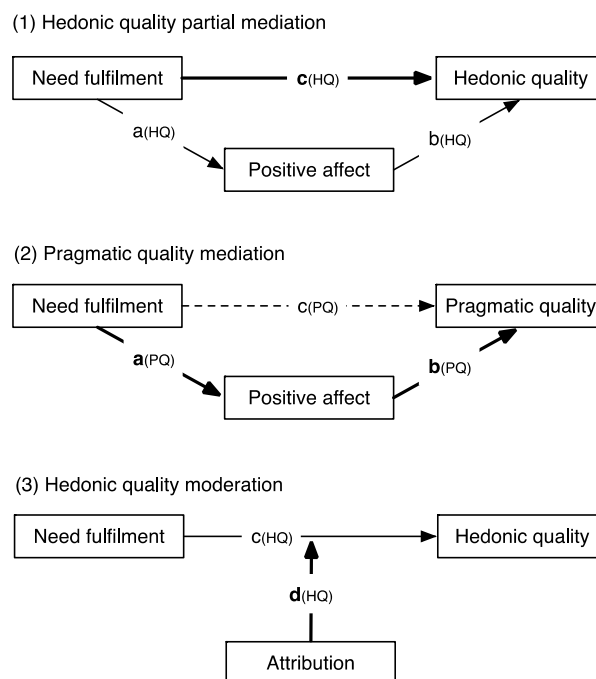


Figure 1. Three claims made by Hassenzahl et al. [2010]: (1) direct relation between need fulfillment and hedonic quality ($c(HQ)$) and indirect relation through positive affect ($a(HQ) \times b(HQ)$), (2) indirect relation between need fulfillment and pragmatic quality through positive affect ($a(PQ) \times b(PQ)$), and (3) relation between need fulfillment and hedonic quality depending on attribution ($d(HQ)$).

In conclusion, users are more likely to attribute a product’s ability to fulfill needs directly to its hedonic quality (e.g., I had a stimulating experience because the product is novel and creative), whereas pragmatic quality develops from the fulfillment of needs that leads to positive affect (e.g., I had an experience of competence that makes me feel good, hence the product must be easy to operate).

From these results Hassenzahl and colleagues concluded that hedonic quality is “capturing the product’s perceived ability to create positive experiences through need fulfillment” whereas pragmatic quality is “enabling the fulfillment of needs through removing barriers but not being a source of positive experience in itself” (p. 359). One explanation in the literature of these differences was offered by Herzberg and colleagues (1959) and recently discussed in the context of user experience by Tuch and Hornbaek [2015]. They explained Herzberg’s key idea as identifying “two types of factors contributing to either job satisfaction or dissatisfaction. The factors were called hygienes (e.g., salary, work conditions) and motivators (e.g., recognition, challenging work). According to Herzberg, a low level of hygienes will generate dissatisfaction with the job, but a high level alone is not sufficient for job satisfaction. In contrast, a high level of motivators leads to job satisfaction, but the absence of a high level of motivators will not result in dissatisfaction. Herzberg thereby showed that whereas motivators can positively add to satisfaction, hygienes cannot.” In one interpretation of Herzberg’s work, satisfiers may be mapped onto hedonic quality and dissatisfiers onto pragmatic quality [Hassenzahl et al. 2010]. This mapping could explain the findings by Hassenzahl and colleagues.

In similar studies, Partala and Kallinen [2012] and Tuch et al. [2013] investigated the role of need fulfillment in user experiences. Partala and Kallinen [2012] compared users’ level of need fulfillment in positive and negative

experiences and found that only the level of experienced self-esteem differed between positive and negative experiences. Tuch et al. [2013] also compared user-generated descriptions of positive and negative experiences. They analyzed the descriptions not only in terms of psychometrically measured experience, but also in terms of narrative structure, psychological processes, and personal concerns based on a linguistic analysis of the descriptions, and in terms of emotional content and sentiment based on a machine-learning analysis. Unlike Partala and Kallinen [2012], Tuch et al. found large differences between positive and negative experiences in the levels of need fulfillment for all needs (i.e., higher levels of need fulfillment in positive experiences). A possible explanation for this discrepancy is the methodological particularities of the two studies. Although the studies used the same questionnaires, there are notable differences in participants and study procedure. Partala and Kallinen used a comparatively small and homogenous sample of students that took part in the study in the context of a master-level course about user experience evaluation and design, whereas Tuch et al. recruited a comparatively large and heterogeneous sample of participants through Amazon Mechanical Turk. Moreover, Partala and Kallinen contrasted positive with negative experiences within participants and Tuch et al. contrasted them between participants. Finally, in Partala and Kallinen there was a time interval of 10-30 days between the time participants described their experience and the time they indicated their levels of need fulfillment in regard to the described experience. In contrast, Tuch et al. had participants complete all questions in one go.

Tuch et al. further showed that the importance of need fulfillment within UX is not only reflected in the users' ratings, but also in their descriptions of experience. The themes in the descriptions were frequently related to psychological needs such as relatedness, autonomy, and competence. Although the studies by Partala and Kallinen [2012] and Tuch et al. [2013] were similar to the one by Hassenzahl et al. [2010], they did not directly test Hassenzahl et al.'s model of the interplay between need fulfillment, affect, and product perception by replicating the modeling of mediation and moderation described above.

2.2 Positive and negative experiences with technology

Since the shift in focus from usability to UX, research has increasingly focused on studying positive rather than negative user experiences [Bargas-Avila and Hornbæk 2011; Hassenzahl and Tractinsky 2006]. One might argue that the emphasis on positive experiences is appropriate as understanding their determinants and underlying mechanism helps design products that elicit positive user experiences. Nevertheless, studying negative user experiences is equally valuable, as understanding their determinants and mechanisms informs designers about potential pitfalls in the user experience of their products. In their seminal review-paper "Bad is stronger than good", Baumeister et al. [2001] presented evidence that across a broad range of psychological phenomena negative experiences have a stronger impact on people than positive ones. In their estimate, five positive experiences are needed to make up for one negative [Baumeister et al. 2001; Gottman and Silver 1995]. Hence, avoiding negative user experiences should be of high priority for every product designer. Fokkinga and Desmet [2012] presented another motivation for the significance of negative experiences. In their model, negative experiences with technology are important because they produce negative emotions in users and, as a consequence, transform users' perception of and attitude towards the situation. In their view and based on Apter [1989], the resulting experiences can even be made 'pleasant' through the provision of a 'protective frame'.

Some UX research investigates negative experiences by comparing them with positive ones. For instance, Partala and Kallinen [2012] compared the experiences of 45 participants who reported a recent satisfying and unsatisfying experience where technology played a substantial part. Similar to the work of Hassenzahl et al. [2010], participants subsequently evaluated each experience on need fulfillment and affect. Results suggest that negative and positive experiences differed strongly on affect, but to a much lesser extent on need fulfillment. Participants experienced moderate to high levels of positive affect and low levels of negative affect in satisfying experiences, whereas in unsatisfying experiences they reported moderate levels of both negative and positive affect. In other words, the two types of experience differ much more for negative than positive affect. Moreover, the study showed that ‘interested’ and ‘enthusiastic’ were the most salient positive affect items for satisfying experiences, whereas ‘irritable’ was the most salient negative affect item for unsatisfying experiences. In conclusion, Partala and Kallinen characterized satisfying experiences as being related to personally meaningful aspects of the interaction with the interactive product (using the product is stimulating and users can identify themselves with it). Unsatisfying experiences in contrast are often related to pragmatic problems and are accompanied by more direct affective responses.

In a related study, Tuch et al. [2013] analyzed 691 user-generated narratives on positive and negative experiences with technology and ratings on affect, need fulfillment, and product perception collected along with the narratives. In line with previous research they showed that affect discriminates positive and negative experiences. Positive experiences are primarily associated with enthusiasm and excitement, whereas being upset and feeling irritation are most salient for negative experiences. In addition, Tuch et al. systematically analyzed the content of the narratives and found that positive narratives are mostly about social aspects such as family and friends and that technology is positively experienced when it enables users to do things more efficiently or in new ways. In contrast, negative narratives often contain expressions of anger and frustration due to technological failures.

Other studies have also contrasted positive experiences with negative ones, but not in conjunction with affect and need fulfillment. For instance, Provost and Robert [2013] aimed at identifying UX dimensions (e.g., functionality, usability, psychological, social) by analyzing positive and negative user experience descriptions provided by participants. Korhonen et al. [2010] investigated contextual factors in written user descriptions about positive and negative experience with personal mobile products provided over a ten-day period. And Sauer and Sonderegger [2010] investigated the effects of experimentally induced negative usage events (unsolvable task) on users’ subsequent task performance with and perception of a mobile phone. These studies do not investigate any of the central components of Hassenzahl’s et al. [2010] model (i.e., hedonic and pragmatic quality, affect, and need fulfillment), and are of minor relevance for the present study. Still they serve as general examples of studies that investigate UX by also taking negative experiences into account.

Despite the above-mentioned research, we still know relatively little about what distinguishes positive from negative experiences and whether the UX model of Hassenzahl et al. [2010] holds for both positive and negative experiences.

2.3 Domain of activity: experience of leisure and work

Previous research has compared people’s experience of leisure and work, but not addressed the role of technology. For the purpose of this research a distinction

is made between work and leisure as follows. Work includes both paid and unpaid work [Haworth and Lewis 2005]. Leisure can be defined 'residually' as "time ... not occupied by paid work, unpaid work or personal chores and obligations ([Haworth and Lewis 2005], p. 69).

Tinsley and Tinsley's [1986] model of leisure includes four prerequisites (also called 'causal conditions')³ and seven attributes⁴ of leisure experience. Tinsley et al. [1993] used a repeated measures design to elicit people's descriptions of three types of experience: most memorable leisure experience ever, most meaningful type of leisure experience commonly occurring during typical daily life, and most meaningful type of work experience commonly occurring during typical daily life. They compared these three types of described experience in terms of attributes and benefits, using content analysis. They found that the frequency of constructs used to describe experience significantly differed between experience types. On the one hand, enjoyment, companionship, novelty, relaxation, aesthetic rewards, and intimacy were characteristic of leisure. On the other hand, extrinsic rewards, accomplishment, learning, and altruism were characteristics of work. However, no analysis was reported to identify those characteristics that are uniquely predictive of type of activity (e.g., leisure or work).

Within UX there is little research that directly compares work with leisure experiences. Mostly the two activity domains are studied separately and to the authors' knowledge there is no study investigating Hassenzahl et al.'s [2010] model or its separate components (e.g., hedonic and pragmatic quality) simultaneously for both domains.

Although not systematically comparing work and leisure experiences, some UX studies explicitly discuss differences between the work and leisure domain. For instance, Sonderegger and Sauer [2010] suggested activity domain (work vs. leisure) as a possible moderator for the effect of design aesthetics on task performance: when using a visually appealing interface, task completion time increased in the leisure domain ("prolongation of joyful experience"-effect; [Ben-Bassat et al. 2006; Sauer and Sonderegger 2009]), but decreased in the work domain ("increased motivation"-effect; [Sonderegger and Sauer 2010]).

Another study examining UX in work is Schrepp et al. [2006]. They investigated whether the effect of hedonic aspects of user interfaces on perceived usability and attractiveness also apply to business management software. Thereby they showed that these effects, which were originally investigated in the leisure domain, also hold in a work domain.

Finally, in a review of empirical UX studies, Bargas-Avila and Hornbæk [2011] made two points about the distinction between work and leisure: (1) in UX research there has been a strong emphasis on art and consumer products and (2) research studies are much more frequently conducted in the leisure domain than in the work domain (64% pure leisure, 18% mixed, and 18% pure work). Based on this observation they suggested: "The UX movement criticized traditional HCI for focusing only on work related products. Correspondingly we think that a narrow

³ voluntariness, perception of intrinsically motivating benefits, experience of facilitative level of arousal, and psychological commitment to the activity.

⁴ according to [Tinsley et al. 1993], three cognitive attributes – total [absorption or] concentration in the activity, lack of focus on self, decreased awareness of the passage of time – and four affective attributes – feelings of freedom, enriched perception of objects and events, increased sensitivity to bodily sensations, increased sensitivity to and intensity of emotions.

focus on consumer products and art only is comparably harmful to UX research, because the contribution to the understanding of a broad range of products is largely ignored” (p. 2695). In response, we argue for further UX research that strengthens our understanding of the commonalities and differences of the work and leisure domain in regard to user experience.

3 RATIONALE AND CURRENT STUDIES

We identify the following gaps in existing research and, in response, propose four research questions that we address in two studies. Research Question 1 and 2 are addressed in Study 1 and Research Question 3 and 4 in Study 2.

First, existing research has studied the relation between need fulfillment and pragmatic and hedonic quality in positive, but not in negative experiences [Hassenzahl et al. 2010].

Research Question 1: does Hassenzahl et al.’s [2010] model of the relation between need fulfillment and pragmatic and hedonic quality hold not only for positive, but also for negative experiences?

Second, UX research focuses on positive user experience. Only few studies have investigated negative experiences by comparing them to positive experiences [Partala and Kallinen 2012; Tuch et al. 2013]. This might bias our view of UX.

Research Question 2: on which aspects of experience do positive and negative experiences with the use of technology differ?

Third, the relation between need fulfillment and pragmatic and hedonic quality has been studied in mostly leisure-oriented domains, but not analyzed in other activity domains such as work. To address this issue we raise the following research question:

Research Question 3: does Hassenzahl et al.’s [2010] model of the relation between need fulfillment and pragmatic and hedonic quality hold not only for experiences from leisure domain, but also from the work domain?

Fourth, existing research on UX and UX narratives has predominantly studied leisure [Bargas-Avila and Hornbæk 2011], although the importance of the distinction between UX in leisure and UX in work has been stressed [Lindgaard 2012]. Therefore, previously studied experiences may not be representative and, most important, it remains unclear how UX in leisure and work differ.

Research Question 4: On which aspects of experience do work and leisure activities involving technology differ?

4 STUDY 1: POSITIVE AND NEGATIVE EXPERIENCES⁵

The goal of Study 1 is to contrast positive with negative user experiences and investigate on which aspects they differ. Moreover, it seeks to reproduce the relation between need fulfillment and pragmatic and hedonic quality posited by Hassenzahl et al. [2010], not only with positive but also with negative experiences.

4.1 Method

⁵ This study was originally reported in Tuch et al. [2013], but here we report results based on a reanalysis of the data in regard to the research questions posed here. For our analyses we used a subset ($N = 344$) of the data ($N = 691$) including only the plainly formulated versions of questions of the Sheldon et al. [2001] need fulfillment inventory (for further details, see Tuch et al. [2013], p. 2081).

Qualitative and quantitative data on positive and negative experiences with technology were collected through a web-based questionnaire by asking participants to recall and describe a recent positive or negative experience they had with technology. Investigating users' experiences on the basis of remembered experiences is not without problems and we will discuss potential memory bias as a limitation towards the end of the paper.

4.1.1 Design

Study 1 used a between-subjects design with valence of the reported experience (positive or negative) as the independent variable. Need fulfillment, affect, technology perception, and attribution were the dependent variables.

4.1.2 Participants

Participants were recruited at Amazon Mechanical Turk (MTurk) through the intermediary company Crowdfunder. MTurk allows a highly efficient recruitment of participants for online studies since it contains a large participant pool in combination with an integrated participant compensation system. Moreover, Buhrmester et al. [2011] showed that participants are more diverse than typical student samples and that the data obtained are as reliable as those obtained via traditional methods used in psychology and the social sciences.

Participants were only allowed to take part in the study once. Tracking their MTurk IDs ensured this. Overall a sample of 344 participants ($n_{\text{positive}} = 199$ and $n_{\text{negative}} = 145$) successfully completed the online study⁶. On average they were 32.7 years old and 200 were female (58%), whereas 144 were male (42%). The majority of participants lived in the US (79.1%), though participants from 33 other countries were included (Canada, 3.5%, as the second-most frequent country). The compensation for taking part in the study was 1.50 US dollars. Based on the average completion time, this corresponds to an hourly salary of 5.10 dollars, close to the salary recommended on the Crowdfunder website. According to Buhrmester et al. [2011] payment level does not affect data quality, only data collection speed.

4.1.3 Materials

All questions used in the survey are displayed in Table 2. To allow us to compare our results with those of Hassenzahl et al. [2010], we followed closely their study procedure and also used the same measures as they did. The questionnaire consisted of one open-ended question that attempted to get a narrative description of a positive or negative experience with technology ("Bring to mind a single outstanding positive experience you have had recently"), followed by questions on the *context of the experience* (derived from the Geneva Appraisal Questionnaire; GAQ; [Scherer 2001]), *need fulfillment* (adapted from Hassenzahl et al. [2010]), experienced *affect* (Positive Affect Negative Affect Schedule; PANAS; [Watson et al. 1988]), and *technology perception* (abridged version of AttrakDiff2 questionnaire; [Hassenzahl et al. 2010]). Further, we asked participants about *attribution* to technology (i.e., extent to which their

⁶ Note that of the 467 participants who started with the study, 351 completed the questionnaire and answered three verification questions at the end of the questionnaire. The verification questions were added after pilot testing and required participants to describe the purpose of the study without being able to go back and look at earlier questions or guidelines. We further excluded 7 participants because they reported vague experiences or attempted to repeat earlier responses, reducing the total number of acceptable data to a final sample of 344 participants ($n_{\text{positive}} = 199$ and $n_{\text{negative}} = 145$).

experiences are attributed to technology). Psychometric analyses of need fulfillment, technology perception, and affect are presented in Online Appendix 1.

4.1.4 Procedure

After accepting the job on Crowdfunder, participants were directed to the online questionnaire, where they were randomly allocated to one of the two experimental conditions (reporting a positive or a negative experience with technology). Having described a particular experience with technology in the form of a short narrative, they were presented with the remaining questions that they had to answer in relation to their reported experience. Participants could not go back to earlier questions. All questions except the one on age were mandatory because we wanted a full data set.

4.1.5 Data preparation

Before conducting the actual analyses we checked the factor structure of each questionnaire by means of exploratory factor analysis (for details on the analyses, see the online appendix). All questionnaires showed the expected factor structure with the exception of Sheldon et al. [2001]’s psychological-needs inventory. In both Study 1 and Study 2 the factor structure for *autonomy* was poorly defined. Instead of loading on a single factor the three autonomy items were loading on factors of other needs, as in Hassenzahl et al.’s work [2010]. Therefore, as in Hassenzahl et al. [2010], the subscale autonomy was removed for our subsequent analyses (seen Online Appendix 1 and Online Appendix 4). It seems that applying the autonomy subscale in the context of user experiences is not straightforward. Maybe this is because the psychological-needs inventory was developed in another context than user experience. Sheldon and colleagues asked their participants to base their ratings on “the single most personally satisfying event that they experienced” during the past week, the last month, or the past semester. Apparently, not all the subscales developed in that context also apply to a user experience context. Nevertheless, the psychological-needs inventory has been used in several UX studies (e.g., [Hassenzahl et al. 2010; Partala 2011; Tuch et al. 2013; Partala and Kallinen 2012]).

4.2 Results and discussion

First, we test Hassenzahl et al.’s [2010] model of need fulfillment for positive and negative experiences. We then examine how positive and negative experiences differ in terms of rated experience (need fulfillment, affect, and technology perception) and narrated experience (content). Finally, we analyze how positive and negative experiences with technology differ in terms of their context, technology used, and activity with technology.

4.2.1 UX model for positive and negative experiences (Research Question 1)

Table 2
 Questions used in the online survey.

Experience

1 open question: “Bring to mind a single outstanding positive experience you have had recently”

Context: derived from the Geneva Appraisal Questionnaire; GAQ; [Scherer 2001]

3 questions with ordinal and nominal options: “How long ago did the experience occur?” (“some hours ago” – “some years ago”); “Where were you when you had the experience?” (e.g., “in my home”, “a natural setting”, “in the street or another public place”); “Who was present when you had this experience” (e.g., “Nobody. I was alone”, “A partner or friend”, “Several friends or acquaintances”)

Need-fulfillment: adopted from Hassenzahl et al. [2010] and Sheldon et al. [2001]

21 questions answered as “not at all” (1) to “extremely” (5) capturing 7 psychological needs with 3 items each: autonomy, competence, relatedness, self-actualization/meaning, pleasure stimulation, security, and popularity/influence. Examples: “During this experience I felt I was successfully completing difficult tasks and projects”; “During this experience I felt that I was ‘becoming who I really am’”; “During this experience I felt free to do things my own way”.

Affect: Positive Affect Negative Affect Schedule; PANAS; [Watson et al. 1988]

20 questions answered as “not at all” (1) to “extremely” (5) capturing positive and negative affect each with 10 items. Examples: During this experience, to what extent did you feel excited”; “During this experience, to what extent did you feel afraid”

In this section we address Research Question 1: does Hassenzahl et al.’s [2010] model of the relation between need fulfillment and pragmatic and hedonic quality not only hold for positive, but also for negative experiences? As discussed in Section 2.1, Hassenzahl et al.’s [2010] UX model implies that (1) the effect of need fulfillment on hedonic quality is mainly direct (only partially mediated) by positive affect; (2) the effect of need fulfillment on pragmatic quality is mediated by positive affect (i.e., need fulfillment influences affect and this, in turn, influences pragmatic quality); and (3) the effect of need fulfillment on hedonic quality is moderated by attribution (i.e., the extent to which users attribute their experience to the product they use is influential on the strength of the effect of need fulfillment on hedonic quality)⁷. To investigate the overall effect of need fulfillment on technology perception we computed the average score of all needs. As in Hassenzahl et al. [2010], we conducted moderated mediation analysis⁸ to test claims (1), (2), and (3)⁹. Significance tests were performed on the data from positive experiences and negative experiences separately. Because we studied both types of experience we analyzed both positive and negative affect in the model as mediators.

⁷ [Hassenzahl et al. 2010] analysed positive experience, but – in contrast to the research reported here – did not distinguish between positive and negative experiences (our Study 1) or between leisure experiences and work experiences (our Study 2).

⁸ Moderated and simple mediation analysis were conducted with the SPSS PROCESS [Hayes 2013].

⁹ The distribution of attribution was heavily skewed (both in Study 1 and in Study 2) and was therefore coded as a binary variable by way of a median split (‘the technology was the cause of the specific experience to some extent’ or less vs. ‘the technology was the cause of the specific experience to a very large extent’).

Our analyses showed that the effect of need fulfillment on neither hedonic quality nor pragmatic quality was mediated (or partially mediated) by positive affect. The effect of need fulfillment on hedonic quality was not moderated by attribution. Furthermore, the (direct) effect of positive affect on hedonic quality and pragmatic quality was also not moderated. Moreover, the simple (unmoderated) effect of need fulfillment on hedonic quality was not mediated either.¹⁰ Therefore, the results of multiple-regression analysis, testing a model with only direct effects, are reported here (Table 3). All tolerance values were $\geq .41$, indicating no evidence of multicollinearity.

Positive experiences. For hedonic quality, the model with need fulfillment, positive affect, and attribution as predictors, was statistically significant, with 11% of variance ($R^2 = .11$) explained. The predictor need fulfillment was significant. For pragmatic quality, the model was not statistically significant, with 1% of variance ($R^2 = .02$) explained. Subsequent analysis used partial correlations to explore if fulfillment of individual needs explained unique variance in technology perception (see Table 3). For hedonic quality, significant needs were competence and pleasure/stimulation. Correlations (see Table 3) provide additional information, but great care must be taken in the interpretation of (a) their size, as these include overlap in variance between several variables with hedonic- or pragmatic quality, and at least as much in (b) their statistical significance, because the number of correlations examined increases the chance of a significant correlation, and thereby the Type I error. From the correlations, it seems that the main contributors explaining variability in hedonic quality were need fulfillment and positive affect, but the latter not significantly independently. Besides competence and pleasure, which uniquely contributed to the predictive value of need fulfillment, self-actualization, security and popularity also contributed through small correlations, but not significantly independently. The non-significant model (with small R^2) for pragmatic quality is reflected in (very) small correlations.

Negative experiences. For hedonic quality, the model was statistically significant, with 12% of variance in this quality explained. The predictor need fulfillment was approaching significance. For pragmatic quality, the model was statistically significant, with 9% of variance in this quality explained (see Table 2). The negative predictor attribution was statistically significant, with more attribution resulting in less perceived pragmatic quality, so the greater the degree to which a negative experience was attributed to the product, the less pragmatic (usable) the product was perceived to be; the predictor negative affect was also significant, with greater negative affect resulting in lower perceived pragmatic quality. Analysis of partial correlations (see Table 3) showed that for pragmatic quality competence was a significant need. Again, correlations (see Table 3) provide additional information, but great care must be taken this time as well. Just as in the case of positive experiences, in negative experiences the main contributors explaining variability in hedonic quality were need fulfillment and positive affect, but the latter not significantly independently. Although fulfillment of none of the needs uniquely contributed to variance in hedonic quality, competence made the most substantial contribution in terms of total variability explained by each need, followed by the remaining needs. Besides competence, which uniquely contributed to the predictive value of need fulfillment for

¹⁰ After we established through moderated mediation analysis that moderation was not significant, we conducted ('unmoderated') mediation analysis to test whether ('unmoderated') mediation was significant.

pragmatic quality, security and popularity also contributed through small correlations, but not significantly independently.

Overall, our results provide some support for the idea that technology perceptions are derived from need fulfillment, in particular for hedonic quality, which is in line with Hassenzahl et al. [2010]. Pragmatic quality, however, was not related to need fulfillment in positive experiences and only to a very limited extent in negative experiences. Again, this is mostly in line with Hassenzahl et al. and supports the notion that pragmatic quality is not directly related to need fulfillment. Influential needs were mainly competence (for hedonic quality in positive experiences, and pragmatic quality in negative experiences), but also pleasure (for hedonic quality in positive experiences). Moreover, the unique effect of positive affect was not significant, with need fulfillment and attribution held constant. However, negative affect was a significant predictor of pragmatic quality in negative experiences. Moreover, attribution was also a significant predictor of pragmatic quality, indicating that when users attribute a negative experience to the technology that they use they judge the product more negatively. It is also notable that attribution, whether statistically significant or not, correlated positively with hedonic- and pragmatic quality in positive experiences, but negatively in negative experiences, so when users attributed their experience to the product, their technology perception was increased in the direction of the valence of the experience (more positive with positive experiences and more negative with negative experiences). The finding that the size of the correlations and regression coefficients of attribution for hedonic quality and pragmatic was greater for negative experiences than for positive experiences may be related to the more general distinction in psychology between internal attribution and external attribution [Kelley 1973]. In the first type, people typically attribute their success in a particular activity to themselves (their talent and effort expended), but in the second type they attribute failure in their activities to others or the environment (e.g., the technology they used).

The results differ from those of Hassenzahl et al. [2010] as follows. First, the effect of need fulfillment was not mediated by positive affect. Second, positive affect was not a significant independent predictor of either hedonic or pragmatic quality and the strength of the effect of need fulfillment did not change as a function of attribution (in particular, the effect was not greater when participants attributed their experience to the technology use than when they did not).

4.2.2 *Difference between positive and negative experiences (Research Question 2)*

In this section we address Research Question 2: on which aspects of experience do positive and negative experiences with the use of technology differ? We conducted a series of logistic-regression analyses on (1) the collected ratings (i.e., affect, need fulfillment, technology perception) as well as on (2) content-features of the narratives¹¹.

Ratings on affect, need fulfillment, and technology perception. Stepwise logistic-regression analysis was conducted to identify unique predictors of valence of experience¹² (see Table 4). For *need fulfillment*, four significant predictors explained 41% of the variance (competence, relatedness, pleasure/stimulation,

¹¹ A systematic comparison between positive and negative experiences in regard to ratings is presented in Online Appendix 2.

¹² where positive experience was the response category and negative experience was the reference category.

Table 3
Technology perception in relation to need fulfillment (Study 1)

a. Multiple regression

	Positive experiences				Negative experiences			
	Hedonic quality		Pragmatic quality		Hedonic quality		Pragmatic quality	
R ²	***.11		.02		***.12		*.09	
Need fulfillment ^a	*.22	***.30	.11	.10	#.18	***.30	#.19	*.19
Positive affect ^a	.13	***.27	-.02	.07	.16	***.29	-.07	.10
Negative affect ^a	.03	-.02	-.07	-.08	-.01	-.05	*-.17	*-.18
Attribution ^a	.08	.09	.06	.07	-.11	#.15	*-.17	*-.19

b. Partial correlation^b

	Positive experiences				Negative experiences			
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and popularity, chi square (4) = 181.21, $p < .001$). For *affect*, positive affect and negative affect explained 44% of the variance (chi square (2) = 200.39, $p < .001$). For *technology perception and evaluation*, beauty and pragmatic quality explained 44% of variance (chi square (2) = 181.42, $p < .001$).

The results may be summarized as follows. Need fulfillment, affect and technology perception each contribute about equally in terms of distinguishing positive experiences from negative experiences. In particular, a person's experience is more likely to be positive if the needs of competence, relatedness and pleasure/stimulation (but not popularity) are met, and if users evaluate the product highly in terms of beauty and pragmatic quality.

Content of narrated experiences¹³. In a first step we used the LIWC2007 tool [Tausczik and Pennebaker 2010] – a fully automated content-analysis-tool that counts the occurrence of words of specific categories such as Money, Religion, Family – to quantify the extent to which the narratives contain information about the following categories: social processes, affective processes, and personal concerns. Subsequently, we conducted a stepwise logistic-regression analysis for each category to identify unique predictors of valence of experience for each of these categories (see Table 4). Within *social processes*, the predictors family and friend together explained 9% of variance (chi square (2) = 33.06, $p < .001$). Within *affective processes*, the set of positive emotion, negative emotion, and anger explained 31% of variance, chi square (4) = 128.28, $p < .001$. Within *personal concerns*, three significant predictors (home, money, and work) explained 8% of variance (chi square (3) = 29.17, $p < .001$).

In sum, an experience is more likely to be positive (or less likely to be negative), if it is described by an increased use of words related to family and a decreased use of words related to negative emotion, and anger; furthermore, positive experiences are more likely with an increased use of terms such as

¹³ A systematic comparison between positive and negative experiences in regard to LIWC categories is presented in Online Appendix is presented in Online Appendix 2 presented in Online Appendix 3.

friend, positive emotion, home, and money, and a decreased use of words related to work.

4.2.3 *Contextual Factors*

We also examined differences between positive and negative experiences in regard to contextual factors such as time of occurrence, location, and social setting during the experience (Table 5). No statistically significant differences in distance in time from present (chi square (4) = 0.68), location (chi square (5) = 3.92), and presence of others (chi square (5) = 8.80), all $p > .05$, all Cramer's $V \leq .16$, were found. Most experiences occurred between some days ago and some months ago, in the home or in the street/another public place, and while the person was alone or with partner/friend.

4.2.4 *Type of Technology and Activity*

Table 4
Logistic regression analysis (Study 1)

Type of datum	Domain	Predictor	Odds ratio ^a	Wald	<i>p</i>
Ratings	Need fulfillment				
		$R_{CS}^2 = .41$			
		Competence	2.98	44.07	< .001
		Relatedness	2.12	28.61	< .001
		Pleasure/stimulation	1.74	16.24	< .001
		Popularity	0.57	9.76	.002
		Affect			
		$R_{CS}^2 = .44$			
		Positive affect	4.76	47.88	< .001
		Negative affect	0.32	51.74	< .001
		Technology perception			
		$R_{CS}^2 = .41$			
		Beauty	2.44	41.64	< .001
		Pragmatic quality	1.84	14.67	< .001
	Narration	Social processes			
		$R_{CS}^2 = .09$			
		Family	1.69	19.46	< .001
		Friend	1.29	5.42	0.02
		Affective processes			
		$R_{CS}^2 = .31$			
		Positive emotion	1.44	28.25	< .001
		Negative emotion	0.64	23.51	< .001
		Anger	0.31	9.75	< .001
		Personal concerns			
	$R_{CS}^2 = .08$				
	Home	1.49	10.84	< .001	
	Money	1.25	6.91	.009	
	Work	0.91	8.08	.004	

^aResponse category: positive experience. Reference category: negative experience.

Experience narratives were coded for technology used and activity with technology. Besides the description of their experience, participants had to indicate which specific technology they had used. Based on this information and

the description of the experience, one of the authors coded all experiences for technology used and for activity with technology. Eleven categories for technology (i.e., smartphone, VoIP, laptop, GPS, desktop computer, camera, mobile media player, tablet, video game console, e-reader, other) and 10 categories for activity with technology (i.e., communication, navigation, productivity, photography, video, audio/music, social media, gaming, reading, other) were identified. Positive and negative experiences differed by *technology*: in positive experiences smartphones and VoIP were most frequently used, but in negative experiences, smartphones and laptops were most frequently used (see Table A6), chi square (10) = 42.72, $p < .001$, Cramer's $V = .35$. Moreover, experiences differed by *activity* with technology: in positive experiences communication and navigation were most frequent, but in negative experiences navigation and various other activities were most frequent (see Table A6), chi square (9) = 60.48, $p < .001$, Cramer's $V = .42$.

4.2.5 Summary of results

No evidence was found for (moderated or unmoderated) mediation in Hassenzahl's model of need fulfillment. Rather, need fulfillment had a direct positive influence on hedonic quality in positive experiences, so as needs were fulfilled to a larger extent people perceived the technology they used as more hedonic. However, attribution had a direct negative effect on pragmatic quality in negative experiences, so the greater the degree to which a negative experience was attributed to the product, the less pragmatic (usable) the product was perceived to be. In conclusion to Research Question 1 it can be said that Claim 1 of Hassenzahl's model (a direct relation between HQ and need fulfillment) was supported in positive as well as in negative experiences. Claim 2 (the relation between PQ and need fulfillment is mediated through affect) and Claim 3 (the relation between HQ and need fulfillment is moderated by attribution), however, were supported for neither positive nor negative experiences.

Table 5
Context of reported experiences (Study 1)

	Negative (n = 145)	Positive (n = 199)
Time of occurrence		
Some days ago	28%	29%
Some weeks ago	28%	29%
Some months ago	24%	26%
Some hours ago	10%	9%
Some years ago	10%	8%
Location of experience		
In my own home	52%	46%
In the street or another public space	26%	23%
At work	10%	10%
In a public building or in a strangers home	6%	11%
In a natural setting	4%	6%

In comparison with ratings, factors extracted from narration seem less powerful in distinguishing positive experiences from negative experiences. In terms of distinguishing positive experiences from negative experiences, affective processes are about three times more influential than social processes or personal concerns. Positive and negative experience did not differ by context. However, the results show that positive and negative experiences differ in terms of both the technology used (with VoIP more common in positive experiences, but laptops more common in negative experiences) and the activity with technology (with communication more common in positive experiences, but various not-further-categorized activities more common in negative experiences). In regard to Research Question 2 it can be concluded that positive and negative experiences clearly differ in their experiential aspects. Need fulfillment, affect and technology perception are about equally good in terms of distinguishing positive experiences from negative experiences.

5 STUDY 2: LEISURE AND WORK EXPERIENCES

The goal of Study 2 is to contrast leisure with work user experiences and investigate how they differ. Moreover, it seeks to reproduce the relation between need fulfillment and pragmatic and hedonic quality claimed by Hassenzahl et al. [2010], not only for experience from the leisure and but also for experience from the work domain.

5.1 Method

Similar to Study 1, qualitative and quantitative data on experiences with technology were collected through a web-based questionnaire, but this time from different activity domains (i.e., work and leisure).

5.1.1 Design

Study 2 used a between-subjects design with activity domain of the reported experience (leisure or work) as the independent variable. The levels were (a)

memorable positive leisure experience with the use of technology, and (b) memorable positive work experience with the use of technology. Dependent variables were the same as in Study 1 (need fulfillment, affect, technology perception and attribution; see Table 2) with the need fulfillment variable self-esteem added, as in Partala and Kallinen [2012].

5.1.2 Participants

As in Study 1, participants were recruited at MTurk through the intermediary company Crowdfunder. Only people living in the United States were allowed to take part in the study. They received 1.20 US dollars for taking part in the study. Based on the average completion time (15.7 minutes), this corresponds to an hourly salary of 4.60 dollars. We did not control whether participants already took part in Study 1. However, regarding the two-year time interval between the two studies and large participant pool of MTurk, there is only a small chance that participants took part in both studies.

In total, 255 participants successfully completed the study: 159 in the leisure condition and 96 in the work condition¹⁴. The sample consisted of 155 female (60.8%) and 97 male participants (38%); 3 did not indicate their gender (1.2%). The mean age was 35 years by ranging from 16 to 72 years.

5.1.3 Materials

The online questionnaire consisted of one open-ended item instructing the participants to describe a memorable positive work or leisure experience involving technology. The exact wording of the item (in the leisure condition) was the following: “Bring to mind one particular memorable moment of a positive LEISURE experience with the use of technology you have had in your life. Please try to describe this particular leisure experience as accurately and detailed as you remember in at least 50 words, and try to be as concrete as possible. You can use as many sentences as you like, so we can easily understand why this moment is a memorable leisure experience for you.” Several closed items that had to be answered in relation to the described experience followed. These were the same as in Study 1 (see Table 2) with the addition of self-esteem, measured with part of Sheldon et al. [2001]’s psychological-needs inventory. Psychometric analyses of need fulfillment, technology perception, and affect are presented in Online Appendix 4.

5.1.4 Procedure

After accepting the task on Crowdfunder, participants were directed to the online questionnaire and randomly assigned to either the work or leisure condition. They were then instructed on how to fill out the questionnaire. After

¹⁴ A total of 544 participants (282 leisure; 262 work) started filling out the questionnaire. The data of 220 participants had to be excluded: 9 provided incomplete data, 147 failed to answer the verification questions correctly, and 64 did not provide meaningful descriptions of their experience. The verification questions required participants to describe the purpose of the study without being able to go back and check the questions. The aim of these questions was to ensure that the questionnaire was filled out attentively. As a manipulation check, one of the authors and two research assistants (who were blind to the experimental condition (leisure or work) under which participants reported their experience) sorted the experience descriptions of the remaining 324 participants into work and leisure experiences (inter-rater agreement with Fleiss’ Kappa of .69 was satisfactory). Based on this procedure 33 experiences had to be excluded as they were not described clearly enough to be classified as either work or leisure experience and a further 36 because they were wrongly classified as work or leisure experience. A final sample of 255 participants remained: 159 in the leisure condition and 96 in the work condition.

describing their experience, participants were presented with the remaining questions that had to be answered in relation to the reported experience. All questions except the one on age were mandatory.

5.2 Results and discussion

In a first step, we test Hassenzahl et al.'s [2010] model of need fulfillment for leisure- and work experiences. We then examine how leisure- and work experiences differ in terms of rated experience and narrated experience. Finally, we analysed how positive leisure- and work experiences with technology differ in terms of their context, in terms of place, time, social context, technology used, and activity with technology.

5.2.1 Effect of need fulfillment on technology perception (Research Question 3)

In this section we address Research Question 3: does Hassenzahl et al.'s [2010] model of the relation between need fulfillment and pragmatic and hedonic quality hold not only for experiences from the leisure, but also from the work domain? We analyzed Hassenzahl et al.'s [2010] model as we did in Study 1, but now for work and leisure experiences separately rather than for positive and negative experiences. In contrast to Hassenzahl et al.'s [2010] claims (Figure 1), for both work and leisure experiences, the results showed that the indirect effect of need fulfillment (operationalized as the average of the individual needs, as in Hassenzahl et al. [2010]) on hedonic quality and pragmatic quality was not moderated. The direct effect was not moderated either. Furthermore, the (direct) effect of positive affect on hedonic quality and pragmatic quality was not moderated. Moreover, the simple (unmoderated) effect of need fulfillment on hedonic quality was not mediated either¹⁵. Therefore, the results of multiple-regression analysis, testing a model with only direct effects, are reported here (Table 6). All tolerance values were $\geq .35$, indicating no evidence of multicollinearity.

Leisure experiences. For hedonic quality, the model with need fulfillment, and attribution as predictors was statistically significant, with 20% of variance ($R^2 = .20$) in this quality explained. Significant predictors were need fulfillment and attribution. For pragmatic quality, the model was also significant, with 12% of variance ($R^2 = .12$) explained and need fulfillment and negative affect as a significant predictor. Subsequent analysis explored the extent to which the fulfillment of individual needs explained variance in technology perception, through partial correlation. For hedonic quality, pleasure/stimulation was a need approaching significance. As in Study 1, correlations (see Table 6) provide additional information, but great care must be taken this time as well. Besides need fulfillment and attribution, which uniquely contributed to the predictive value of hedonic quality, positive affect also contributed through a small to moderate correlation, but not significantly independently. Regarding variance explained by need fulfillment in hedonic quality, the fulfillment of most needs contributed with small to moderate correlations, but not significantly independently. In explaining variance in pragmatic quality, need fulfillment, negative affect, positive affect and attribution all contributed through small to moderate correlations, but the latter two not significantly independently. Regarding variance explained by need fulfillment in pragmatic quality, the

¹⁵ After we established through moderated mediation analysis that moderation was not significant, we conducted ('unmoderated') mediation analysis to test whether ('unmoderated') mediation was significant.

Table 6

Technology perception in relation to need fulfillment (Study 2)

a. Multiple regression

	Leisure experiences		Work experiences	
	Hedonic quality	Pragmatic quality	Hedonic quality	Pragmatic quality
R ²	***.20	** .12	***.20	.08
Need fulfillment ^a	** .28	*** .31	** .28	** .25
Positive affect ^a	.00	** .24	-.01	* .18
Negative affect ^a	-.06	.00	* -.19	# .14
Attribution ^a	*** .32	*** .35	.13	* .16
			# .22	*** .34
			.05	.08
			.14	*** .37
			-.04	-.07
			-.17	# .19
			.20	* .23

b. Partial correlation^b

	Leisure experiences		Work experiences	
	Hedonic quality	Pragmatic quality	Hedonic quality	Pragmatic quality

fulfillment of most needs contributed with small to moderate correlations, but not significantly independently.

Work experiences. For hedonic quality, the model was statistically significant, with 20% of variance in this quality explained. The predictors attribution and need fulfillment were approaching significance. For pragmatic quality, the model was approaching significance, with 8% of variance explained. Subsequent analysis of partial correlations showed that for pragmatic quality, security was a significant need and popularity was approaching significance. As before, correlations (see Table 6) provide additional information, but great care must be taken this time as well. Three predictors – need fulfillment, positive affect and attribution – contributed mostly to experience variance in hedonic quality, but not significantly independently. Regarding variance explained by need fulfillment in hedonic quality, the fulfillment of most needs contributed with small to moderate correlations, but not significantly independently. Although there were no significant unique predictors of pragmatic quality, both negative affect and attribution contributed to variance explained, both with small to moderate correlations, but not significantly independently. Although overall need fulfillment was not a significant unique predictor of pragmatic quality, need fulfillment of security was significant. Therefore, as users feel more secure, they perceive the product to be more pragmatic.¹⁶

Overall, our results provide support for the idea that technology perceptions in leisure experiences are derived from need fulfillment, in particular hedonic quality, but also pragmatic quality. Moreover, attribution was influential on hedonic quality in leisure experiences. Furthermore, negative affect was influential on pragmatic quality, in particular in leisure experiences. Influential needs were pleasure/stimulation for hedonic quality in leisure experiences and security for pragmatic quality in work experiences.

16 The borderline significant negative predictor popularity will not be interpreted here, as this is likely a case of suppression and given the non-significance of overall need fulfillment.

On a general level our results regarding positive experiences across our two studies support Hassenzahl et al.'s [2010] central notion that need fulfillment is primarily related to hedonic quality. This is because hedonic quality was correlated to need fulfillment in work as well as in leisure experiences and more strongly correlated than pragmatic quality. However, on a more detailed level our results differ to some extent from those of Hassenzahl et al. who did not distinguish between leisure and work experiences. They found that in experiences with technology, participants derive pleasure as a product quality (hedonic quality) from need fulfillment, but that this is partially mediated by positive affect, while for perceptions of usability (pragmatic quality) the effect is fully mediated. In contrast, our results indicate that need fulfillment directly influences hedonic quality in leisure- and work experiences, and pragmatic quality in leisure experiences. The absence of a partial mediation between need fulfillment and hedonic quality through positive affect can be considered as minor deviation of the model, but the finding that need fulfillment was directly related to pragmatic quality in leisure experiences warrants further attention. According to Hassenzahl et al., there should not be such a relation because pragmatic quality does not directly provide need fulfillment; it only "enables the fulfillment of needs through removing barriers but not being a source of positive experience in itself" (p. 359). In our study, however, users seem to experience need fulfillment such as pleasure/stimulation that is positively related to their perception of the pragmatic quality of the technology used. Interestingly pragmatic quality was only related to need fulfillment in leisure, but not in work experiences. At first this is puzzling since one would assume pragmatic quality to be of primary importance in a work rather than leisure setting. However, in work settings people use the same technology/products on a daily basis over a long period of time. For such experienced users, pragmatic quality does not present an obstacle anymore; they know how to interact with the technology even when its usability is not optimal. In contrast, in a leisure setting people are more likely to come across technologies they have no or only little experience with. To be able to handle the product/technology they depend on its pragmatic quality. Consequently, products that offer a good pragmatic quality in such a context are likely to provide need fulfillment and result in a positive experience. So the difference between work and leisure with regard to the correlation between pragmatic quality and need fulfillment maybe due to the different levels of expertise people have in the two activity domains.

Furthermore, Hassenzahl et al. [2010] found that attribution moderates the effect of need fulfillment on hedonic quality (i.e., the extent to which users attributed the experience to the product they use is influential on the strength of the effect of need fulfillment on hedonic quality); in contrast, our results show that attribution directly influences hedonic quality. Interestingly, attribution was not predictive for hedonic quality within positive experiences in Study 1. Maybe this difference in results between Study 1 (positive and negative experiences) and Study 2 (positive leisure and work experiences) is a consequence of partitioning positive experiences into work and leisure experiences in Study 2. It should be noted, however, that attribution in both studies was heavily skewed toward "large extent of attribution" and had to be transformed into a binary variable. This means that "lack of attribution" is underrepresented in the variable and therefore the related correlations must be interpreted with caution. It seems that the wording of the attribution question in the present study (adopted from Hassenzahl et al. [2010]) was not optimal. In their most recent study, Hassenzahl et al. [2015] changed the wording of the attribution question from "To what extent do you feel that the technology was the cause of the experience?" to "Think

back to the feelings and emotions you had during the experience. What do you think: How much had they been caused by the product?”.

There is a further noticeable difference between the results of Study 1 and 2. In comparison to Study 1 the percentage of explained variance in the models is generally larger, especially with regard to positive experiences (20% in work and 20% in leisure experience vs. 11% in positive experiences for hedonic quality, and 8% in work and 12% in leisure experiences vs. 2% in positive experience for pragmatic quality). At first this seems puzzling since one would expect similar results when comparing positive experiences in general to positive work and leisure experiences. There is, however, a possible methodological explanation for this discrepancy. In Study 2 we had a more rigorous data cleaning procedure with an additional manipulation check where the collected experiences were evaluated by three independent raters. Consequently, over 53% of the participants were discarded from the analyses. In contrast, in Study 1 we primarily relied on the verification questions to identify low quality data leading to an exclusion rate of only 26% (see footnotes 6 and 14). Thus it seems plausible to assume that there is simply more error variance in Study 1 than Study 2 that cannot be explained by the predictors. Moreover, the fact that participants had a more concrete task in Study 2 (to describe a positive work or leisure experience with technology) than in Study 1 (to describe a general positive experience with technology) may have led to less heterogeneous ratings in Study 2, which in turn results in less variance needed to be explained in the models. Specifically, this may also explain why attribution was a stronger and significant predictor of hedonic quality in Study 2 than in Study 1. In other words, the difference in explained variance between Study 1 and 2 might arise from the fact that in Study 1 data are more multifaceted and variable than those in Study 2 and therefore contain additional variance that cannot be explained by need fulfillment, affect and attribution only.

5.2.2 *Difference between work and leisure experiences (Research Question 4)*

In this section we address Research Question 4: On which aspects of experience do work and leisure activities involving technology differ? To analyze which aspects of work experiences and leisure experiences differ, we conducted a series of logistic-regression analyses on (1) the collected ratings (i.e., affect, need fulfillment, technology perception) as well as on (2) content-features of the narratives.

Ratings on affect, need fulfillment, and technology perception.¹⁷ Stepwise logistic-regression analysis was conducted to identify unique predictors of activity domain¹⁸ (see Table 7). For *need fulfillment*, a set of five significant predictors explained 36% of the variance (competence, relatedness, pleasure/stimulation, security and popularity), chi square (5) = 111.82, $p < .001$). As regards *affect*, there were no significant predictors¹⁹. Moreover, the results for positive- and negative affect of positive work- and leisure experiences from Study 2 are consistent with those from positive experiences from Study 1; based on figures from Tables A4 and A9, mean values were about 3.95 (strongly positive) for positive affect and 1.6 (hardly negative) for negative affect. For *technology*

¹⁷ A systematic comparison between work and leisure narratives in regard to ratings is presented in Online Appendix 5.

¹⁸ where work was the response category and leisure was the reference category.

¹⁹ Non-significant results not shown in Table 7.

perception, the predictor beauty explained 3% of the variance (chi square (2) = 6.66, $p < .01$).

The results show that an experience is more likely to be in the work domain (or less likely to be leisure domain), the higher it is rated on competence, security, popularity (odds ratios > 1). An experience is more likely to be in the leisure domain, the higher it is rated on relatedness, pleasure/stimulation, and beauty (odds ratios < 1).

Content of narrated experiences²⁰. As in Study 1, we first ran an LIWC analysis on the narrative data to automatically analyze their content to quantify the extent to which the narratives contain information about (a) social processes, (b) affective processes, and (c) personal concerns. Then we conducted stepwise logistic-regression analysis to identify unique predictors of activity domain (see Table 7). For *social processes*, two significant predictors (family and friend) explained 14% of variance (chi square (2) = 38.41, $p < .001$). For *affective processes*, one significant predictor, positive emotion, explained 8% of variance, chi square (1) = 22.28, $p < .001$ ²¹. In particular, ‘family and friends’ supports Tinsley et al.’s [1993] leisure characteristic ‘lack of focus on self’ and presence of ‘positive emotion’ supports these authors’ leisure characteristic ‘intensity of emotions’.

According to the results, an experience is more likely to be in the leisure domain (or less likely to be in the work domain), if it is described by an increased use of words related to family, friend, and positive emotion. Therefore, again as in Study 1, the quality of experience reflects psychological characteristics of the described experience and provides supporting evidence for the validity of the data.

5.2.3 Contextual factors

We examined differences between leisure and work on time of day, location, presence of others, and distance in time from present. Experiences differed by location (with leisure most frequently in people’s own home, but work experiences most frequently at work; see Table 8), chi square (5) = 130.85, $p < .001$, Cramer’s $V = .72$, and by presence of others (with leisure most frequently occurring when a person was alone or with a partner/friend, but work experiences most frequently occurring when the person was alone or with another person [acquaintance or colleague]; see Table 8), chi square (5) = 40.27, $p < .001$, Cramer’s $V = .40$, but not by time, chi square (4) = 8.72, $p > .05$, Cramer’s $V = .19$.

5.2.4 Type of Technology and Activity.

²⁰ A systematic comparison between work and leisure narratives in regard to LIWC categories is presented in Online Appendix 6.

²¹ As a manipulation check we also analysed *personal concerns*. A set of two significant predictors (work [OR = 2.15, Wald = 51.29, $p < .001$] and leisure [OR = 0.65, Wald = 22.99, $p < .001$]) explained 55% of variance, chi square (2) = 202.53, $p < .001$.

Table 7

Logistic regression analysis (Study 2)

Type of datum	Domain	Predictor	Odds ratio ^a	Wald	<i>p</i>
Ratings	Need fulfillment				
		$R_{CS}^2 = .36$			
		Competence	2.60	15.86	< .00
		Popularity	2.40	11.15	< .00
		Security	1.73	6.34	.012
		Relatedness	0.64	5.32	.021
		Pleasure/stimulation	0.31	25.93	< .00
	Technology perception				
		$R_{CS}^2 = .03$			

Experience narratives were coded for technology used and activity with technology. Apart from the description of their experience, participants also indicated the kind of technology involved in their experience. Based on this information and the description of the experience, one of the authors coded all experiences for technology used and for activity with technology. We identified 11 categories for technology and 10 categories for activity with technology. Leisure and work experiences differ by technology, with more use of desktop in work experiences and more use of tablet in leisure experiences (chi square (10) = 32.07, $p < .001$, Cramer's $V = .36$). Moreover, experiences differed by activity with technology, with more productivity activity in work experiences and more gaming and (video-)watching activities in leisure experiences (chi square (9) = 113.69, $p < .001$, Cramer's $V = .67$). See Table A12 in Appendix 8 for an overview of the frequency of technologies and activities.

5.2.5 Summary of Results. No evidence was found for (moderated or unmoderated) mediation in Hassenzahl's model of need fulfillment. Rather, need fulfillment had a direct positive influence on both hedonic quality and pragmatic quality in leisure experiences, but attribution had a direct positive effect on hedonic quality in both activity domains. With regard to Research Question 3 it can be concluded that Claim 1 of Hassenzahl's model (a direct relation between HQ and need fulfillment) was supported in both activity domains. However, there was no evidence in favor for Claim 2 (the relation between PQ and need fulfillment is mediated through affect) and Claim 3 (the relation between HQ and need fulfillment is moderated by attribution).

For Research Question 4 the results suggest that there is a clear difference between work and leisure experiences in regard to experiential aspects. Especially need fulfillment is a reliable indicator for distinguishing between experiences from the two activity domains. In comparison with technology perception, need fulfillment was more than 10 times stronger in distinguishing work experiences and leisure experiences. In terms of narration, in contrast to Study 1, where affective processes were most influential, here social processes (i.e., the use of words associated with family and friends) were more powerful in distinguishing work experience and leisure experiences. In contrast to Study 1, time and social context were influential on type of experience (work versus leisure). As in Study 1, both technology and activity were influential. Uniquely

Table 8
Context of reported experiences (Study 2)

	Leisure (n = 159)	Work (n = 96)
Time of occurrence		
Some days ago	11%	6%
Some weeks ago	21%	11%
Some months ago	12%	21%
Some hours ago	30%	30%
Some years ago	26%	31%
Location of experience		
In my own home	63%	20%
In the street or another public space	15%	10%
In a natural setting	12%	2%
In a public building or in a stranger's home	6%	3%

significant predictors of activity domain (leisure or work) were competence, popularity, security, relatedness and pleasure/stimulation (in terms of need fulfillment), beauty (in terms of technology evaluation), positive emotion, and friends and family (in terms of social processes)²².

The results show that positive leisure and work experiences differ in terms of location, social environment (in leisure more commonly with a partner/friend, but in work more commonly with an acquaintance or colleague), technology used (with desktop computers more common in work experiences, but tablets more common in leisure experiences) and the activity with technology (with productivity activity common in work experiences, but gaming and video-watching more common in leisure experiences).

6 GENERAL DISCUSSION

We discuss the findings for the four research questions in turn and present some implications of our findings.

6.1 Evaluation of Hassenzahl's UX model on need fulfillment (Research Question 1 and 3)

We aimed to investigate whether the UX model of Hassenzahl et al. [2010] holds for other types of experience (viz., outstanding negative experiences) and in other activity domains²³ (viz., work). In particular, we were interested in the three main claims of the model (see Section 2.1): (1) that the effect of need fulfillment on hedonic quality is mostly direct (only partially mediated by positive affect), (2) that the effect of need fulfillment on pragmatic quality is mediated by

²² as well as work and leisure (in terms of personal concerns).

²³ Note that Hassenzahl et al. [2010] studied positive experiences, but did not specify the activity domain in the instructions to their participants.

positive affect, and (3) that the effect of need fulfillment on hedonic quality is moderated by attribution²⁴.

Claim 1: hedonic quality is directly related to need fulfillment. Hassenzahl et al. [2010] found that the relation between hedonic quality and need fulfillment is more direct than the relation between pragmatic quality and need fulfillment. This means that need fulfillment directly affects users' perception of a product's hedonic quality. Our results corroborate this notion even more strongly than Hassenzahl et al. In all conditions, the relation between hedonic quality and need fulfillment was exclusively direct and not, as in Hassenzahl et al. [2010], partially mediated by positive affect. It seems that the experience of need satisfaction with a product increases the users' perception of its hedonic quality.

Claim 2: pragmatic quality is not directly related to need fulfillment. Hassenzahl et al. [2010] found that the perception of pragmatic quality does not come from a product's ability to fulfill needs. Nevertheless, pragmatic quality still plays an important role for need fulfillment. In the words of Hassenzahl et al. [2010], hedonic quality is "capturing the product's perceived ability to create positive experiences through need fulfillment" whereas pragmatic quality is "enabling the fulfillment of needs through removing barriers but not being a source of positive experience in itself" (p. 359). Our findings, however, offer no support for this claim. In neither of our conditions was the relation between need fulfillment and pragmatic quality mediated by positive affect. Instead pragmatic quality was either directly related to need fulfillment (in negative and leisure experiences), or not related to need fulfillment (in positive and work experiences). It seems that whether pragmatic quality is related to need fulfillments depends on the type of experience (positive vs. negative) as well as the activity domain (leisure vs. work). This challenges – at least to some extent – one of the claims of Hassenzahl et al.'s model, namely that need fulfillment primarily affects the users' perception of hedonic quality and influences pragmatic quality indirectly through affect.

Claim 3: the relation between need fulfillment and hedonic quality is moderated by attribution. Hassenzahl et al. [2010] also studied the role of attribution (i.e., the users' belief that the product was responsible for the experience) in the relation between need fulfillment and product perception. They found that need fulfillment was only related to hedonic quality if users attributed the product to their experience. We found such a moderator-effect neither for leisure/work, nor for positive/negative experiences. However, our results do suggest a direct effect of attribution on hedonic quality for leisure and work experiences. This means that the more users believe that the product was responsible for their experience the higher they rate it on hedonic quality. However, attribution was not related to hedonic quality in Study 1, where we asked users to describe positive or negative experiences without specifying the activity domain.

In conclusion, our findings mostly support Hassenzahl et al.'s [2010] central notion that need fulfillment is more strongly related to hedonic than to pragmatic quality. Correspondently, we found that need fulfillment is directly linked to hedonic quality independently from the experience's valence or the activity

²⁴ Similar as Hassenzahl et al. [2010] we do not have a strong notion about the directionality of the causation of the investigated relations. The implied causality in the text serves only to facilitate the communication of the findings from the statistical analyses.

domain. However, we found that in some cases need fulfillment is also directly related to pragmatic quality and not as suggested by Hassenzahl et al.'s model partially or fully mediated through positive affect. Hence, our results emphasize the primary importance of need fulfillment in shaping hedonic quality [Hassenzahl et al., 2010], but they only partially support the model's claim that hedonic quality, but not pragmatic quality, is associated with need fulfillment as we find instances in which also pragmatic quality is directly related to need fulfillment. It seems that in some situations pragmatic quality can serve as a source of need fulfillment (e.g., in leisure experiences). However, further research should investigate such situations to see if and how users eventually get need satisfaction from product features such as utility and efficiency that are associated with pragmatic quality.

In general, however, the results of both studies show consistently that the model explains more variance (R^2) in hedonic quality (.11 for positive experiences and .12 for negative experiences in Study 1; .20 for leisure experiences and .20 for work experiences in Study 2) than in pragmatic quality (.02 positive experiences and .09 negative experiences in Study 1; .12 for leisure experiences and .08 for work experiences in Study 2). In other words, core aspects of an experience such as experienced need fulfillment and affect are more strongly related to hedonic than to pragmatic quality of a product. This finding is in line with Hassenzahl et al.'s general notion that hedonic quality is essential in providing a good user experience (i.e., providing pleasure in use and ownership) [Hassenzahl et al. 2015; Hassenzahl et al. 2010].

Herzberg's two-factor theory of job satisfaction is not the subject of this paper and neither Study 1 nor Study 2 were designed based on the theory. Still our results are related to this theory (and to the work by Tuch and Hornbæk [2015] on adapting Herzberg to user experience research). Consistent with Hassenzahl et al.'s [2010] model and results, in our two studies predictors differed between hedonic quality and pragmatic quality, with hedonic quality more strongly predicted by need fulfillment, possibly supporting the idea of hedonic quality as a motivator and pragmatic quality as a hygiene factor. However, in contrast to this interpretation, pragmatic quality was related to need fulfillment in some situations. This is similar to the findings by Tuch and Hornbæk [2015], who discussed utility and convenience as motivators for product use, both not consistent with the view of pragmatic quality as a hygiene factor. Thus, as in the study by Tuch and Hornbæk [2015], a simple interpretation of the relation among needs and pragmatic/hedonic quality seems difficult.

6.2 Differences between positive and negative experiences (Research Question 2)

Our analyses suggest that needs differ in how well they discriminate positive and negative experiences. An increase in users' feelings of competence, relatedness, and pleasure/stimulation, and a drop in the feeling of popularity make an experience more likely to be positive. Thus, our study provides a much more elaborate picture than Tuch et al. [2013] by suggesting competence, relatedness, and pleasure/stimulation, as specific positive predictors and popularity as a specific negative predictor for the valence of an experience. Moreover, the logistic-regression analysis suggests that competence is the strongest predictor of positive experiences (increase in odds of a positive experience by 198%), followed by relatedness (112%), and pleasure/stimulation (74%). Popularity is similarly strong in predicting negative experiences as pleasure/stimulation is in predicting positive experiences (75%). Overall it appears that a product's ability to provide a user with a feeling of competence is essential for user experience. In turn, as suggested by self-determination theory,

the fulfillment of such needs has positive effects on people's subjective well-being [Ryan and Deci 2000].

Regarding users' experienced affect, both positive and negative affect strongly predict the valence of an experience. An increase in positive affect by one unit (on a scale from 1 to 7) increases the odds for an experience to be positive by 376%. In contrast, an increase by one unit in negative affect increases the odds of an experience to be negative by 213%. Although these results may appear trivial, they illustrate the important role of affect in user experience and corroborate previous findings on the relevance of affect and emotion in UX [Bargas-Avila and Hornbæk 2011]. Moreover, the results indicate that the increase in odds of a positive experience as a function of positive affect is about twice as high as the odds of a negative experience as a function of negative experience. Therefore, the valence of an experience is determined about twice as much by its positive affect than by its negative affect. This finding can be interpreted as a justification for the focus on positive emotional outcomes in product design that has been promoted by UX research [Hassenzahl and Tractinsky 2006]. Moreover, it stands in contrast to Baumeister et al. [2001]. They argued that "bad is stronger than good" and showed that across a range of psychological phenomena, negative experiences have a stronger impact on people than positive ones. A possible explanation for this contrast is that the negative experiences studied by Baumeister et al. (e.g., losing money, being abandoned by friends, and receiving criticism) are more serious than negative experiences that occur when interacting with technology. Further there is research showing that people's recollections of past experiences are often positively biased. People tend to perceive events in their lives as pleasant rather than unpleasant; the affect associated with unpleasant events also fades faster than the affect associated with pleasant events [Richard et al. 2003]. As the experiences reported in the present study are derived from participants' recollection from memory it might be that there is a general positivity bias in our data. We will return to this point in Section 6.4.

For technology perception, beauty and pragmatic quality are the best predictors of the valence of an experience. The more beautiful and the higher in pragmatic quality a product is perceived, the higher the likelihood for the experience to be positive. These findings provide further evidence for the notion that product qualities of beauty or aesthetics [van Schaik et al. 2012; Hassenzahl and Monk 2010] and pleasurability [Jordan 2000] are influential in shaping positive experiences. They also show that pragmatic qualities such as usefulness and usability are important for positive user experiences [Tuch and Hornbæk, 2015]. Previous studies also found that both usability and aesthetics are unique predictors of overall satisfaction [Tractinsky and Zmiri 2006; Mahlke and Thüning 2007; Aranyi and van Schaik 2015; Aranyi and van Schaik 2016]. Hedonic quality did not emerge as a predictor for valence. This was due to the high correlation between beauty and hedonic quality ($r = .73$). With beauty removed from the analysis, hedonic quality becomes a significant predictor alongside pragmatic quality.

The main findings on contextual factors show that positive experiences often contain social aspects such as the need for relatedness, family and friends, and communication. Negative experiences, in contrast, are more diverse and cannot be associated with a specific context.

6.3 Differences between leisure and work experiences (Research Question 4)

Need fulfillment predicts activity domain differently from the way it predicts the valence of an experience. Competence, popularity, and security are associated

with experiences from the work domain, whereas the experience of pleasure/stimulation to a large extent and relatedness to a somewhat lesser extent are indicative of leisure experiences. These observations are in line with previous research on leisure experience in psychology [Tinsley and Tinsley 1986; Tinsley et al. 1993], which has suggested that companionship and intimacy (in our case the need for relatedness), as well as stimulation (in our case the need for pleasure/stimulation) are defining aspects of leisure experience, whereas achievement is not (in our case competence). This interpretation is corroborated by the automated content analysis (i.e., LIWC), which confirms that leisure narratives contain more words from the social process category and that work narratives contain more words related to achievement. Our findings on need fulfillment extend previous research [Partala and Kallinen 2012; Hassenzahl et al. 2010; Tuch et al. 2013; Wiklund-Engblom et al. 2009] by offering a more nuanced view on the role of need fulfillment in UX in regard to activity domain. The finding that other needs are of relevance in work than in leisure supports the point made byargas-Avila and Hornbæk [2011] that the current focus of UX research on consumer products and arts may be too narrow. Moreover, our findings suggest that products targeted towards the leisure domain are more likely to generate positive experiences if they have the ability to provide pleasure and relatedness, whereas products for the work domain should enable the user to experience the feeling of competence, popularity, and security.

For technology perception, only beauty was a significant predictor for activity domain. With an explained variance in activity domain of 3%, it is a modest predictor. An increase in beauty by one scale point increases the odds of the experience to be from the leisure domain by 28%. Therefore, it seems that the beauty of a product matters more in leisure than in work. The fact that only beauty is a significant predictor for activity domain may seem somewhat surprising at first. Hassenzahl et al. [2008] suggested that in contexts with externally given tasks (as often is the case in the work domain) users tend to focus on the pragmatic quality of a product, whereas in contexts without a concrete task (as often is the case in the leisure domain) on the hedonic quality of a product. Therefore we expected pragmatic quality to be more relevant in the work domain and hedonic quality in the leisure domain. According to our results, however, it seems that a product's pragmatic quality matters equally in both activity domains. One reason why pragmatic quality is not predictive for activity domain could be that we only investigated positive work and leisure and that positive experiences in general tend to be high on pragmatic quality (see Table A9). Overall, our findings on technology perception are in line with Tinsley and Tinsley's [1986] suggestion that leisure experiences lead to aesthetic reward and stimulation. This is supported by the results of our logistic-regression analysis, which show that increased beauty is predictive of leisure (reflecting aesthetic reward in the Tinsley and Tinsley model), and by the descriptive statistics (Table A10), which show higher hedonic quality and beauty for leisure experiences (reflecting stimulation in the Tinsley and Tinsley model) compared to work experiences.

Regarding contextual factors, leisure experiences were more commonly experienced with a partner/friend, but work experiences more commonly with an acquaintance/colleague. Unsurprisingly, leisure experience predominantly took place at home, whereas work experiences took place at work. This is in part also reflected in the content of the narratives. For instance, the LIWC analysis revealed that an experience is more likely to be from the leisure domain if it is described by an increased use of words related to family, friends, and leisure, and a decreased use of words related to work.

6.4 Limitations and future research

Our research is limited in several ways. First, we asked participants to remember experiences with technology and to rate how they felt during the experience and how they perceived the technology at that time. Obviously, this approach is prone to memory bias. For instance, as mentioned earlier, people tend to remember events more positively than they actually were experienced at the time [Richard et al. 2003]. Hence, our finding that positive experiences with technology are experienced to a larger extent as positive than negative experiences with technology are experienced as negative should be considered with caution, as it might be an artefact of positive memory bias and the memories were recalled in response to experimental instructions rather than created through experimental manipulations. Our study, however, is not the only one suffering from this issue. All the more, this calls for further studies on the role of need fulfillment that capture users' experiences closer to the moment they occur. Diary studies, studies using the day reconstruction method [Kahneman et al. 2004], or user-experience tests with think-aloud and realistic tasks [Aranyi et al. 2012] can provide an alternative to current studies on need fulfillment relying only on participants' memory.

Second, and related to the first point, our findings are solely based on peak-experiences. It is unclear if the findings also apply to more commonplace, daily experiences [for example, reading online news; Aranyi et al. 2012; Aranyi and Van Schaik 2015 and 2016]. This issue is a serious problem, as UX models should be generalizable across various types of user experience. Again, this can be addressed through studies applying experience-sampling techniques that capture people's technology use in the context of their daily lives. However, a disadvantage of these techniques is that it is unlikely that data on peak experiences will be collected this way and more ordinary ('non-peak') experiences will be found when data collection occurs close in time to the collected experiences (e.g., diary, day reconstruction, user-experience tests with think-aloud). Nevertheless, peak experiences are more likely to be collected through retrospective narratives (as in the research reported here). This is because ordinary experiences are unlikely to sufficiently stand out in their mind when users are prompted to recall a past experience – and the results of pilot work that we have conducted are consistent with this idea.

Third, our results are solely based on user experiences at a single point in time. We therefore do not know how the relation between product quality and need fulfillment develops over time. Longitudinal studies that investigate need fulfillment through product use over longer periods of time would be useful in this respect.

Fourth, current insights into need fulfillment and UX are mainly derived from correlational data, not allowing any causal interpretations. Future studies could experimentally manipulate a product's need-fulfilling capabilities and study the role of need fulfillment as a mediator on product perception and evaluation as well as affect.

Fifth, the present study has a focus on needs as the underlying concept for understanding user experience, although there are other noteworthy approaches for doing so. For instance, a recent study by Partala and Kujala [2015] showed that users' personal values such as power, achievement, and hedonism may play an important role in evaluations of products and services. Users' values seem to be an interesting concept that may complement psychological needs in understanding user experience. Further studies could investigate to what extent

needs and values differ or overlap conceptually as well as psychometrically, and how needs and values differ or are similar as antecedents and consequents of other user experience constructs.

Future research may also expand modeling work taking a multilevel perspective upon the organization of (human) behavior [Sheldon 2011; see also Kim-Prieto et al. 2005]. For example, need fulfillment in Hassenzahl et al.'s model forms the bottom layer of four levels of personality in Sheldon et al.'s [2011] model called Multiple Levels of Personality in Context (MLPC). In Sheldon et al.'s model higher-order personality levels (self, goals/motives, and traits) as well as need fulfillment affect subjective well-being and behavior directly. Moreover, need fulfillment also mediates the effects of the higher levels. With the integration of Hassenzahl et al.'s model into MLPC, it may become possible to simultaneously examine higher-order personality variables as well as need fulfillment in relation to technology perception in a systematic way. This could provide insight into why and how user experience can differ between people who differ in their personality, even if the context of use is similar.

In our study we distinguished work and leisure experience. Although at first sight this distinction seems meaningful and intuitive, it could be argued that it is merely descriptive and does not allow inferences about the psychological mechanisms that drive the differences between different activity domains. An alternative approach to study the influence of activity domains on user experience is the notion of usage modes as proposed by Hassenzahl [2003]. He distinguished goal and action mode. Users in a goal mode have a specific goal in mind that they want to achieve by using a product. In that mode users' actions are primarily driven by that goal. In contrast, users in an action mode are guided by the current activity and goals are determined "on the fly". Users are not using a product to achieve a previously set goal; using the product is an "end in itself". Future research could investigate the role of usage mode in regard to the relation between need fulfillment and technology perception and how it relates to work and leisure experiences.

Finally, we suggest that future work should control the type of activity users engage in when interacting with technology, since it is likely that different types of activities differ in the way they fulfill needs. A recent study by Hassenzahl et al. [2015] corroborates this view. They investigated three different types of leisure activity (i.e., watching movies with DVD players, listening to music with mp3 players, and playing video games with a console) and found activity-specific need profiles. This suggests that some activities are better suited to fulfill certain needs than others. Similarly, future studies could systematically investigate specific types of activity involving technology in the work domain.

7 CONCLUSIONS

The aim of the present study was to investigate the role of need fulfillment in different types of experience (negative vs. positive) and in experiences from different activity domains (work vs. leisure). In two studies we analyzed ratings on need fulfillment, experienced affect, and product perception collected along with descriptions of user experiences from almost 600 participants. Our results suggest that need fulfillment is in most instances directly related to a product's hedonic quality, and only sometimes to pragmatic quality. Moreover, we show that high levels of experienced competence, relatedness, and pleasure/stimulation are predictive for positive experiences. Further, high levels of competence,

popularity, and security are indicators for work experiences and high levels of pleasure/stimulation and relatedness are indicative of leisure experiences.

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