Computers in Human Behavior 53 (2015) 381–395

Contents lists available at ScienceDirect

Computers in Human Behavior

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

Full Length Article

Understanding the most influential user experiences in successful and unsuccessful technology adoptions

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ARTICLE INFO

Article history:
Received 4 September 2014
Revised 8 July 2015
Accepted 9 July 2015
Available online 23 July 2015

Keywords:
Technology adoption
Technology acceptance
User experience
Emotions
User needs
Well-being

ABSTRACT

Understanding processes underlying technology adoption or non-adoption is an important research theme often addressed using the technology acceptance model (TAM) approach. The objective of this research was to investigate most influential user experiences in successful and unsuccessful technology adoptions using user experience related concepts and methods in conjunction with the TAM. Participants ($N = 76$) described their most influential user experiences related to one successful and one unsuccessful technology adoption process and evaluated both experiences using rating scales, including the central TAM related scales and user experience related scales probing emotions, psychological needs, user values, task load, and the impact of technology on the user's well-being.

The results suggested that user experience and technology acceptance related viewpoints can complement each other in order to gain a more holistic understanding of the factors affecting the success or failure of technology adoptions, and the results showed how these variables typically behave in both contexts. The overall valence of user experience was significantly affected by perceived usefulness, the fulfillment of psychological needs, and the salience of negative emotions in the most influential user experiences of successful adoptions, and by perceived usefulness, output quality, and the salience of negative emotions in the unsuccessful adoptions.

1. Introduction

Technology adoption is a growingly important research theme, as new technologies are being rapidly introduced, and it is currently typical for a user to have many personal devices and interact with multiple information technology services including different commercial and public services. Different information technology devices and services are now also increasingly used in the less developed countries. From the user's viewpoint, successful technology adoption is important in order to fully participate in the rapidly changing modern society and it is also crucial in many professions. Those who cannot adopt new technology are limited in their ability to become productive members of their communities. Understanding the factors influencing technology adoption helps us predict and manage, which technologies are successfully adopted, by whom, and under what kind of conditions. Designers of technology and technology-based services can also use that information toward building systems, which can overcome the most common barriers in technology adoption.

The most popular approach for studying technology adoption has been the Technology Acceptance Model (TAM) and the related questionnaire-based research methods. Davis (1989) developed the original TAM model based on the theory of reasoned action (Fishbein & Ajzen, 1975). In the TAM model, system usage behavior is determined by behavioral intention to use, which is affected by perceived usefulness, or "the degree to which a person believes that using a particular system would enhance his or her job performance" and perceived ease-of-use or "the degree to which a person believes that using a particular system would be free from effort". These perceptions are in turn affected by a number of external variables The original model was later extended into TAM2 (Venkatesh & Davis, 2000), in which the external variables of subjective norm, image, job relevance, output quality, and result demonstrability were identified, affecting the perceived usefulness and behavioral intention variables of the original model. The model also introduced experience of using the system and voluntariness of use as moderating variables. Later, Venkatesh and Bala (2008) released the third version of the model, TAM3, in which further determinants of perceived ease of use were added to the model: computer self-efficacy, perceptions of external control, computer anxiety, computer playfulness, perceived enjoyment, and objective usability.

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http://dx.doi.org/10.1016/j.chb.2015.07.012

Despite its importance for the technology acceptance research field and practical studies, TAM has also received a great deal of criticism. For example, Legris, Ingham, and Collerette (2003) suggested that TAM and TAM2 models explain only about 40% of information technology use and significant factors are not included in the models. Bagozzi (2007) published a commentary article pointing out a number of limitations with the TAM model and the related research. A major conclusion was that besides variables included in TAM, new variables are needed for understanding the users' decision making related to technology adoption and these variables are likely to be grounded in emotional, social, and goal-directed behavior research.

Recently, these kinds of variables have been applied to the study of interactive systems in the research field of user experience (UX), which is currently one of the most significant directions in human technology interaction research. While there is plenty of literature on technology acceptance and a growing body of research on user experience, only a little research exists combining both research directions. Some of the most potential user experience related concepts include emotions, user needs, and user values, all of which have been already applied successfully in practical user experience studies based on well-established theories from psychological research. Another promising concept is experienced well-being impact of technology, which can be assumed to be especially important when studying technologies used daily or frequently such as different work systems and equipment. In the following chapters, we introduce these user experience related concepts in detail and present the aims and hypotheses of the current study.

2. User experience

User experience is a growing research field, which has in recent years gained considerable interest from both scholars and practitioners. Generally, the research field of user experience is seen to include all factors, which affect the user's interaction with and experience of a system or a product. At the core of the concept is experience itself. The current scholarly conception of user experience mostly follows the psychological line of thinking, in line with the "technology as experience" approach (McCarthy & Wright, 2004), which shifted the focus of product design from technological and pragmatic aspects toward subjective and emotional qualities of interaction with products. Many different definitions have been suggested for user experience stressing different aspects of experience or factors affecting user experience. However, most researchers and practitioners agree that user experience is subjective (vs. objective), holistic (vs. instrumental), situated (vs. abstract), and dynamic (vs. static) (Hassenzahl, 2010; Law, Roto, Hassenzahl, Vermeeren, & Kort, 2009). Below we briefly introduce some of most important established and emerging concepts and methods of user experience research, all of which are also applied in the current research.

2.1. Emotions

In the study of human experiences, emotion is generally seen one of the most central and pervasive aspects and consequently they also play a central role in understanding user experiences. Most of the scientific research on user experience follows the notion is that emotions are integral to experiences and they are also intertwined with our actions (Carver & Scheier, 1989; Hassenzahl, 2010). Emotions can be studied from two main viewpoints: dimensional and discrete emotions, which are currently seen as complementary to each other. Empirical research using the dimensional viewpoint has shown that emotions can be organized along two main dimensions: valence (ranging from negative to neutral and positive affect) and arousal (ranging from very calm to neutral and very highly aroused). From the discrete emotions point of view, there are numerous theories and methods on which particular emotions are the most central and should be included in emotion research. One of the most widely used methods has been the Positive Affect Negative Affect Schedule (PANAS, Watson, Tellegen, & Clark, 1988), which studies experienced emotions through a balanced set of ten positive and ten negative emotions (e.g. inspired, excited, scared, distressed). There is evidence about the reliability and validity of the method in a general population (e.g. Crawford & Henry, 2004). This method enables calculating salience scores separately for positive and negative emotions, as well as an affect balance score. This is especially useful, as there is evidence that people can experience both positive and negative emotions as parts of the same experience (Russell & Carroll, 1999).

Emotion-related concepts have a history of being used in technology adoption studies, but for example, Straub (2009) has noted that there is not a sufficient empirical basis for understanding the influence of emotions on the technology adoption process. The research on emotion-related constructs in technology adoptions is mostly limited to the notions included in Technology Acceptance Model 3 that perceived enjoyment and computer anxiety are (positively and negatively, respectively) related to perceived ease of use (Venkatesh, 2000). Other researchers have also found these variables to be related with other TAM variables in different contexts. For example, Van der Heijden (2004) found that perceived enjoyment can be directly related to intention to use in hedonic information systems (e.g. a movie website). There are, however, also a few studies that have used more advanced emotion concepts. Cenfetelli (2004) averaged a range of different positive and negative emotions and found that positive emotions were positively related and negative emotions were negatively related to perceived ease of use of the TAM model in an e-business context. Kim, Chan, and Chan (2007) used the two main emotional dimensions: valence and arousal, in a study focusing on the continued use of mobile Internet services, and found that both dimensions were positively related to attitude toward using the services (the concept which predicts actual intention to use in TAM2). Based on appraisal theory, Beaudry and Pinsonneault (2010) developed a framework of four emotions: anger, anxiety, excitement, and happiness, and found that these emotions were either directly or indirectly related to IT use among bank account managers.

2.2. Psychological needs

Another central concept in understanding human experiences and also well-being is the concept of psychological needs. Self-determination theory (Deci & Ryan, 2014; Ryan & Deci, 2000) suggests that three needs are of central importance: autonomy (to actively participate in determining own behavior without external influence), competence (to experience oneself as capable and competent in controlling the environment and being able to reliably predict outcomes), and relatedness (to care for and be related to others). Sheldon, Elliot, Kim, and Kasser (2001) presented a model of ten candidate psychological needs extending self-determination theory with seven other needs: self-actualization-meaning, physical thriving, pleasure-stimulation, money-luxury, security, self-esteem, and popularity-influence. They also presented a questionnaire method for studying the degrees of satisfaction for the ten needs using 30 statements (three statements for each need) and applied the method in two studies on the most and least satisfying experiences of college students in two different cultural settings. The results showed that autonomy, competence, and relatedness were consistently among the most salient needs, together with self-esteem needs.

Later, the model of ten psychological needs and the related methods have been found to be useful in understanding users' experiences and behavior. Psychological needs are seen as "be-goals" underlying the users' actions, or "do-goals" (Carver & Scheier, 1989; Hassenzahl, 2010). For example, the need for being related may motivate a phone call to a close person. Hassenzahl, Diefenbach, and Göritz (2010) studied positive user experiences with technology using the framework and method by Sheldon et al. (2001) and found a clear relationship between need fulfillment and positive experiences, with stimulation, relatedness, competence, and popularity as especially salient needs. Using similar methods, Partala (2011) was able to understand salient needs motivating the usage virtual worlds (e.g. autonomy, self-esteem, physical thriving), and Partala and Kallinen (2012) found the needs of autonomy, competence, and self-esteem as salient in underlying most satisfying user experiences over a range of different technologies. In the context of technology adoptions, psychological needs have been studied only rarely. Roca and Gagné (2008) found that the needs of autonomy and competence were significantly related to the central TAM concepts of perceived usefulness and perceived ease of use in the context of predicting e-learning continuance. Also in the context of e-learning continuance, Sørebø, Halvari, Gulli, and Kristiansen (2009) found that the psychological need of competence had an important role in predicting perceived usefulness, as well as intrinsic motivation for use.

2.3. Values

User values are a concept, which has gained increased attention in the past few years. Like psychological needs, personal values have been found to be related to emotions (e.g. Desmet & Hekkert, 2007). For example, in an early explorative study in the context of consumer experiences, Laverie, Kleine, and Kleine (1993) found that consumers' values can be related to both positive and negative emotions. The research on personal values in technology adoptions has been scarce, even though Malhotra and Galletta (1999) found in an early study that social influence (e.g. whether a system is line with the users' values) strongly influenced the user's attitude toward using a system. Srite and Karahanna (2006) have also found that national cultural values can have a moderating role in technology acceptance. Schwartz (1992) presented a well-known model of ten universal values based on extensive empirical studies in multiple countries: power, achievement, hedonism, stimulation, self-direction, universalism, benevolence, conformity, tradition, and security. In a qualitative study. Isomursu, Ervasti, Kinnula, and Isomursu (2011) studied the success of the adoption of a school attendance control system in detail by using the framework of Schwartz (1992) as the basis of the analysis. Recently, Partala and Kujala (in press) presented a quantitative approach aimed for evaluating the users' personal values in relation to products and services systematically based on Schwartz's model of ten universal values. This approach offers a possibility for theory-based evaluation of user values using quantitative methods. In their study on the role of universal values in the use of products and services, hedonism, self-direction, security, and universalism emerged as the value categories rated as the most important overall by their participants.

2.4. Well-being

There has been a recent interest in designing and evaluating information technology in relation to its impact on the users' life well-being (e.g. Desmet & Hassenzahl, 2012; Kamp & Desmet, 2014), but this approach is not yet visible in technology acceptance literature. When the aim is to evaluate the impact of perceived long-term technology use and technology acceptance in the long run, there is a need for more stable indicators of individuals' well-being besides emotions, needs, and values. Subjective well-being combines the hedonic (e.g. well-being as an affectively pleasant state) and eudaimonic (e.g. well-being as living a meaningful life) approaches to well-being (Argyle & Martin, 1991; Keyes & Waterman, 2003). Subjective well-being is often conceptualized as a broad domain of interest rather than a specific construct (e.g. Diener, Suh, Lucas, & Smith, 1999), including the idea of predominantly positive mood and emotional states and a cognitive evaluation of the person's life circumstances and conditions, such as satisfaction with one's life. One effective approach for studying well-being is through two complementary viewpoints: psychological flourishing and lack of depressive symptoms. Psychological flourishing assesses psychological wealth and well-being which goes beyond positive emotions and life satisfaction (Diener et al., 2009). It measures key aspects of psychological wealth such as social relationships, self-respect, competence, engaging work and spirituality as well as life purpose and meaning. Additionally, we are interested in the role of mental health in well-being via examining the lack of depressive symptoms as a secondary indicator of well-being (e.g. Argyle & Martin, 1991; Elliot & Sheldon, 1998).

2.5. Task load

Finally, the concept of task load can be helpful in studying the perceived difficulty of the task or goal-directed activity at hand, and the associated effort, including mental, physical, and temporal effort invested by the user (Hart & Staveland, 1988). Understanding these concepts has been highlighted as an important challenge in usability studies by Hornbæk (2006). It is generally thought that any activity with interactive products will have demands on the user, and in design it is advisable to minimize extraneous task load to achieve better usability and more positive user experiences (e.g. Hollender, Hofmann, Deneke, & Schmitz, 2010).

3. Aims and hypotheses

Most of the existing research on technology adoption has concentrated on studying the interrelations of the technology acceptance model variables (and possibly additional variables) in the context of single systems or products. In the current study, we adopt a basic research oriented approach, in which technology adoptions are studied by means of analyzing *the most influential single user experiences* related to adoptions over a range of different products. Each participant described and rated the most influential user experience of one *successful technology adoption* and one *unsuccessful technology adoption* in a questionnaire. Using this approach allows within-subject comparisons between the most influential experiences of successful and unsuccessful adoptions. To our knowledge, a similar design drawing from both user experience and technology adoption research has not been used before.

Thus, in the current research, the aim was to study the most influential user experiences in successful and unsuccessful technology adoptions in order to gain a systematic understanding of those experiences. We aimed at forming an overall understanding of which variables are the most central in studies combining the technology acceptance and user experience paradigms. User experience concepts described in the previous chapter were studied in conjunction with the central variables from the technology acceptance model to investigate, whether there are significant relationships between those variables.

In line with many advances from previous literature focusing on user experience (e.g. Desmet & Hekkert, 2007; Hassenzahl, 2010; Hassenzahl et al., 2010; Partala & Kallinen, 2012) we assumed that the participants' most influential experiences of successful and unsuccessful technology adoptions would have clear differences on the level of emotional experiences. In line with this notion, we were especially interested in understanding the variables affecting the central dimensions of emotional valence and arousal in both of these contexts. Two additional, broader emotion-related variables, flourishing and depression were also of special interest in order to be able to study the perceived effect of the technology to be adopted to one's life well-being. Thus, four emotion-related variables (valence and arousal of user experience, flourishing, and depression) were selected as dependent variables, and the rest of the main variables were treated as independent variables. Following this arrangement, hypotheses for the relationships of the main variables in this study are presented in Table 1.

It was noted before that user experiences can involve varying levels of both positive and negative emotions, both of which can contribute to overall valence of the experience (Partala & Kallinen, 2012; Russell & Carroll, 1999). In line with this, we predicted that the amount of positive emotions experienced would be positively associated with user experience valence in the context of both successful and unsuccessful technology adoptions and the amount of negative emotions would have a negative relation with user experience valence in both cases. Riva, Banos, Botella, Wiederhold, and Gaggioli (2012) have suggested in the context of designing for positive technologies that emotional qualities and experiences can be linked to well-being. In line with this notion, we also predicted that positive emotions would have a positive relation to flourishing and a negative relation to depression and that negative emotions would have exactly opposite effects.

For predicting arousal, typical interaction patterns of valence and arousal from existing literature were taken as a starting point (see e.g. Bradley & Lang, 1994). In line with this, it was hypothesized that positive emotions would enhance positive arousal in the context of most influential user experiences of successful technology adoptions and alleviate negative arousal in the context of unsuccessful adoptions. In contrast, negative emotions could decrease the level of positive arousal in the context of successful adoptions and increase negative arousal in unsuccessful adoptions.

The central technology acceptance model variables (usefulness, ease of use, output quality and intention to use) were predicted to be positively associated with the valence of the most influential user experiences and perceived impact on positive well-being (flourishing), and negatively associated with perceived depression. For perceived enjoyment, similar effects were predicted to those of positive emotions. Task load was expected to contribute toward negative valence and high arousal, as well as less flourishing and more depression. In addition, based on previous findings, we expected that need fulfillment would have a positive effect on valence of user experience (Hassenzahl et al., 2010) and flourishing (Ryan & Deci, 2000), and a negative effect on perceived depression (cf. Ryan & Deci, 2000) in the context of both successful and unsuccessful technology adoptions. Similar effects were predicted for value concordance based on corresponding findings from the field of psychology (e.g. Sheldon et al., 2004). Finally, it was predicted that need fulfillment and value concordance, as well as the technology acceptance model variables would have no direct effects on perceived arousal.

Besides finding relationships between these variables, a second aim was to analyze the ratings of individual variables (e.g. specific emotions, psychological needs, and universal values) in the context of most influential user experiences of successful and unsuccessful technology adoptions. By doing so, it is possible to analyze, whether the specific variables, which have been suggested to be of central importance in previous research (e.g. the psychological needs of autonomy, competence, and relatedness), also turn out to be important based on the results of the current study. It is also possible to analyze, which of the variables differ significantly between most influential user experiences in successful and unsuccessful technology adoptions. Based on previous results utilizing somewhat similar basic research settings (e.g. Partala & Kallinen, 2012), we expected that the participants' ratings on most of the studied individual variables would differ significantly between these two extreme conditions.

Table 1
Hypothesized relationships between variables. Before the slash: relationships in the most influential user experiences in successful technology adoptions. After the slash: relationships in the most influential user experiences in unsuccessful technology adoptions.

Variable	Valence	Arousal	Flourishing	Depression
Positive emotions	+/+	+/−	+/+	−/−
Negative emotions	−/−	−/+	−/−	+/+
Usefulness	+/+	0/0	+/+	−/−
Ease of use	+/+	0/0	+/+	−/−
Output quality	+/+	0/0	+/+	−/−
Intention to use	+/+	0/0	+/+	−/−
Task load	−/−	+/+	−/−	+/+
Enjoyment	+/+	+/−	+/+	−/−
Need fulfillment	+/+	0/0	+/+	−/−
Value concordance	+/+	0/0	+/+	−/−

+ positive relationship between variables; − negative relationship between variables; 0 no significant relationship between variables.

4. Materials and methods

4.1. Participants

76 participants (48 male and 28 female university students) completed all parts of the questionnaire with satisfactory responses. The mean age of the participants was 26.6 years (range 20–48 years). The participants consisted of 37 participants originally from Finland and 39 international participants from different ethnic backgrounds. The participants also had different academic backgrounds ranging from technical to humanistic disciplines. All the participants answered to the questionnaire in English, which was also the official language on the courses, on which this study was arranged. The participants were instructed to use a dictionary, if they encountered unfamiliar terms in English. The participants were familiar with the basic concepts in the fields of usability and user experience and during the course they had also been introduced to the specific user experience related concepts studied in the current study (i.e. emotions, needs, values, etc.). It was assumed that at this point of their academic careers, the students had the required skills for analyzing their experiences using introspective methods and also capabilities for understanding all the scales used in the current study.

At the time of the reported most influential experiences of successful technology adoptions, the participants had been the using the evaluated product or system on average for 26.5 days, and at the time of the reported most influential experiences of unsuccessful technology adoptions on average 24.9 days (no significant difference). The participants reported that they were using the system more frequently around the time of most influential experience in a successful adoption when compared to the most influential experience in unsuccessful adoption (respective average ratings 1.8 and 3.3 on the scale of 1 = several times each day, 2 = about once each day, 3 = several times a week, 4 = about once each week, and 5 = less than once each week).

4.2. Procedure

This research was carried out as part of course requirements for two user experience related courses at Tampere University of

Technology, Finland, and the participants consisted of Master's students and doctoral students enrolled for the courses. If a student had enrolled for both of the courses, the assignment was carried out only once. The assignment was introduced for the participants during course lectures. Before answering to the questionnaire, the participants were asked to think of two kinds of technology adoptions: one successful technology adoption (defined as a process, in which a participant had adopted some kind of *interactive* technology, for example, a system, an application or an interactive product, successfully into her/his long-term usage during the past year) and one unsuccessful technology adoption (a process, in which the participants had tried to adopt some kind of interactive technology, again, a system, an application or an interactive product, into their voluntary long-term usage, but – for any reason – the adoption process has been unsuccessful and the use of the technology has not become part of the participant's routines). The participants were also instructed not to report adoptions of faulty technologies. As the most influential user experiences, the participants were instructed to report "the single experiences, which had the largest influence on the success (or failure) of the technology adoption".

The participants signed up for the study in the Moodle online learning environment, where they were identified using their university network IDs. The participants were provided a link to the questionnaire in Moodle, and they had more than two weeks to respond to the questionnaire, before it was closed. The actual questionnaire was filled in the web questionnaire system Webropol. Individual questionnaire responses were anonymous, but in order to give course credit for participation, the researchers had access to the list of names of the students, who responded to the survey. This was achieved in practice so that after the participants had submitted responses to both phases of the research anonymously, they were automatically forwarded to a different Webropol survey, in which they were prompted to enter their names and student numbers. This way it was possible to keep track of the participants who had responded to the survey, but individual responses were still anonymous.

4.3. Tasks and materials

On the first page of the questionnaire, the participants were again told that in the study their task is to focus on one successful and one unsuccessful technology adoption of interactive technology and focus on the most influential single user experience in both technology adoption processes. They were also told that their responses will be confidential and anonymous and that the results of the research will be presented so that no single participants can be identified based on the results. On the second page, the participants' task was to describe the most influential user experience in a successful technology adoption process in a text field in about 30–70 words. The definition for the most influential user experience in a successful technology adoption and the instructions given earlier were repeated on this page. The participants were also asked to estimate, how many days they had been using the technology, when the reported experience took place (days since first time of use, "0" if the reported experience happened on the first day of use). Further, they were asked to choose from five alternatives, how often they were using the system at the time of the experience (see section 2.1).

On the next three questionnaire pages (pages 3–5), the participants were asked to analyze the most influential user experience in a successful technology adoption using blocks of rating scales, which are presented in Appendix A. A summary of the methods and scales used in this research is presented in Table 2.

On page three, the participants evaluated their emotions during the user experience using two different methods. First, they evaluated their experienced emotions using the two main affective dimensions: valence (unhappiness – happiness) and arousal (calm – highly aroused) using the self-assessment manikin method (SAM; Bradley & Lang, 1994), which contained two pictorial scales consisting of nine pictures each. On both scales, the user selected the picture, which best described his/her emotions by clicking on the picture. Second, the participants evaluated the extent of 20 specific emotions during the experience using the PANAS method (Watson et al., 1988) with the original set of ten positive and ten negative emotions and the original 1–5 scale (see Appendix A).

On page four, the participants rated their perceptions of the technology using the Technology acceptance model 3 scales (Venkatesh & Bala, 2008) for perceived usefulness, perceived ease of use, output quality, and intention to use. These scales were presented to the participants as one block of 14 statements using the original 1–7 Likert scale ranging from "strongly disagree" to "strongly agree". On the same page, there were six NASA Task Load Index scales (Hart & Staveland, 1988) probing mental demand, physical demand, temporal demand, effort, frustration, and performance.

On page five, perceived enjoyment was first studied using four semantic differential 1–7 scales taken directly from Van der Heijden (2004). After that, psychological needs were studied using 16 statements based on the questionnaire items from Sheldon et al. (2001). The self-determination theory related concepts of autonomy, competence, and relatedness were studied using three scales, while the other seven candidate needs suggested by Sheldon et al. (2001) were studied by one selected scale. User values were

Table 2
The main variables, methods, and scales used in this study.

Concept	Variable	Scale	Method	Source
Emotions	Valence Arousal	Pictorial 1–9	Self-assessment manikin (SAM)[a]	Bradley and Lang (1994)
	Positive emotions Negative emotions	1–5	Positive Affect Negative Affect Schedule (PANAS)	Watson et al. (1988)
Technology acceptance	Perceived usefulness Perceived ease of use Output quality Intention to use	Likert 1–7	Technology Acceptance Model 3 (TAM3)	Venkatesh and Bala (2008)
Enjoyment	Perceived enjoyment	Semantic differential 1–7		Van der Heijden (2004)
Task load	Task load	1–7	NASA-TLX[a]	Hart and Staveland (1988)
Psychological needs	Need fulfillment	Likert 1–7		Sheldon et al. (2001)[a]
User values	Value concordance	Likert 1–7	Custom statements based on Partala and Kujala (in press)	
Well-being	Flourishing	Likert 1–7	Flourishing scale[a]	Diener et al. (2009)
	Depression	Likert 1–7	CES-D[a]	Radloff (1977)

[a] Items or scales were slightly modified to fit the current study.

studied with a customized set of ten items inspired by a more detailed value questionnaire developed by Partala and Kujala (in press). The salience of each of the ten universal values (Schwartz, 1992, 2006) was studied with one item. Finally, the perceived well-being impact of technology was studied using 16 scales. The first eight scales were the items from Flourishing Scale (Diener et al., 2009) and the scales from nine to sixteen were selected from the CES-D scale (Radloff, 1977), studying flourishing and depression, respectively.

It should be noted that some of the methods (marked with an asterisk in Table 2) were slightly adjusted to fit the current aim of analyzing single user experiences. The pictures used in assessing emotional valence and arousal were enhanced versions of the original pictures from the Self-Assessment Manikin (Bradley & Lang, 1994). To study task load, the original NASA-TLX scale anchors were retained, but instead of the original 21-point scale, we used a more convenient seven point scale, which was also consistent with most of the other evaluations. The statements were also slightly modified to fit the current aim of studying user experiences relative to using a particular interactive system or product. For example, the question "How mentally demanding was the task?" was adjusted to "How mentally demanding was your use of this system?". The statements probing psychological needs and user values had to be somewhat similarly modified in order to study user experiences. For example, the item "During this event I felt free to do things my own way" from Sheldon et al. (2001) studying the fulfillment of the autonomy need became "Using this system made me feel free to do things my own way." Similar adjustments were also made to the items studying flourishing and depression. For example, the item "I felt that everything I did was an effort." of the original CES-D method was changed to "Using this system made me feel that everything I did was an effort." The original CES-D scale with four options was also changed to a seven point Likert scale in line with most of the other evaluations.

On pages six to nine, the participants carried out the second phase of the questionnaire. In the second phase, the participants reported and analyzed their selected most influential user experiences related to *unsuccessful* technology adoptions using the same methods as in the first phase (writing a qualitative description of 30–70 words and filling in three questionnaire pages with the scales described in Appendix A). The definition for the most influential user experience in an unsuccessful technology adoption, as well as the instructions given before the study were repeated on page six. On page ten, the participants filled in a brief personality survey using quantitative scales. After all, the scales on page ten were not informative enough to be included in the analyses reported in this paper. On the final page of the questionnaire (Page 11), the participant could report her/his gender and age, and also give feedback about the questionnaire. When the participants had submitted the questionnaire, they were forwarded to the second brief questionnaire, in which only their names and student numbers were asked in order to give them course credit.

4.4. Data analysis

First, the data of selected single variables were averaged to form new variables as follows: positive emotions (average rating of the ten positive PANAS emotions), negative emotions (average rating of the ten negative PANAS emotions), task load (average of the NASA-TLX ratings), need fulfillment (average rating of the ten psychological needs), value concordance (average rating of the ten user values), flourishing (average rating of items 1–8 in the well-being block), and depression (average rating of items 9–16 in the well-being block, with item 12 reverse scored). In the analysis of psychological needs, autonomy, competence, and relatedness, which were studied using three items, were first averaged over those items, and after that, the scores for all the ten needs were averaged to form the need fulfillment score. The technology acceptance model related variables were analyzed in line with the analyses in Venkatesh and Bala (2008) to form the concepts of perceived usefulness, perceived ease of use, output quality, and intention to use. Items studying perceived enjoyment (Van der Heijden, 2004) were reverse scored and then averaged.

Friedman's rank tests were used to compare the participants' ratings across multiple categories (e.g. the ten psychological needs) for significant differences and Wilcoxon's matched pairs signed ranks tests were used in pairwise comparisons. These tests were selected because not all individual scales followed a normal distribution. Bonferroni corrected significance levels are presented in pairwise comparisons. Cronbach's α scores were calculated to estimate the reliability of the scales consisting of multiple items.

The composite variables (and valence and arousal) followed normal distribution more closely. An examination of the skewness and kurtosis of the composite variables showed a skewness range from -1.35 for Intention to use (successful adoptions) to 1.51 for Enjoyment (successful adoptions) and a kurtosis range of -1.24 for Intention to use (unsuccessful adoptions) to 1.64 for Intention to use (successful adoptions). For regression analyses, assumptions of linearity, homoscedasticity, and lack of outliers were visually confirmed from *P–P* plots. Based on these findings, it was decided that multiple regressions can be used in the analysis of the data from the composite variables, valence, and arousal.

Hierarchical multiple regressions with two blocks of variables (method: "Enter") were used to analyze the ability of a set of independent variables (block 2) to predict the dependent variables (valence, arousal, flourishing, and depression) after controlling for three demographic variables: age, gender, and technology skills (block 1). The independent variables (usefulness, ease of use, intention to use, output quality, task load, enjoyment, positive emotions, negative emotions, need fulfillment, and value concordance) entered the regression models as predictors, and separate regressions were run for each of the four dependent variables and for both most influential user experiences in successful and unsuccessful adoptions. Indicators of multicollinearity (tolerance and variance inflation factors) were well within acceptable limits (tolerance > .25; VIF < 10) in all reported regression analyses.

5. Results

5.1. Technology adopted by the participants

The main focus of this research was on the quantitative data; however, brief qualitative data were also collected to understand the objects of the successful and unsuccessful technology adoptions reported. In line with many related studies (e.g. Hassenzahl et al., 2010; Sheldon et al., 2001), the user experience descriptions collected in the current study were also too varied in many respects (e.g. length, contents) to warrant a full qualitative analysis. In line with previous user experience studies (e.g. Partala & Kallinen, 2012), the descriptions were also mainly very pragmatic, and as a consequence classifying user experiences on experiential dimensions was not feasible.

However, the objects of evaluation (the technology that the successful or unsuccessful adoption experiences were related to) were analyzed and categorized to aid in the interpretation of the current results. The technologies adopted by the participants were first categorized to devices and software technologies. In case of successful technology adoption, 44 out of 76 technologies were primarily about adopting devices, while the remaining 32 descriptions were about adopting software technology. When the

44 devices were further categorized, it was found that 22 descriptions were about mobile phones, six descriptions about tablet or e-reader devices, four about laptops, and three about accessories (e.g. a wireless mobile battery charger). The remaining nine descriptions were about other devices such as a digital camera, a smart TV, and a game console. Of the 32 adopted software technologies, 12 descriptions were about computer software applications (e.g. image processing software, a web browser), 7 were about mobile applications (e.g. a calendar app), 6 were about operating systems, and 5 were about software services (e.g. location-aware and social media services).

In case of unsuccessful technology adoption, 28 out of 76 technologies were primarily about adopting devices, while the remaining 48 descriptions were about adopting a software technology. Out of the 28 devices, seven were mobile phones, four were tablet or e-reader devices, four were accessories (e.g. a game controller), and nine descriptions were about other kinds as devices such as digital cameras, a digital amplifier, or an ATM. Of the 48 adopted software technologies, 22 descriptions were about computer software applications (e.g. a video editing software, a CAD application), 14 were about mobile apps (e.g. calling and messaging apps, apps related to exercising, and an app for creating and sharing shopping lists), nine were about software services (e.g. different social media services and web services), and three were about operating systems. In general, most of the technologies adopted successfully or unsuccessfully by the participants included both hardware and software components.

The technologies adopted by the participants were also classified according to the purpose of usage to personal technologies (with a voluntary technology adoption context), technologies used for work or studies (with a more compulsory technology adoption context), and technologies explicitly stated to be used for both personal and work/study purposes. The results of this analysis showed that 57 out of the 76 descriptions given in the context of successful technology adoptions were about personal technologies (e.g. voluntary adoptions of personal mobile phones, tablets, or laptops with no mention of using them for work/study purposes). 13 descriptions expressed a work or study context (e.g. a project management tool used at the workplace and a collaboration tool used in a school project), and six descriptions expressed both kinds of usage (e.g. a tablet computer used for reading both personal and study materials), or did not explicitly specify the context of use. For the unsuccessful technology adoptions, 56 descriptions were about personal technologies (again different personal devices and, for example, personals apps such as a sports tracker or a sleep cycle alarm clock). 17 descriptions expressed a work or study context (e.g. a data analytics program), and three descriptions did not explicitly specify the context of use.

5.2. Quantitative results

5.2.1. Overview

An overview of the quantitative results is presented in Table 3 below. For a detailed description of the methods and scales used, see Table 2 above.

Pairwise statistical tests for the emotion ratings confirmed that the participants experienced more happiness (higher emotional valence) $Z = 7.5$, $p < .001$, more positive emotions $Z = 7.2$, $p < .001$, and less negative emotions $Z = 7.1$, $p < .001$ in the context of most influential user experiences related to successful technology adoptions, when compared to unsuccessful technology adoptions. For arousal, there was no statistically significant difference between experiences related to successful and unsuccessful technology adoptions. Overall, the participants also reported more need fulfillment $Z = 7.0$, $p < .001$ and value concordance $Z = 6.8$, $p < .001$ in the context of successful technology adoptions, when compared to unsuccessful technology adoptions.

Table 3
Overview of the descriptive results (mean ratings). Scale 1–7 unless otherwise indicated.

		Successful technology adoption	Unsuccessful technology adoption
Emotions	Valence (1–9)	7.7	2.3
	Arousal (1–9)	6.3	5.8
	Positive emotions (1–5)	3.3	2.3
	Negative emotions (1–5)	1.4	2.4
Technology acceptance	Perceived usefulness	5.8	2.5
	Perceived ease of use	5.5	2.9
	Output quality	5.6	2.6
	Intention to use	6.2	3.4
	Perceived enjoyment	5.8	3.2
Task load	Task load	2.6	4.1
Psychological needs	Need fulfillment	4.0	2.7
User values	Value concordance	4.1	2.8
Well-being	Flourishing	4.2	3.2
	Depression	2.4	3.7

5.2.2. Experienced emotions

Average ratings for the ten positive and ten negative PANAS emotions are presented in Figs. 1 and 2 for most influential experiences related to both successful and unsuccessful technology adoptions. Statistical testing confirmed that there were significant differences between ratings of the ten positive emotions for both successful technology adoption $\chi^2_F = 231.7$, $p < .001$ and unsuccessful technology adoption values $\chi^2_F = 91.5$, $p < .001$. Similarly, variations in the ratings of negative emotions differed significantly for both successful technology adoption $\chi^2_F = 115.9$, $p < .001$ and unsuccessful technology adoption values $\chi^2_F = 220.1$, $p < .001$.

When the participants' ratings for the positive emotions (Fig. 1) were compared pairwise between successful and unsuccessful technology adoption experiences, it was found that for nine out of ten emotions, the participants gave higher ratings in the context of successful technology adoption (Interested $Z = 6.8$, $p < .001$; Excited $Z = 6.2$, $p < .001$; Strong $Z = 4.1$, $p < .001$; Enthusiastic $Z = 7.0$, $p < .001$; Proud $Z = 6.0$, $p < .001$; Inspired $Z = 5.8$, $p < .001$; Determined $Z = 3.2$, $p < .01$; Attentive $Z = 4.7$, $p < .001$; Active $Z = 5.9$, $p < .001$). For Alert, there was no statistically significant difference.

The ratings of negative emotions (Fig. 2) were also significantly higher in the reported unsuccessful adoption experiences, when compared to corresponding ratings for successful experiences, in the case of nine of the ten emotions (Distressed $Z = 5.3$, $p < .001$;

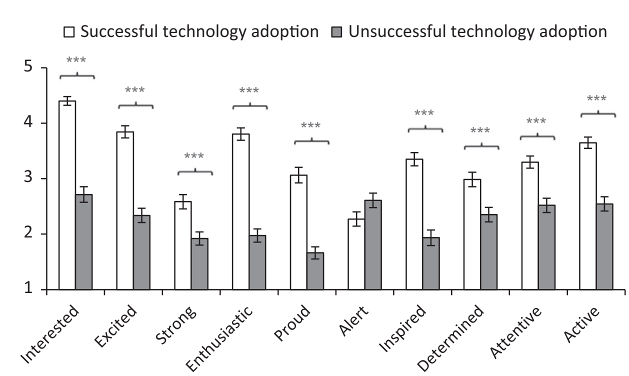

Fig. 1. Average ratings of positive emotions during the evaluated user experiences (1 = very slightly or not at all – 5 = extremely; error bars denote standard errors of the means).

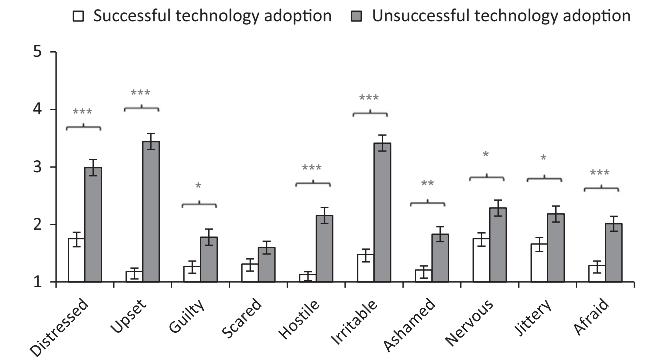

Fig. 2. Average ratings of negative emotions during the evaluated user experiences (1 = very slightly or not at all – 5 = extremely; error bars denote standard errors of the means).

Upset $Z = 7.2$, $p < .001$; Guilty $Z = 3.1$, $p < .05$; Hostile $Z = 5.5$, $p < .001$; Irritable $Z = 6.8$, $p < .001$; Ashamed $Z = 3.7$, $p < .01$; Nervous $Z = 3.0$, $p < .05$; Jittery $Z = 3.1$, $p < .05$; Afraid $Z = 4.6$, $p < .001$). For Scared, there was no statistically significant difference. Significant pairwise differences between the most influential user experiences in successful and unsuccessful technology adoptions are also marked to all figures (asterisks denote significance levels: $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$).

5.2.3. Technology acceptance and perceived enjoyment

Average ratings for the technology acceptance model variables, as well as enjoyment, are presented in Fig. 3 for both successful and unsuccessful technology adoption experiences. The statistical analyses showed significant variation among the ratings given for the four technology adoption model variables (usefulness, ease of use, output quality, and intention to use) both in the context of successful $\chi^2_F = 21.3$, $p < .001$ and unsuccessful $\chi^2_F = 8.3$, $p < .05$ technology adoption experiences.

As expected, pairwise statistical tests for the technology acceptance model related ratings showed that in the context of successful technology adoption experiences, the participants gave significantly higher ratings in terms of usefulness $Z = 7.4$, $p < .001$, ease of use $Z = 7.2$, $p < .001$, output quality $Z = 7.4$, $p < .001$, and intention to use $Z = 7.0$, $p < .001$, when compared to unsuccessful technology adoption experiences. Perceived enjoyment was also rated higher in the context of successful technology adoption experiences $Z = 7.0$, $p < .001$.

5.2.4. Task load

Average ratings for the NASA Task Load Index variables are presented in Fig. 4 for both successful and unsuccessful technology adoption experiences. The statistical analyses showed significant variation among the NASA TLX ratings both in the context of successful $\chi^2_F = 180.0$, $p < .001$ and unsuccessful $\chi^2_F = 95.6$, $p < .001$ technology adoption experiences.

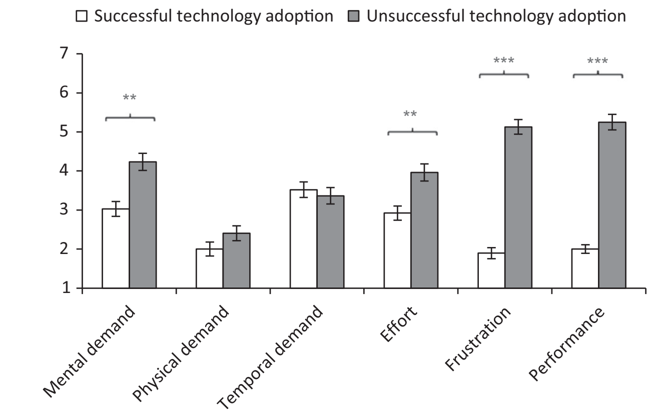

Fig. 4. Average ratings for the NASA Task Load Index questions (1 = very low – 7 = very high, except for performance: 1 = success, 7 = failure; error bars denote standard errors of the means).

Overall task load scores (see Table 3) were rated as significantly higher in most influential experiences of unsuccessful (vs. successful) technology adoption $Z = 3.3$, $p < .01$. Pairwise statistical tests comparing successful and unsuccessful adoption experiences for each of the task load dimensions showed that the participants reported more mental demand $Z = 3.9$, $p < .01$, effort $Z = 3.7$, $p < .01$, and frustration $Z = 7.3$, $p < .001$ in the context of unsuccessful technology adoption experiences. As expected, they also reported more successful performance in the context of successful technology adoption experiences $Z = 7.2$, $p < .001$. The differences in reported physical demand and temporal demand were not statistically significant between successful and unsuccessful technology adoptions.

5.2.5. Psychological needs

Fig. 5 illustrates the average ratings for the fulfillment of the ten psychological needs for both successful and unsuccessful technology adoption experiences. The statistical analyses showed significant differences among the ratings for the ten psychological needs both in the context of successful $\chi^2_F = 197.3$, $p < .001$ and unsuccessful $\chi^2_F = 34.3$, $p < .001$ technology adoption experiences.

Pairwise comparisons between successful and unsuccessful technology adoption experiences showed that need fulfillment ratings for seven of the ten needs were higher in the context of successful adoption experiences (Autonomy $Z = 7.4$, $p < .001$;

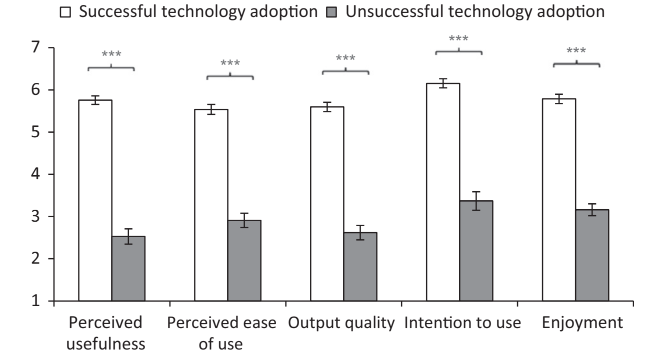

Fig. 3. Average ratings for the main Technology acceptance model variables and perceived enjoyment (1 = strongly disagree – 7 = strongly agree; error bars denote standard errors of the means).

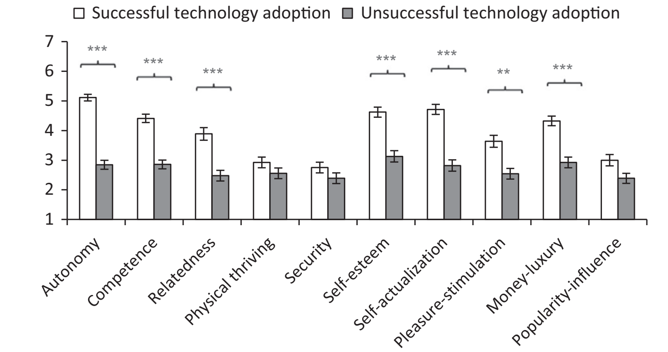

Fig. 5. Average ratings for the statements probing the fulfillment of psychological needs (1 = strongly disagree – 7 = strongly agree; error bars denote standard errors of the means).

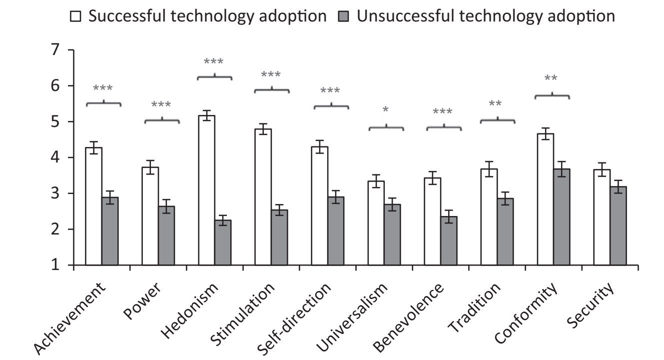

Fig. 6. Average ratings for the statements probing concordance with personal values (1 = strongly disagree – 7 = strongly agree; error bars denote standard errors of the means).

Competence $Z = 6.5$, $p < .001$; Relatedness $Z = 5.5$, $p < .001$; Self-esteem $Z = 5.3$, $p < .001$; Self-actualization $Z = 5.7$, $p < .001$; Pleasure-stimulation $Z = 3.9$, $p < .01$; Money-luxury $Z = 5.3$, $p < .001$). For physical thriving, popularity-influence, and security, no statistical differences were found.

5.2.6. User values

Fig. 6 illustrates the average ratings for the concordance with the ten universal values for both successful and unsuccessful technology adoption experiences. The statistical analyses showed significant differences among the ratings for the ten universal values both in the context of successful $\chi^2_F = 132.6$, $p < .001$ and unsuccessful $\chi^2_F = 64.4$, $p < .001$ technology adoption experiences.

Pairwise comparisons showed that the participants reported higher concordance with nine of the ten values in the context of experiences related to successful technology adoption, when compared to unsuccessful adoption experiences (Achievement $Z = 5.3$, $p < .001$; Power $Z = 4.2$, $p < .001$; Hedonism $Z = 7.1$, $p < .001$; Stimulation $Z = 6.7$, $p < .001$; Self-direction $Z = 5.0$, $p < .001$; Universalism $Z = 3.2$, $p < .05$; Benevolence $Z = 4.3$, $p < .001$; Tradition $Z = 3.8$, $p < .01$; Conformity $Z = 3.9$, $p < .01$). For the security value, no statistically significant difference was found.

5.2.7. Well-being impact

The average score for flourishing (questions 1–8 in the well-being question block) was 4.2 for the most influential user experiences in the context of a successful technology adoption and 3.2 in the context of an unsuccessful adoption. The difference was statistically significant $Z = 5.8$, $p < .001$. The average depression score (questions 9–16 in the well-being question block) was 2.4 for the most influential user experiences in the context of a successful technology adoption and 3.7 in the context of an unsuccessful adoption. This difference was also statistically significant $Z = 6.5$, $p < .001$.

5.2.8. Reliability analysis

Cronbach's α scores were calculated for the all the constructs, which were measured using multiple scales. In the context of user experiences related to successful technology adoption, the reliability scores for the technology acceptance model variables were as follows: Usefulness $\alpha = .81$, Ease of use $\alpha = .82$, Output quality $\alpha = .81$, Intention to use $\alpha = .76$. The corresponding scores in the context of unsuccessful technology adoption were: Usefulness $\alpha = .96$, Ease of use $\alpha = .84$, Output quality $\alpha = .91$, Intention to use $\alpha = .94$. The reliability score for the scale used for measuring enjoyment was for successful technology adoption experiences $\alpha = .86$ and for unsuccessful technology adoption experiences $\alpha = .82$.

For the self-determination theory related needs, Cronbach's α scores were as follows in the context of successful technology adoption experiences: Autonomy $\alpha = .71$, Competence $\alpha = .80$, and Relatedness $\alpha = .94$. The corresponding scores in the context of unsuccessful technology adoption were: Autonomy $\alpha = .78$, Competence $\alpha = .77$, and Relatedness $\alpha = .93$. Finally, in the context of successful technology adoption, the reliability scores were $\alpha = .93$ for the Flourishing Scale, and $\alpha = .77$ for the modified Depression Scale. In the context of unsuccessful technology adoption the scores were $\alpha = .90$ for flourishing and $\alpha = .70$ for depression. Thus, all of the reliability scores calculated were above or equal to .7, indicating satisfactory internal reliability. These scores were also compared to the reliabilities reported in the original publications (see Table 2 for references), or in the case of psychological needs, for which alphas were not reported in the original publication, to user experiences studies applying the methods (Hassenzahl et al., 2010; Partala, 2011; Partala & Kallinen, 2012). In the current study, the alphas were on the same level than in these publications, except for depression, in which the original CES-D scale consisting of 16 items had higher internal consistency ($\alpha = .84 - .90$; Radloff, 1977). The alpha for intention to use in the context of successful adoptions was also slightly lower in the current study (.76) than in the TAM literature ($\alpha = .82 - .97$; Venkatesh & Davis, 2000).

Table 4
Correlations (r) between the main variables. Lower left diagonal: most influential experiences in successful technology adoptions. Upper right diagonal: most influential experiences in unsuccessful technology adoptions.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Valence	1	–.33**	.26*	–.42***	.50***	.39***	.61***	–.06	–.11	.18	.16	–.33**	.32**	.30*
2. Arousal	.20	1	.15	.28*	–.21	–.31**	–.19	.04	.15	.04	.08	.21	.04	–.06
3. Positive emotions	.28*	.13	1	–.03	.30**	.10	.28*	.23	–.03	.40***	.30**	–.18	.28*	.33**
4. Negative emotions	–.49***	.05	.02	1	–.10	–.33**	–.20*	.12	.32**	–.13	–.06	.58***	–.08	–.09
5. Usefulness	.35**	–.05	.24*	–.15	1	.41***	.54***	.18	–.01	.31**	.46***	–.16	.54***	.60***
6. Ease of use	.36**	.04	.06	–.15	.10	1	.46***	.00	–.37**	.28*	.31**	–.43***	.40***	.43***
7. Output quality	.31**	–.01	.10	–.05	.09	.40***	1	–.05	–.02	.26*	.28*	–.43***	.45***	.45***
8. Intention to use	.37**	.08	.14	–.29*	.16	.26*	.43***	1	.14	.23*	.18	.18	.11	.20
9. Task load	–.20	.00	.08	.24*	.04	–.34**	–.28*	–.22	1	–.10	–.01	.32**	–.05	.00
10. Enjoyment	.30**	.27*	.27*	–.03	.02	.15	.32**	.24*	–.08	1	.15	–.24*	.20	.26*
11. Flourishing	.10	–.08	.24*	.05	.25*	–.04	.03	–.02	.16	–.08	1	–.13	.78***	.82***
12. Depression	–.26*	.08	–.09	.30**	–.14	–.10	–.12	–.25*	.26*	.14	.00	1	–.20	–.13
13. Need fulfillment	.20	.08	.27*	.16	.20	.12	.14	–.05	.20	–.16	.64***	.23	1	.85***
14. Value concordance	.06	–.04	.18	.06	.20	.05	.10	.06	.06	–.13	.75***	.00	.62***	1

* Correlation significant at $p < .05$.
** Correlation significant at $p < .01$.
*** Correlation significant at $p < .001$.

Table 5
Summary of hierarchical multiple regression analyses predicting valence of user experience and flourishing in the context of *most influential user experiences of successful technology adoptions* after controlling for age, gender, and technology skills. For the other dependent variables (arousal and depression), the *F* values did not become significant.

Variable	Valence of user experience			Flourishing		
	B	Std. error	*β*	*B*	Std. error	*β*
Positive emotions	.283	.196	.129	.120	.151	.066
Negative emotions	−1.091	.227	−.439***	−.112	.175	−.054
Usefulness	.335	.124	.245**	.082	.095	.073
Ease of use	.146	.110	.128	−.095	.085	−.101
Output quality	.046	.135	.035	−.007	.104	−.007
Intention to use	.069	.131	.053	−.010	.101	−.009
Task load	−.017	.136	−.012	.016	.104	.014
Enjoyment	−208	.113	.167	.023	.087	.022
Need fulfillment	.383	.158	.274*	.311	.122	.269*
Value concordance	−.221	.140	−.167	.619	.107	.567***
ΔR^2		.469			.614	
F (13, 62)	6.85***			8.62***		

* Significant at $p < .05$.
** Significant at $p < .01$.
*** Significant at $p < .001$.

5.2.9. Regression analyses

Pearson correlations between the main variables were first calculated to aid in the interpretation of the regression analyses. They are presented in Table 4 below with significance levels denoted by asterisks.

In order to identify significant relationships among the studied variables, hierarchical regression analyses were performed. The results are presented in Tables 5 and 6 below for most influential experiences of successful and unsuccessful technology adoptions, respectively. These results showed that the overall valence of the user experience was significantly affected by perceived usefulness, the fulfillment of psychological needs, and the PANAS score for negative emotions in the context of successful technology adoptions. Somewhat similarly, overall user experience valence was significantly affected by perceived usefulness, output quality, and the PANAS score for negative emotion in the context of unsuccessful adoptions. Depression was significantly affected by negative emotions and output quality in the context of unsuccessful technology adoptions (Table 6), but not in the context of successful technology adoptions. In both most influential user experiences of successful and unsuccessful technology adoptions, flourishing (positive well-being) was largely determined by need fulfillment and value concordance. In both analyses more than half of the variance in flourishing could be explained by need fulfillment and value concordance together. For predicting arousal, no significant results emerged in this analysis, even though the regression model was significant for most influential experiences in unsuccessful technology adoptions.

6. Discussion

Overall, the results of the current research highlighted the importance of user experience related variables focusing on the user's felt experience of technology use in the most influential technology adoptions. In the current study, we asked our participants to rate most influential user experiences related to successful and unsuccessful technology adoptions. The participants were not directed in any way regarding, which aspects (e.g. pragmatic vs. hedonic aspects) of user experience they should consider before deciding which experiences to report. Nevertheless, the results showed that the reported experiences were highly emotional: the overall emotional valence of user experience was given very high ratings in the context of the most influential experiences of successful adoptions and very low ratings in the most influential experiences of unsuccessful adoptions. The results on specific emotions further highlighted the dominant role of emotions in the reported user experiences. These results are in line with the holistic notion of user experience Hassenzahl (2010), according to which "feelings are integral to experiences (maybe even its core)".

The next step was to understand the antecedents of these positive or negative experiences, which were critical to the success of the reported technology adoptions. Contrary to our hypotheses presented in chapter three, only a few significant predictors emerged in the multiple regression analysis explaining valence of user experience, flourishing, and depression. Of the TAM variables, perceived usefulness and output quality were most directly related to experienced emotions. Perceived usefulness had a significant relationship with experienced valence in both successful and unsuccessful technology adoptions, which suggests that it may have a central role in predicting overall user experience evaluations across the full range of felt user experiences. Higher output quality also predicted higher valence and it was inversely related with depressive symptoms in the most influential experiences related to unsuccessful adoptions.

The results on specific emotions suggest that users may form their overall valence evaluations of user experience valence more closely based on the presence of negative emotions than positive emotions, at least when analyzed using the model of ten positive and ten negative emotions in the research instrument used in the current research (PANAS). This was indicated by the finding

Table 6
Summary of hierarchical multiple regression analyses predicting the four dependent variables (valence and arousal of user experience, flourishing, and depression) in the context of *most influential user experiences of unsuccessful technology adoptions* after controlling for age, gender, and technology skills.

Variable	Valence of user experience			Arousal of user experience			Flourishing			Depression		
	B	Std. error	*β*	*B*	Std. error	*β*	*B*	Std. error	*β*	*B*	Std. error	*β*
Positive emotions	.331	.225	.146	.633	.401	.187	.101	.136	.057	−.158	.146	−.109
Negative emotions	−.637	.201	−.302**	.519	.358	.165	.037	.122	.023	.535	.130	.397***
Usefulness	.323	.117	.324**	−.391	.209	−.262	.021	.071	.027	.054	.076	.085
Ease of use	−.020	.125	−.019	−.249	.223	−.159	−.009	.076	−.011	−.108	.081	−.162
Output quality	.447	.123	.421**	−.122	.220	−.077	−.102	.075	−.123	−.211	.080	−.310*
Intention to use	−.017	.076	−.020	−.063	.136	−.052	.013	.046	.021	.053	.049	.100
Task load	−.101	.180	−.059	.367	.321	.143	−.019	.109	−.015	.077	.117	.070
Enjoyment	.121	.127	.095	−.212	.227	−.111	.059	.077	.059	.082	.083	.100
Need fulfillment	.098	.256	.066	.804	.457	.361	.409	.155	.352*	−.228	.167	−.239
Value concordance	−.263	.242	−.196	−.247	.432	−.123	.633	.147	.605***	.214	.158	.249
ΔR^2		.513			.230			.717			.521	
F (13, 62)	6.14***			2.90**			13.30***			5.82***		

* Significant at $p < .05$.
** Significant at $p < .01$.
*** Significant at $p < .001$.

that the PANAS negative emotions score was a significant predictor of experienced overall valence in the context of most influential experiences of both successful and unsuccessful technology adoptions. In the context of successful adoptions, need fulfillment was also a significant predictor of overall valence, which is in line with the results by Hassenzahl et al. (2010), who also found a clear relationship between need fulfillment and positive affect in their study on positive experiences with interactive products. In order to achieve positive user experiences, the perceived pragmatic value of a product or system has to be high, but the product or system has to be also fulfilling in respect to hedonic aspects such as psychological needs. Psychological needs also seem to be more relevant in the context of positive than negative experiences, which are instead more directly caused by pragmatic aspects instead of hedonic or psychological aspects. A similar observation has been made, for example, by Partala and Kallinen (2012) in the context of participants' most satisfying and most unsatisfying recent user experiences. This might also explain why output quality was in the current study inversely related to valence and depression only in the context of unsuccessful adoptions: outcome, which is considered inappropriate by the user, may be alone enough to lead to an unsuccessful adoption, especially if it is associated with a negative emotional response from the user.

The current results also suggested that the concepts of need fulfillment and value concordance are related to positive long-time well-being (flourishing) in the most influential experiences of both successful and unsuccessful technology adoptions. These results suggest that in order to design for technologies, which can bring everyday value to people and improve the quality of life (cf. life-based design), psychological needs and especially values are of central importance. On the other hand, negative well-being (depression) seems to be related to negative emotional responses caused by unusable system outcomes in the context of unsuccessful adoptions. It is possible that the failure to adopt a system with desired outcomes itself affected the reported depression ratings in the context of the reported unsuccessful adoptions in the current study.

Overall, the descriptive results paint a picture, in which most influential experiences of successful technology adoptions are perceived as hedonically stimulating, enjoyable, and highly fulfilling of the most important psychological needs such as autonomy. The experiences are also accompanied by high levels of motivation-related positive emotions such as interest and enthusiasm, and almost complete lack of experienced negative emotions. They are also associated with pragmatic concepts such as usefulness and output quality, as well as ease of use and lack of effort. In contrast, the most influential experiences of unsuccessful technology adoptions are short on perceived pragmatic aspects such as usefulness and output quality. This also leads to pronounced levels of negative emotions such as being irritable, upset, or frustrated.

When the results for the successful and unsuccessful adoptions were compared to each other, statistically significant pairwise differences were found for most of the studied variables. These findings suggest that overall the current selection of variables was very relevant for the current study. Of the variables that did not differ significantly between the two conditions, physical demand and temporal demand seem to be more contextual than experiential variables and the equal fulfillment of the security need may also be due to similar use contexts in this respect. There were also no differences in experienced emotional arousal, which is in line with the common notion that both highly positive and negative experiences are often associated with more than average arousal (see e.g. Bradley & Lang, 1994). The participants may have also associated their ratings of the specific emotion "alert" (also no significant difference) with their general level of arousal. The insignificant differences between the ratings for both the security need and the security value in successful and unsuccessful adoptions suggest that security-related feelings did not play a large role at in the current results.

The results of the current study are well in line with previous research with one clear exception. In the majority of previous studies and also in the TAM3 model, the emotion-related concepts (most typically enjoyment and anxiety) are directly related to perceived ease of use, but not to perceived usefulness. In contrast, the current result showed that perceived usefulness (and also output quality in unsuccessful adoptions) was significantly related to emotional valence of the reported user experiences. These results suggest that in fact, there are usefulness (and output quality) related emotions, which may become important mainly in the context of single (decisive) user experiences, possibly as evaluative feelings contributing to technology acceptance or rejection.

The other results are much more consistent with previous research. As one would expect, all the TAM related variables – perceived ease of use, perceived usefulness, intention to use, output quality, and perceived enjoyment – were all significantly higher in the context of most influential experiences of successful than unsuccessful technology adoption. The mean ratings for these central TAM variables were about on the same level compared to each other, as in many existing TAM studies (see e.g. Hu, Clark, & Ma, 2003; Park & Chen, 2007), and the mean ratings in the context of most influential experiences of successful and unsuccessful adoptions were higher and lower, respectively, than in average TAM studies, in which mean ratings for the TAM variables typically settle around 4 or 5 on the 1–7 scale. The emotion ratings of both dimensional and specific emotions also followed typical patterns obtained in previous literature using those methods (e.g. Bradley & Lang, 1994; Partala & Kallinen, 2012).

The results on psychological needs are also mostly in line with previous research (e.g. Hassenzahl et al., 2010; Partala & Kallinen, 2012), as the self-determination theory related needs of autonomy, competence, and relatedness, as well as self-esteem were rated among the most salient needs. On the other hand, however, the fulfillment of self-actualization-meaning and money-luxury needs were rated as more salient in the current study compared to previous research, especially in the context of most influential user experiences related to successful technology adoptions. These results may be due to the current emphasis on the acquisition of *personal* technologies in the descriptions of the participants. Similarly, the results on values are in line with previous research, (e.g. Partala & Kujala, in press), as hedonism, self-direction, achievement, and tradition were rated among the most influential user values. In contrast, stimulation and conformity were also among the most salient values in the current study. This might be because of the large number of experiences reported on personal technologies, which the participants found personally stimulating and not interfering with their social relationships. Security values were also not emphasized in the current results. Otherwise, the results on user values also give support to findings by Partala and Kujala (in press) that all ten universal values are potentially relevant in user experiences.

In previous research, flourishing has been shown to increase with positive emotions and has been linked to fulfilled psychological needs (e.g. Diener et al., 1999). The flourishing scale used in the study is based on theories of universal human needs, such as competence, relatedness and self-acceptance, so it would be expected that flourishing increases while key psychological needs are being filled (Ryan & Deci, 2000). This was confirmed in the current data in both successful and unsuccessful technology adoption contexts, and the results also suggested that higher reported value concordance increased flourishing in both contexts, which is also in line with notions from the field of psychology (e.g. Sheldon et al., 2004). However, in the current data, the relationship between positive emotions and flourishing did not become statistically significant. Depression is increased by negative emotions and has been shown to decrease when psychological needs are filled (e.g. Meifen, Schaffer, Young, & Zkalik, 2005). The current findings also suggest that negative emotions affect depression in the context of user experiences, but this relationship was statistically significant only in the context of unsuccessful technology adoptions, in which the participants reported much more negative emotions. Again, this relationship is in line with prior findings from general psychology (e.g. Gentile et al., 2009). In contrast, the relationship between need fulfillment and depression was not statistically significant in the current research design focusing on most influential user experiences, even though a line psychological research suggests that level of fulfillment of psychological needs underlies both positive and negative mental health (e.g. Ryan & Deci, 2000).

When interpreting the current results, one has to keep in mind that the current research was carried out using a basic research approach, in which a phenomenon is studied through its extremities, in this case, the most influential experiences in successful and unsuccessful technology adoptions. It is reasonable to believe that the current approach was highly sensitive in identifying the most important variables, which have practical value on the user's decision on technology adoption or non-adoption. This was an important goal of the current research. On the other hand, the limitation of this approach is that the data does not represent the full range of all situations and user experiences, for example, typical technology use situations, which often are quite neutral in many respects. The current results also did not warrant a fully successful structural modeling or path analysis by taking the central TAM concepts as the basis and structuring the UX variables around these concepts, and this is why the analysis presented is limited to studying direct effects between the selected independent and dependent variables. Overall, the correlations between the TAM concepts were also lower than in previous studies. This was probably because the users reported highly positive and negative user experiences and also gave the TAM evaluations in the context of those experiences instead of the general impression of the system like in most TAM studies. It may be that the TAM model loses some of its explanatory power in the context of evaluating single highly influential positive and negative user experiences, in which hedonic variables become more pronounced. However, this notion should be confirmed in further research. In more neutral settings, user experience variables (e.g. the variables significantly related to TAM concepts in this study) might also be successfully augmented to the entire TAM model (e.g. TAM3). Further research is also needed to study, for example, to what extent the current regression based findings would hold in more neutral everyday user experiences of technology use. In addition, future research could aim at more detailed understanding of the qualitative contents of central user experience variables such as emotions, psychological needs and values, and also of behavioral patterns, which lead to negative user experiences and unsuccessful adoptions.

We aimed at including all the central user experience variables in the current research to understand the nature of most influential user experiences in technology adoptions in detail. In fact, the current study is distinguished from most user experience studies by its aim of understanding user experience holistically. However, one might argue there are still other factors influencing user experiences, which could have been added to this research. For example, it is known that user experiences are greatly affected by the purpose of use, as well as the use context more generally. Within the resources of the current study, it was only possible to take context into account briefly through some of the statements to study task load (see Appendix A) and also by classifying the qualitative descriptions to voluntary vs. more compulsory contexts of technology adoption. The current study also did not concentrate on cultural factors affecting technology use, which have been studied in previous user experience studies mostly using qualitative methods.

Another limitation of the current study is that the current participants were undergraduate and graduate university students, partly from different cultures, which may mean that some participants understood some of the statements somewhat differently than others. There were also more male than female participants. These are limitations in the generalizability of the results to the wider population, which typically has less education and familiarity with technology acceptance and user experience related issues. However, according to a meta-analysis, there is previous evidence of "the value of using students as surrogates for professionals in some technology adoption studies, and perhaps more generally" (King & He, 2006). Indeed, it is reasonable to believe that the current sample understood the different scales and assignments well and the participants were also sensitive to the scales used in the current study, which might have enhanced the validity of the results. The experiences described were unique for each participant and the anonymity of the participants was protected, which gives reason to believe that a valid enough data set could be obtained using the current methods.

From the practical perspective, the most important implication of the current research seems to that besides traditional attributes (e.g. usefulness, ease of use, output quality), designers have to pay attention to the users' emotional responses to products in order to promote successful technology adoptions. In the current study, the objects of technology adoptions were mostly personal technologies, but they were not especially hedonic in nature. Still, the participant reported highly emotional positive or negative experiences as the most influential user experiences in technology adoptions. From this perspective, it seems that the designers of technology products may be overlooking the current knowledge on emotional design (e.g. Norman, 2004). The results also give support to the important role of the concept of psychological needs (Hassenzahl, 2010; Sheldon et al., 2001; Deci & Ryan, 2014) especially in designing for positive experiences, which can in turn contribute to successful technology adoptions. Systematic knowledge how psychological needs should be considered in design is, however, still emerging and it is mostly up to individual designers to utilize their insight in this respect. Finally, designers and technology managers should pay attention to the wider context of the technology use, including also activities more generally. The technologies and activities have to be in line with the users' values (cf. value-sensitive design) and they also have to fit into the use's life so that the user thinks that any changes contribute positively to overall well-being (flourishing; cf. life-based design).

In all, the results add to the current knowledge on the exact nature of most influential user experiences of successful and unsuccessful technology adoptions from a psychological perspective. The results also highlighted relationships between user experience and technology acceptance concepts, which have not been systematically explored in previous studies. The results suggest that concepts and variables from the user experience research field complement the existing TAM methods in a beneficial way, especially in understanding the complexity of positive user experiences associated with successful technology adoptions. The concepts and methods currently available in the research field of user experience are mainly based on well-established theories and methods from psychological sciences, and using them in technology adoption studies is likely to result in a more comprehensive and holistic account of all the factors affecting usage behavior, as well as technology adoption and non-adoption. The current results suggest that an integrated approach focusing on both the users' perceptions related to technology use and most influential felt user experiences would be an improvement in broadening the scope of current technology adoption research.

Acknowledgements

The authors would like to thank all the participants for their thoughtful responses. This research was supported by Finnish Work Environment Fund (grant 113103) and Tampere University of Technology.

Appendix A. Statements and scales used in the study

See Section 2.3 for explanation of the origin of the scales.

A.1. Emotions

Dimensional emotions:

1. Unhappiness – Happiness

2. Calmness – Arousal

Specific emotions:

1. Interested	11. Irritable
2. Distressed	12. Alert
3. Excited	13. Ashamed
4. Upset	14. Inspired
5. Strong	15. Nervous
6. Guilty	16. Determined
7. Scared	17. Attentive
8. Hostile	18. Jittery
9. Enthusiastic	19. Active
10. Proud	20. Afraid

Scale:	Very Slightly or Not at All	A Little	Moderately	Quite a Bit	Extremely
	1	2	3	4	5

A.2. Technology acceptance model

1. Using the system improved my performance.
2. Using the system increased my productivity.
3. Using the system enhanced my effectiveness.
4. I found the system to be useful.
5. My interaction with the system was clear and understandable.
6. Interacting with the system did not require a lot of my mental effort.
7. I found the system to be easy to use.
8. I found it easy to get the system to do what I want it to do.
9. The quality of the output I got from the system is high.
10. I had no problem with the quality of the system's output.
11. I rated the results from the system to be excellent.
12. Assuming I had access to the system, I intended to use it.
13. Given that I had access to the system, I predicted that I would use it.
14. I planned to use the system in the next few months.

Scale:	Strongly disagree agree			Neither agree nor disagree			Strongly
	1	2	3	4	5	6	7

A.3. Task load

1. How mentally demanding was your use of this system?
2. How physically demanding was your use of this system?
3. How hurried was your use of this system?
4. How hard did you have to work to accomplish your level of performance when using this system?
5. How insecure, discouraged, irritated, stressed, and annoyed were you when using this system?
6. How successful were you in accomplishing what you were trying to do when using this system?

Scale in questions 1–5:	Very low						Very high
	1	2	3	4	5	6	7

Scale in question 6:	Failure						Success
	1	2	3	4	5	6	7

A.4. Enjoyment

When using this system, I thought that the use was:

Enjoyable	1	2	3	4	5	6	7	Disgusting
Exciting	1	2	3	4	5	6	7	Dull
Pleasant	1	2	3	4	5	6	7	Unpleasant
Interesting	1	2	3	4	5	6	7	Boring

A.5. User needs

1. Using this system made me feel that my choices were based on my true interests and values.
2. Using this system made me feel free to do things my own way.
3. Using this system made me feel that my choices expressed my "true self".
4. Using this system made me feel that I was successfully completing difficult tasks and projects.
5. Using this system made me feel that I was taking on and mastering hard challenges.
6. Using this system made me feel very capable in what I did.
7. Using this system made me feel a sense of contact with people who care for me, and whom I care for.
8. Using this system made me feel close and connected with other people who are important to me.
9. Using this system made me feel a strong sense of intimacy with the people I spent time with.
10. Using this system made me feel a sense of deeper purpose in life.
11. Using this system made me feel a strong sense of physical well-being.
12. Using this system made me feel that I was experiencing new sensations and activities.
13. Using this system made me feel that I had nice things and possessions.
14. Using this system made me feel safe from threats and uncertainties.
15. Using this system made me feel quite satisfied with who I am.
16. Using this system made me feel that I strongly influenced others' beliefs and behavior.

Scale:	Strongly disagree			Neither agree nor disagree			Strongly agree
	1	2	3	4	5	6	7

A.6. User values

1. Using this system made me feel that I was an ambitious and successful individual.
2. Using this system made me feel that I had a high social status in my community.
3. Using this system made me feel that my use was pleasurable.
4. Using this system made me feel that I was getting exciting stimulation.
5. Using this system made me feel that I was a creative and independent individual.
6. Using this system made me feel that my actions were well in line with global values such as social justice and protecting the environment.
7. Using this system made me feel that I could help other people near me.
8. Using this system made me feel that my actions were well in line with traditions I consider as important.
9. Using this system made me feel that I was not causing any harm or disorder in my community.
10. Using this system made me feel that I could advance the safety and stability of myself and my environment.

Scale:	Strongly disagree			Neither agree nor disagree			Strongly agree
	1	2	3	4	5	6	7

A.7. Psychological well-being

1. Using this system made me feel I lead a purposeful and meaningful life.
2. Using this system made me feel that my social relationships are supportive and rewarding.
3. Using this system made me feel that I am engaged and interested in my daily activities.
4. Using this system made me feel that I actively contribute to the happiness and well-being of others.
5. Using this system made me feel that I am competent and capable in the activities that are important to me
6. Using this system made me feel that I am a good person and live a good life.
7. Using this system made me feel optimistic about my future.
8. Using this system made me feel that people respect me.
9. Using this system made me feel that I was bothered by things that usually don't bother me.
10. Using this system made me feel that I could not "get going".
11. Using this system made me feel sad.
12. Using this system made me feel that I was just as good as other people.
13. Using this system made me feel that I had trouble keeping my mind on what I was doing.
14. Using this system made me feel that everything I did was an effort.
15. Using this system made me feel depressed.
16. Using this system made me feel that my sleep was restless.

(statements 1–8 indicate flourishing; statements 9–16 indicate depression, statement 12 was reverse scored).

Scale:	Strongly disagree			Neither agree nor disagree			Strongly agree
	1	2	3	4	5	6	7

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