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ABSTRACT

User experience is commonly considered important for IT adoption and use. However, a formal measure that captures a user's holistic experience obtained through the use of an IT artifact has not been developed. In this study, we propose a new measure of user experience and examine its validity using the data collected from over 240 smartphone mobile users in South Korea. Based on prior research on brand experience in marketing, we conceptualize user experience as a second order construct with four sub-dimensions. The convergent and discriminant validity of the measurement items of mobile user experience is examined along with the established measurement items of the cognitive absorption, which is similar to the proposed construct in that both capture what a user has experienced while interacting with an IT artifact. Further, we examine the effects of the proposed construct on perceived usefulness, satisfaction, and continuous intention.

Keywords

User experience; Cognitive absorption; Measure development; Mobile application

INTRODUCTION

User experience is a critical issue for mobile business, which seeks to help its users improve their daily experience through its services for almost every aspect of life. Mobile service market has recently emerged as an important sector of IT business particularly driven by the rapid development of so called "smart phones" and their applications.

Apple's App Store, the most popular destination for mobile phone applications, was introduced in July 2008 and over 10 billion applications were already downloaded by January 2011. These smart phone applications are now redefining how people think, communicate, and live, influencing many parts of every day experience of their users.

User experience has gained momentum in recent years and has been studied in diverse fields such as human-computer interaction (HCI), marketing, and design (Hassenzahl & Tractinsky, 2006). Many mobile service providers and mobile device manufacturers showcase on their web sites their commitment to attend to the users' experience and foreground experience-centered approaches (IBM, 2008; Microsoft, 2010; Nielsen et al., 2000). Even though user experience is well known to be important, it has been mostly studied at the conceptual level. To systematically explore the effects of technologies on user experience, we must understand not only what it is, but also how to measure it. In this study, we develop a new measure of mobile user experience and empirically validate the measure.

Based on the Brakus et al's work (2009) in marketing, we conceptualized user experience as a second order construct with four sub-dimensions: sensory, affective, intellectual, and behavioral. Compared to prior research, our approach to the measurement of user experience represents a holistic, comprehensive perspective that provides a fuller exploration of construct space of user experience. Further, for each dimension of user experience, we generated multiple measurement items targeted for mobile service experience, and examined their psychometric properties using the data collected from 244 smartphone users in South Korea. Finally, in this study we examined how user experience was distinct from cognition absorption (Agarwal & Karahanna, 2000), which is similar to user experience in that both capture what a user has experienced while interacting with an IT artifact, and compared how their effects were different on other variables, such as perceived usefulness, user satisfaction, and intention to continue using the service.

The measurement scales of mobile user experience developed and validated by this study represent a significant value for those practitioners who are interested in refining their on-going mobile services for the betterment of user experience.

THEORETICAL BACKGROUND

User Experience

Despite the growing interest in user experience, it has been difficult to reach an agreement on the nature and scope of user experience (Law et al., 2009). Forlizzi and Battarbee (2004) assert that user experience is associated

with a wide variety of meanings, ranging from traditional usability to beauty, hedonic, affective or experiential aspects of technology use.

From a marketing perspective, Hoch (2002) argues that experience can be seductive and engaging. Because it stimulates more than one of the senses and creates multiple traces in memory, experience is memorable and multidimensional. Consistent with this view, Desmet and Hekkert (2007) define product experience as the entire set of affects that is elicited by the interaction between a user and a product including all the senses that are gratified (aesthetic experience), the meanings attached to the product (experience of meaning), and the feelings and emotions that are elicited (emotional experience). Also, from a design perspective, Norman (2004) asserts that experience is not only governed by cognition but also by emotion, and proposes emotional reactions into visceral, behavioral, and reflective.

User experience has a long historical root for its multidimensional nature. The philosopher John Dewey (1925) views experience as a totality, engaging self in relationship with object in a situation. Researchers and practitioners in a variety of disciplines have built on the foundations of Dewey's theory to accumulate knowledge about how people engage with products and the world (Forlizzi & Battarbee, 2004). Following Dewey, Forlizzi and Battarbee (2004) posit that 'an experience' can be articulated or named. This type of experience may be characterized by a number of product interactions and emotions, but is schematized with a particular character in one's memory and a sense of completion. 'An experience' has a beginning and an end, and often inspires emotional and behavioral changes in the experiencer. In addition, Pinker (1997) identifies four mental modules that are closely related to Dewey's experiences: sensory perception, feelings and emotions, creativity and reasoning, and social relationship.

Brakus et al. (2009) argue that experience can arise in a variety of settings. Experience can occur when consumers shop, buy, and consume products. Further, they argue that experience can be associated with specific brand-related stimuli, resulting in brand experience. They define brand experience as "subjective, internal consumer responses (sensations, feelings, and cognitions) and behavioral responses evoked by brand-related stimuli," and identifies four dimensions of brand experience: sensory, affective, intellectual, and behavioral (Brakus, et al., 2009).

Mobile user experience is also multidimensional. As it is with brand experience, mobile user experience can be formed by mobile service-related stimuli. While interacting with mobile applications and services, a user can make cognitive responses (e.g., engage in thinking or organizing thoughts), sensory responses (e.g., develop good visual impressions), affective responses (e.g., become irritated or anxious), and behavioral responses (e.g., move from one location to another or take a walk regularly).

Consistent with the dominant view in the literature about experience as multidimensional in nature, we conceptualize mobile user experience as a particular type of user experience that occur in relation to mobile services, and define it as "the totality of mobile user's experiential responses evoked by mobile services." Furthermore, building upon the Brakus et al's work (2009) on brand experience, we theorize that the totality of mobile user's experiential responses is bounded by the four underlying dimensions of mobile user experience, which is further defined below.

(1) Sensory dimension (of mobile user experience) refers to the visual, auditory, and tactile stimulations provided by a mobile service and includes aesthetic perception of mobile service;

(2) Intellectual dimension refers to the ability of the mobile service to engage users' mental activities and thought processes;

(3) Behavioral dimension refers to the bodily experiences, lifestyles, and physical interactions with mobile services; and

(4) Affective dimension refers to the feelings generated by the mobile service and its emotional bond with the user.

Cognitive Absorption

Synthesizing prior work on the flow and cognitive engagement experiences, Agarwal and Karahanna (2000) proposed cognitive absorption as a construct that can capture user experiences with IT, in particular as they are manifested in absorption and flow, and defined it as a state of deep involvement with an IT artifact. Further, they defined cognitive absorption as a second order construct consisting of five sub-dimensions: (1) temporal dissociation, (2) focused immersion, (3) heightened enjoyment, (4) control, and (5) curiosity.

Cognitive absorption and user experience are similar and closely related in that both intend to capture what a user has experienced while interacting with an IT artifact. Both are state variables that reflect what a user has undergone. At the same time, there are notable differences between the two constructs. Cognitive absorption is about "deep" involvement, a special, heightened state of experience. While involvement is necessary for quality experience, the status of deep involvement is only required for cognitive absorption. In contrast, user experience is broader in capturing the effects of external stimuli as it seeks to capture the totality of responses to the external stimuli evoked through multiple dimensions, while cognitive absorption is rather concerned about how deeply the user is involved. Further, cognitive absorption is focused on a particular type of experience, which is *cognitive* engagement. Thus, it focuses on the cognitive aspects of experience while user experience is concerned about sensory, behavioral, affective, as well as cognitive, aspects.

SCLAE DEVELOPMENT AND DATA COLLECTION

Following standard measure development procedures (Churchill, 1979), scales to measure mobile user experience were developed through iterative steps including specifying the domain of construct, generating a sample of items, and testing and purifying the items. The conceptual definitions of the four dimensions of user experience were used to generate 10-12 candidate items for each. The items were then pretested by a group of expert judges. Based on the feedback from the judges, those items that best fit the theoretical domain of the construct were selected, yielding 10 items for each first order construct of mobile user experience.

A field survey was then conducted online to assess the psychometric properties of the resulting scales. In addition to the measure of mobile user experience, the survey questionnaire included the measure of cognitive absorption, adopted from Agarwal and Karahanna (2000), in order to examine the convergent and discriminant validity of the mobile user experience measure along with the measure of cognitive absorption. To counterbalance any ordering effect, there were two versions of the questionnaire: one starting with the measure of user experience followed by cognitive absorption and the other in the opposite order. The questionnaire also included the measures of perceived usefulness, satisfaction, and continuation intention adopted from Bhattacherjee (2001), so that the effects of user experience on a user's instrumental belief, satisfaction, and behavioral intention to continue using the service could be assessed.

The online survey was conducted in South Korea and resulted in a total of 244 usable responses. According to the survey, 67% of the respondents are males (n=165) and 33% of are females (n=79). A majority of the respondents (80%) range in ages between 21 and 30, implying that this age group perhaps represents the most active smartphone users in South Korea. Results show 95% of the subjects use their smartphones over 30 minutes per day. The average number of mobile applications in a smartphone is 30 applications.

PSYCHOMETRIC PROPERTY ANALYSIS

Measure validation was conducted using IBM SPSS Statistics 19 and Partial Least Squares (PLS) Graph Version 3.0.

Reliability Analysis

Internal consistency is commonly assessed using Cronbach's α or composite reliability (CR) scores, each of which should be higher than 0.7 to be considered adequate (Straub et al., 2004). Table 1 describes the Cronbach's α and CR of each latent construct. All of the latent constructs meet and exceed the suggested cutoff of 0.7 for Cronbach's α and CR.

Latent Constructs	Cronbach's α	CR
UX: SENS	0.893	0.914
UX: INTL	0.887	0.909
UX: BEHV	0.910	0.926
UX: AFFC	0.913	0.928
CA: TEMP	0.931	0.948
CA: FCUS	0.754	0.836
CA: ENJY	0.834	0.893
CA: CTRL	0.764	0.865
CA: CURI	0.830	0.899

Table 1. Cronbach's Alpha and Composite Reliability

Convergent and Discriminant Validity

In this study, PLS approach to confirmatory factor analysis (CFA) (Gefen & Straub, 2005) was employed to assess the convergent and discriminant validities. Of the 40 initial items of the mobile user experience measure, the loadings of 3 items were lower than 0.6, the loadings of 8 items were between 0.6 and 0.7, and the loadings of 29 items were higher than 0.7. After eliminating the three items with the lowest loading scores, the remaining items were reexamined for their content validity, reliability, and convergent and discriminant validities. In this step, several items with similar wording were eliminated to reduce the overlap between the items and increase the representativeness of the construct domain with the remaining items. Then, among the remaining items kept, choices were made to select those items that exhibit stronger psychometric properties. Out of this iterative process, a total number of 24 items (6 items for each dimension) were selected for subsequent analyses. In addition, two measurement items of cognitive absorption were eliminated for subsequent analyses presented below due to their low loading scores.

The factor structure matrix created with the final items of user experience and cognitive absorption. All the items of user experience and cognitive absorption are greater than 0.707 on their respective constructs and that no items are loaded higher on constructs they are not intended to measure, without exception.

Table 2 presents the correlations among the first-order constructs of user experience and cognitive absorption (off-diagonal elements) and the square root of the average variance extracted (AVE) scores (diagonal elements), obtained from PLS. The table shows that the square root of the AVE of each construct is higher than 0.707 and exceeds the constructs' correlation with other constructs, without exception, thus indicating adequate convergent and discriminant validity among the constructs (Gefen & Straub, 2005). In addition, the reliability of each construct was reassessed with the final items and was confirmed to be satisfactory. The Cronbach's α and CR scores were very similar to the numbers reported in Table 1 (all within

the range of 0.05 difference at most) and all higher than 0.7 (all user experience constructs higher than 0.8).

Overall, the results of testing indicate that the final measurement items of user experience and cognitive absorption have strong psychometric properties.

Relationships between the First Order and Second Order Constructs

PLS Graph does not directly permit the representation of second order latent constructs. In order to examine the relationships between the first-order and second-order constructs, it is necessary to run separate models consisting of first order constructs and their indicators and then treating the computed first-order factor scores as manifest indicators of the second-order construct (Yi & Davis, 2003). Following this approach, the loadings of the first-order constructs on their purported second-order construct were estimated. The results are summarized in Figure 1, largely supporting the theorization made for the underlying dimensions of user experience. In fact, consistent with the reflective nature of the construct, the underlying dimensions of user experience show more steady relationships with their higher construct than those of cognitive absorption.

Latent Constructs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) UX: SENS	(0.807)								
(2) UX: INTL	0.617	(0.784)							
(3) UX: BEHV	0.503	0.483	(0.754)						
(4) UX: AFFC	0.524	0.591	0.432	(0.824)					
(5) CA: TEMP	0.391	0.260	0.304	0.341	(0.885)				
(6) CA: FCUS	0.295	0.235	0.183	0.322	0.493	(0.765)			
(7) CA: ENJY	0.514	0.454	0.317	0.417	0.460	0.334	(0.917)		
(8) CA: CTRL	0.265	0.239	0.133	0.149	0.169	0.172	0.391	(0.826)	
(9) CA: CURI	0.520	0.509	0.380	0.452	0.383	0.284	0.528	0.367	(0.865)

Table 2. Correlations of the latent constructs and the square root of AVE

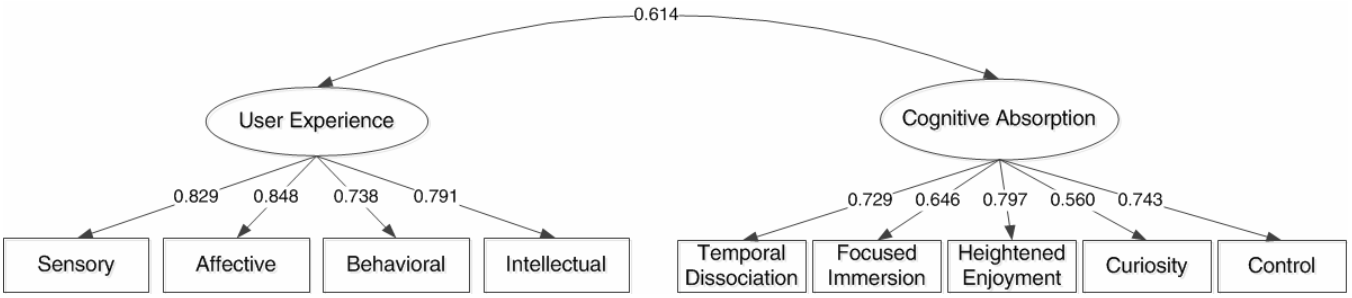

Figure 1. CFA results for the second order constructs and their underlying dimensions

RELATIONSHIP TO OTHER VARIABLES

In addition to user experience and cognitive absorption, the field survey included perceived usefulness, satisfaction, and continuance intention. We explored the relative effects of user experience and cognitive absorption on those variables by running multiple rounds of path analysis in PLS. The results are summarized in Table 3.

The path analyses indicate that the effects of user experience and cognitive absorption are both significant and the two variables account for substantial variance in perceived usefulness and satisfaction. For continuance intention, only cognitive absorption was a significant determinant. In a separate analysis, we have found that perceived usefulness (β=0.43), satisfaction (β=0.23), and cognitive absorption (β=0.27) are all significant determinants of continuance intention, suggesting that user experience affects continuance intention indirectly via these mediators.

Dependent variables	Independent variables		R^2
	UX	CA	
Perceived usefulness	0.289*	0.420*	0.410
Satisfaction	0.350*	0.300*	0.351
Continuance intention	0.033	0.625*	0.418

Note: * $p < 0.001$

Table 3. Regression analyses of the UX and CA on perceived usefulness, satisfaction, and continuance intention

IMPLICATIONS AND CONCLUSION

The primary purpose of this study was to develop a new measure of user experience. The measurement scales of user experience were found to exhibit strong psychometric properties with high reliability and adequate convergent and discriminant validities. The measure was developed to capture holistic experience of mobile service users evoked through multiple underlying dimensions, and the empirical results show promise in properly capturing the purported dimensions of user experience. Although the measure needs to be further validated beyond the specific conditions of this study to establish external validity, the initial results show that the measure can be useful as an indicator of the subjective quality of experience a mobile user receives in the context of mobile service.

Moreover, we have articulated the conceptual differences between user experience and cognitive absorption and empirically demonstrated their differences. While cognitive absorption is about one aspect of user experience (i.e., intellectual dimension) in a deep state of experience, our conceptualization shows that user experience encompasses multiple dimensions, in addition to the intellectual dimension, and not necessarily in very deep level of experience overall. We have found that the constructs were highly correlated but distinct, supporting our conceptualization that the two measures are similar but distinguishable. It has been also found that they both have significant effects on usefulness and satisfaction, but on continuation intention user experience has indirect effects while cognitive absorption has a direct effect. It will be interesting to theorize their relationships more fully and empirically validate the relationships.

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