
Volume 68, issue 9 September 2010
ISSN 1071-5819
ELSEVIER
International Journal of
Human-Computer Studies
Editors-in-Chief
E. Motta
S. Wiedenbeck

Available online at www.sciencedirect.com
ScienceDirect
Int. J. Human-Computer Studies 68 (2010) 572–588
International Journal of Human-Computer Studies
www.elsevier.com/locate/ijhcs

# 'To play or not to play': A cross-temporal investigation using hedonic and instrumental perspectives to explain user intentions to explore a technology

Massimo Magni[a], M. Susan Taylor[b], Viswanath Venkatesh[c,*]

[a]*Institute of Organization and Information Systems, Department of Management, Bocconi University, Via Röntgen 1, 20135 Milan, Italy*
[b]*Department of Management and Organization, University of Maryland, Robert H. Smith School of Business, Van Munching Hall, College Park, MD 20742-1815, USA*
[c]*Department of Information Systems, University of Arkansas, Walton College of Business, Fayetteville, AR 72701, USA*

Received 15 August 2008; received in revised form 17 March 2010; accepted 26 March 2010
Communicated by T.J. Hess
Available online 8 April 2010

**Abstract**

The present research extends prior work on the relationship between users and technology by examining users' intention to explore a technology. Drawing on exploration and individual motivation theories, we developed and tested a model examining the effects of hedonic (i.e., personal innovativeness and cognitive absorption) and instrumental (i.e., performance expectancy and image enhancement) factors on individuals' intentions to explore a technology over time. Based on a study of 94 users exposed to a new technology, with measurements taken at two points in time, we found that both instrumental and hedonic factors affect individuals' intentions to explore, but their effects change over time such that as time goes by, the effect of personal innovativeness decreases and performance expectancy increases. In addition to our contributions and implications for research on technology acceptance, we present practical implications both for developers and managers, with a view toward helping the development and deployment of technologies that satisfy the evolution of users' needs over time.


*Keywords:* Intention to explore; Time; User behavior; Hedonic and instrumental perspectives

## 1. Introduction

There has been a dramatic growth in the use of handheld devices, with 172 million devices sold in 2009 and a yearly market growth rate being about 20% (Pettey and Tudor, 2010). Factors contributing to this impressive growth include the devices' ability to increase communication flow among individuals (anytime–anywhere connectivity) and their flexibility to satisfy a wide range of needs in different domains, such as business, education and healthcare (Constantiou et al., 2007). However, many potential applications and functionalities of these technologies remain untapped (Chamberlain, 2006; Constantiou et al., 2007). On the one hand, new devices are designed to provide an increasing number of features to support users in accomplishing a wide array of activities. On the other hand, the new devices often do not have a user-centric focus and thus discourage users from interacting with them (Zhang et al., 2008). Success of technologies and associated services is an important issue for researchers and practitioners alike (Rai et al., 2002; Rai and Sambamurthy, 2006). Previous human–computer interaction (HCI) research traced this issue back to the fact that the process for designing new devices often do not follow a user-centric approach (Te'eni et al., 2007). As a consequence, users typically interact with only a limited set of features and fail to explore the vast array of features available. Such user behavior is common and relates to the popular 80–20 or even 90–10 rule, wherein regardless of the type of

*Corresponding author. Tel.: +1 479 575 3869; fax +1 479 575 3689.
*E-mail addresses:* massimo.magni@unibocconi.it (M. Magni), staylor@rhsmith.umd.edu (M. Susan Taylor), vvenkatesh@vvenkatesh.us (V. Venkatesh).

1071-5819/$ - see front matter © 2010 Published by Elsevier Ltd.
doi:10.1016/j.ijhcs.2010.03.004

technology, users typically use only 20% or 10% of the features and 80% or 90% of the time (Jasperson et al., 2005; Pierce and Mahaney, 2004).

Perhaps not surprisingly, researchers have called for studies of the use and exploration of handheld devices (e.g., McCreary, 2008; Sarker and Wells, 2003). To this end, Gupta and Karahanna (2004) argued that one important avenue for research is the examination of users' exploratory behaviors that are oriented toward innovation and identification of new principles for performing an activity, rather than the use of routine device features. In keeping with prior research, we consider exploratory behaviors toward technology as those that refer to the search for new applications of a technology either by using additional features or by using basic features in a new way (Gupta and Karahanna, 2004; Nambisan et al., 1999). Thus, it is reasonable to assume that exploratory behaviors may well determine individuals' discovery of value-added and innovative uses of a technology (Nambisan et al., 1999) and further advance our understanding of system success (see Rai et al., 2002).

Whereas the importance of users' exploratory behaviors has been recognized in both the HCI and technology acceptance domains (e.g. Boudreau and Robey, 2005; Nambisan et al., 1999; Rogers and Muller, 2006), little research has examined the factors that may foster users' willingness to explore. Moreover, we have identified little or no prior research that takes into account users' willingness to explore a new technology over time. We seek to address this gap in the literature. As a conceptual foundation for this research, we develop a framework that simultaneously considers two theoretical perspectives rooted in the dichotomy between extrinsic and intrinsic motivations. These perspectives, hedonic and instrumental, have also been invoked as explanations for individuals' general behavior toward technology (Sun and Zhang, 2006; Van der Heijden, 2004; Venkatesh and Speier, 1999).

A second objective of this research derives from the aforementioned cross-sectional designs of existing research on exploratory behaviors related to technologies. As we will argue, there are reasons to expect that the determinants of exploratory behavior may change over time as users move through various stages of technology adoption. Addressing the call of previous researchers to consider the role of time in adoption and HCI research (Venkatesh et al., 2006, 2007, 2008; Zhang et al., 2008), we seek to understand individuals' intention to display exploratory behavior at two stages of technology introduction: (1) the early stage when users are introduced to a new technology and begin to acquire a new body of knowledge in that particular context (Nambisan et al., 1999) and (2) the post-adoption stage when they have sufficient knowledge to fully exploit its standard capabilities (Saga and Zmud, 1994). Moreover, responding to the call by Nah et al. (2006) for work that increases synergies between the HCI and MIS research, this study strives to provide practical insights for both designers and managers as they design new technology products (York and Pendharkar, 2004) and develop training support that facilitates the effective exploitation of the potential of technologies (see Agarwal and Venkatesh, 2002; Thong, 1999; Venkatesh and Agarwal, 2006; Venkatesh and Ramesh, 2006). In sum, this paper reports a longitudinal study of users' willingness to explore technology in the context of mobile device use.

We expect this work to make the following contributions. First, we respond to recent calls for understanding more complex, rather than routine, uses of technology (Jasperson et al., 2005). Moreover, we attempt to explicate the processes by which instrumental and hedonic factors generate an interaction between users and systems that is more proactive and discovery oriented, thus enriching our understanding of exploratory behaviors. Second, we consider the joint, rather than competing, roles of hedonic and instrumental factors in determining users' exploration of new technologies. Such an integration of perspectives is also useful to develop a better understanding of use of technologies that are adopted both for work and fun. Finally, our research complements recent work focused on emergent uses of IT (e.g. Ahuja and Thatcher, 2005; Li and Hsieh, 2007) by explicitly examining the role of time.

## 2. Theoretical development

Our model is shown in Fig. 1. As shown in the figure, we link intention to explore with hedonic—i.e., cognitive absorption and personal innovativeness toward information technology (PIIT)—and instrumental factors—i.e., performance expectancy and image enhancement—and identify time as a moderator of various relationships. In this section, we present the theoretical foundation and justification for the hypotheses.

### 2.1. Exploration theory and intention to explore technology

The exploration theory can be traced back to the seminal works of Berlyne (1950, 1960, 1966) that discussed why individuals display curiosity and explore their environment for seeking new information. In doing this, Berlyne observed that the occurrence of exploratory behavior is driven by a novel external stimulus that creates uncertainty

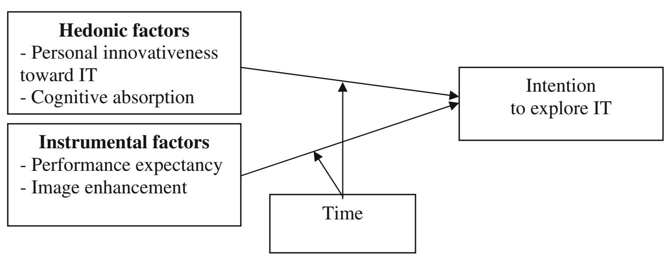


Fig. 1. Research model.

and stimulates individuals to collect further information to reduce such emergent uncertainty. The exposure to an external stimulus develops individuals' sense of novelty, surprisingness and incongruity with past experiences that consequently lead individuals to actively explore and seek new information to restore an equilibrium with the environment. From Berlyne's perspective, the presence of an external stimulus provokes an increase in individuals' arousal and exploratory behaviors can be seen as an attempt to quench such arousal by acquiring more information related to the source of stimulation. By gathering new information about the relevant stimulus, cognitive and perceptual coherence is restored. After investigating the source of stimulation for a while, curiosity decreases, suggesting that uncertainty has been resolved once new information is obtained.

Subsequent research on exploratory behaviors extended the theoretical framework by explaining the conditions under which exploratory behavior occurs. Condry (1977) observed that exploratory behaviors can be triggered by either intrinsic and extrinsic factors. Intrinsically driven exploration is performed for its own sake, independent of external reinforcement, leading individuals to engage in exploratory behaviors for the purpose of satisfying their need to experience cognitive challenge. Indeed, individuals engage in exploratory behaviors because of the sense of pleasure that they get in interacting with novel things or in an attempt to make sense out of an emergent stimulus (Spielberger and Starr, 1994). Conversely, extrinsically driven exploration is performed for the purpose of receiving an external reinforcement. Therefore, in the extrinsic case, individuals activate an exploration process because the discovery of new information is intended to produce to tangible benefit.

The basis of exploration theory has been widely adopted in several studies in management, with a particular focus on consumer behaviors. Table 1 reports some key studies that rely on the theoretical premises of exploration theory and its extensions. For example, in the domain of consumer research, Steenkamp and Baumgartner (1992) investigated the role of optimal stimulation level in affecting consumers' behaviors. In a series of laboratory experiments, they found that a moderate level of stimulation from the external environment triggers consumers' behaviors that are oriented toward exploration, thus facilitating the occurrence of variety seeking and innovation.

Relying on extant research, we extend exploration theory to IS research because it is likely to yield a better understanding of how users search for new information as a reaction to a novel object, such as a new technology. Indeed, although individuals sometimes use IS in a way that is standardized and habitual in order to accomplish a given task, "users can also apply IS in an exploratory or innovative fashion that goes beyond routine and can further unleash the potential of the systems" (Li and Hsieh, 2007, p. 3).

Table 1
Studies on exploration theory.

| Study | Main issues | Longitudinal |
|---|---|---|
| Raju (1980) | Individuals with high optimal stimulation level (OSL) are more likely to explore new stimuli and situations because of a higher need for environmental stimulation | No |
| Joachimsthaler and Lastovicka (1984) | The perceived optimal stimulation level and individual locus of control directly affect consumers' exploratory behavior toward a product | No |
| Steenkamp and Baumgartner (1992) | Individuals having higher OSL exhibit curiosity-motivated behavior, variety seeking and risk taking behaviors | No |
| Ozanne et al. (1992) | Individuals' perceived discrepancy of a new product with existent cognitive categories affects information seeking and exploratory behavior toward the new product | No |
| Morrison (1993) | Proactive information seeking behaviors of newcomers facilitate their socialization process within the organization | Yes |
| Inman (2001) | Consumers' sensory-based stimulation (such as flavor) is more likely to affect individuals' seeking behavior than non-sensory stimulations (such as brand) | No |
| Elliot and Reis (2003) | Secure interpersonal and close relationships in adulthood are consistent with individuals' exploration in achievement settings | No |
| Maner and Gerend (2007) | Curiosity is positively associated with more favorable judgments of a certain situation, which may promote exploration and risk-seeking behaviors | No |

Exploratory behavior toward technology then involves proactively looking for new uses by examining additional features or by using basic features in a new way (Gupta and Karahanna, 2004). Thus, the role of users in contributing to the identification of novel applications for technologies is based in their understanding of the environment in which they operate and in their awareness of the fit between potential uses and contextual environment (Nambisan et al., 1999). Further, consistent with exploration theory, we argue that exploratory behavior toward technology can be triggered by hedonic and instrumental factors under different conditions. This view can be traced back to work that underscored that behavior toward technology is driven by both instrumental and hedonic factors (Van der Heijden, 2004). In particular, hedonic factors affect behavior by providing intrinsic value, whereas instrumental factors affect behavior by providing utilitarian value (Brown and Venkatesh, 2005; Venkatesh and Brown, 2001). According to Van der Heijden (2004, p. 696) while the hedonic interaction represents an end in itself, "instrumentality implies there is an objective external to the interaction between user and system."

Hedonic factors evoke exploratory behavior through basic human desires to engage in activities that are intrinsically motivating because of the sheer pleasure and challenge of performing them, even in the absence of external incentives (Berlyne, 1978). Individuals who experience a positive cognitive state through their exploratory behaviors are more likely to engage in repeating such behaviors (Amabile, 1988; Pilke, 2004). Recent studies in HCI have underscored the importance of a hedonic perspective in studying the interaction between user and technology and called for further empirical research to deepen our understanding of hedonism on users' behaviors over time (Thong et al., 2006; Zhang and Li, 2005).

Moreover, previous research on exploration has found that individuals are more likely to be stimulated by intrinsically motivating factors at the initial, rather than later, stages of interaction. As users repeatedly interact with an object, here a new technology, their sense of novelty and curiosity decreases and with it, the intrinsical motivation to further explore the object (Berlyne, 1966). As time goes by, individuals may develop a better understanding of the novelty and, therefore, may find instrumental value in pursuing exploratory behaviors. Such a perspective is consistent with previous studies in IS research that pointed out that users are more likely to perceive the potential benefits of a certain technology at some point during their use of it, even if those benefits are not identified at the initial point of technology introduction (Karahanna et al., 1999). Table 2 reports previous studies on exploration-oriented behaviors toward technology.

### 2.2. Hedonic perspective

Drawing on the concept of intrinsic motivation (Deci, 1975), the hedonic perspective proposes that individual behavior is driven by the goal of being engaged in enjoyable, self-determined activities (Deci, 1975, Gottschalg and Zollo, 2007; Hirschman and Holbrook, 1982; Thong et al., 2006; Vallerand, 1997). Indeed, intrinsic motivation is related to the essence of the individual's psychological, emotive experience (Hirschman and Holbrook, 1982) that can be triggered both by individual traits and cognitive states (e.g. Csikszentmihalyi, 1990).

Traits are an "enduring predisposition to respond to stimuli" (Thatcher and Perrewe, 2002, p. 383) and may be either broad or situation-specific (Goldsmith and Hofacker, 1991; Watson and Clark, 1984). Broad traits reflect relatively stable, habitual patterns of behaviors and attitudes that differ across individuals. For example, the trait of agreeableness reflects the extent to which an individual can be described as good-natured, forgiving, courteous, helpful, generous and cooperative (Barrick and Mount, 1991). While broad traits have the advantage of permitting comparisons between different settings, they are less predictive than more specific ones in a particular context where individuals may in fact respond differently

Table 2
Previous studies on exploration of technologies.

| Concept | Definition | Main predictors | Main findings | Papers |
|---|---|---|---|---|
| Intention to explore | A user's willingness and purpose to explore a new technology and find potential uses | IT steering committee and strategic IT planning team | The existence of IT steering committee and IT planning team provides clear and specific business rationale and direction for technology deployment | Nambisan et al. (1999) |
| | | Perceived risk of use<br>Ease of use<br>Perceived usefulness | The perceived uncertainty and extent of adverse consequences of using the system affect individuals' willingness to explore | Gupta and Karahanna (2004) |
| | | Intrinsic motivation<br>Perceived usefulness | Perceived usefulness and intrinsic motivation mediate the role of transformational leadership in affecting intention to explore | Li and Hsieh (2007) |
| Try to innovate | A user's goal of finding new uses of existing workplace information technologies. | Autonomy<br>Overload | The perception of an environment characterized by autonomy and stress influences individual trying to innovate | Ahuja and Thatcher (2005) |
| Exploratory behavior | Acquisition of knowledge for satisfying cognitive stimulation. | Flow<br>Telepresence | Mixed results about the direct effect of flow and telepresence in affecting exploratory behaviors | Novak et al. (2000)<br>Ghani and Deshpande (1994) |
| | | Sensor-based interaction technologies | Sensory-based interaction technologies encourage users' exploratory behaviors | Rogers and Muller (2006) |
| Technology reinvention | The degree to which a technology is changed by its adopters after its original development | Social influence | Individual behavioral change from initial inertia to reinvention is driven by the improvised learning derived from the social influence of peers, power users and supervisors | Boudreau and Robey (2005) |

(Agarwal and Prasad, 1998). Conversely, a situation-specific trait is a relatively stable descriptor that "predisposes individuals to respond to stimuli in a consistent manner within a narrowly defined context or group of target objects" (Thatcher and Perrewe, 2002, p. 383). In the domain of technology use, prior research has found specific traits to be particularly valuable in predicting individuals' behavior within the target situation. To this end, Agarwal and Prasad (1998) have developed the concept of PIIT, a domain-specific trait reflecting individuals' willingness to try out any new technology within a particular context. We focused on PIIT (rather than other traits, such as computer playfulness) because prior research has found that individuals' broad trait of innovativeness directly relates to exploration-oriented behaviors (e.g. Rogers, 1995). Indeed, individuals with a high degree of innovativeness are active seekers of information about new ideas. While personal innovativeness reflects an individual's intrinsic willingness to explore, this predisposition does not necessarily imply that individuals experience a sense of engagement in interacting with the technology. Thus, whereas the trait of innovativeness is directly related to exploration-oriented behaviors, the trait of computer playfulness, defined as the degree of spontaneity in IT interactions, has been a significant antecedent of individuals' cognitive states, such as absorption and flow that may in turn affect individual exploration (Agarwal and Karahanna, 2000; Webster and Martocchio, 1992). Thus, we consider computer playfulness as an antecedent of cognitive absorption, and we do not directly relate it to the occurrence of technology-related exploratory behavior.

In addition to the effects of traits, individuals are intrinsically motivated to perform a behavior by positive situational cognitive states. Csikszentmihalyi's (1990) flow theory posits the effects of such states, proposing that individuals' behavior is motivated by the intrinsic positive feelings that emerge when they are working with technology and "things are going well as an almost automatic, effortless, yet highly focused, state of consciousness" (Csikszentmihalyi, 1996, p. 110). Researchers have validated Csikszentmihalyi's theory across a variety of domains, including sports, artistic performance and task-oriented activities.

A significant body of IS research focusing on the hedonic perspective relies on Csikszentmihalyi's (1990) flow theory (e.g., Trevino and Webster, 1992; Koufaris, 2002; Kamis et al., 2008). It has proven successful in explaining individuals' behavior in the technology adoption stream, proposing that the deep involvement and pleasure that users experience when working directly with the technology have an intrinsically motivating effect on their subsequent usage intentions and behaviors (Van der Heijden, 2004). Although several different constructs have been used previously to represent the cognitive states that intrinsically motivate individuals to interact with technology, there is evidence of overlap among these concepts (Agarwal and Karahanna, 2000). As a result, Agarwal and Karahanna (2000) proposed a second-order construct of cognitive absorption. Agarwal and Karahanna (2000) define this construct as a state of deep involvement that individuals experience when interacting with technology and it encompasses five different feelings: (1) temporal dissociation—the state of losing track of time while interacting with a technology; (2) focused immersion—feelings of deep engagement with the technology that distracts one from other tasks; (3) enjoyment—feelings of pleasure during the interaction process; (4) control—a sense of "being in charge of the interaction" (p. 673) and (5) curiosity—the experience of cognitive arousal during the interaction. Our examination of cognitive absorption in this work is consistent with calls to develop and test conceptual models of individuals' holistic experience in interacting with technology (Agarwal and Karahanna, 2000; Venkatesh, 1999, 2000). Further, although considerable research has validated the proposed link between an individual's intrinsic motivation and his or her use of a new technology (Davis et al., 1992; Malone, 1981; Webster and Martocchio, 1992; Venkatesh and Speier, 1999, 2000), scant research to date has examined the impact of intrinsic motivation on users' intention to explore technology (Li and Hsieh, 2007).

### 2.3. Instrumental perspective

Extrinsic motivation, which reflects an expectation of obtaining external rewards, such as status and recognition (Gottschalg and Zollo, 2007), is also theorized to be an important driver of intention to explore a technology. Extrinsic motivation comes from the expected consequences of the behavior, such as improved job performance, pay or promotion, rather than from the individual's enjoyment of performing the behavior itself as is the case with intrinsic motivation. In such a condition, the occurrence of a specific individual behavior depends upon the perception of an instrumental value that links the behavior and its associated consequences. Therefore, extrinsic motivation refers to the occurrence of behaviors not because they are pleasurable in their own right but because of important self-selected aims and purposes.

Prior IS research has shown that the influence of instrumental factors on an individual's intention to interact with technology tends to occur through the process of extrinsic motivation (Yi and Hwang, 2003). The resulting extrinsic motivation then stimulates individuals' display of behaviors toward a technology (e.g., Venkatesh et al., 2003). Two concepts are particularly important in this process: performance expectancy and image enhancement. Performance expectancy is an individual belief that using an information system will result in a valued outcome for the user (Venkatesh et al., 2003). Similarly, image enhancement refers to an individual's belief that using the system will enhance one's image or status within a social context (Venkatesh and Davis, 2000). Both concepts fall within the theoretical foundation of extrinsic motivation because both link the performance of individual behaviors to benefits, external to the system–user interaction. We argue that they also will influence individuals' intentions to engage in exploratory behavior with the technology. Logically, we reason that users will see the connection between display of exploratory behaviors and the discovery of new technology features, and uses that can assist their accomplishment of work tasks (Burton-Jones and Straub, 2006). Likewise, we believe that users will see the connection between their display of exploratory behaviors and the discovery of new technology features, and status gains associated with being recognized as an expert user of the technology. Finally, as Karahanna et al. (1999) note, as time goes by, the formation of beliefs is more related to instrumentality derived from the individuals' direct experience in exploring new technologies over time, which allows the discovery of new features and uses. Receiving the benefits associated with those discoveries is also likely to strengthen the perceived instrumentality between exploratory behaviors and valued extrinsic rewards.

## 3. Hypothesis development

### 3.1. Hedonic factors: intrinsic motivation and intention to explore

Consistent with flow theory, prior research has supported the relationship between hedonic experience and users' intentions to interact with a technology both in home and organizational contexts (e.g., Agarwal and Karahanna, 2000; Koufaris, 2002; Pilke, 2004). For example, Koufaris (2002) reported that online consumers shopped not only for the purpose of buying a product, but also because of the enjoyment of shopping online. Similarly, Webster and Hackley (1997) pointed to the importance of cognitive engagement for interacting in a technology-mediated distance learning context.

Past research on cognitive absorption has found that individuals experiencing a high level of task involvement are more likely to display experimental behaviors than those with low levels of involvement (Ghani and Deshpande, 1994; Webster et al., 1993). As Csikszentmihalyi and Csikszentmihalyi (1988, p. 337) articulated: "For no matter how original one might be, if one is bored by the domain, it will be difficult to become interested enough in it to make a creative contribution." These results are consistent with Amabile et al., (2005, p. 375) proposal that "creative behaviors are often characterized by a flow state, a temporary psychological merger of the person with the activity, which inherently involves positive feelings." Moreover, the creativity literature points out that individuals who are intrinsically motivated by enjoyment, interest and curiosity are more likely to search for new and stimulating cognitive pathways (Amabile, 1997). This research suggests that individuals' involvement in a particular task or activity acts as a trigger for their decision to initiate creative efforts (Amabile, 1988) and thus, for their intention to display exploratory behaviors (Saadé and Bahli, 2005; Zuckerman, 1969). Moreover, previous research has argued that exploration is related to the occurrence of pleasurable states associated with individuals' cognitive engagement. Thus, we posit:

**Hypothesis 1.** *Cognitive absorption will be positively related to intention to explore the technology.*

Personal innovativeness toward IT is an individual domain-specific trait developed in the IS literature that reflects an individual's willingness to try out new technologies (Agarwal and Prasad, 1998). Previous research underscored that innovative individuals are more likely to actively seek information for developing new ideas (Rogers, 1995). The introduction of a new technology represents a source of uncertainty for individuals (Spender and Kessler, 1995), and users characterized by a high degree of PIIT are more tolerant to uncertainty and are more likely to show information seeking and risk-oriented behaviors (Agarwal and Prasad, 1998). Given that exploratory behaviors are characterized by a certain degree of risk and uncertainty (Berlyne, 1960), individuals with high PIIT are more likely to explore a technology. Further, innovative individuals tend to demonstrate higher levels of self-confidence about performing new tasks or in new situations (Kegerreis et al., 1970), thus performing behaviors that corroborate their propensity to innovate and their willingness to change (Thatcher and Perrewe, 2002). Moreover, Venkatraman (1991) reported that innovative individuals are more interested in stimulating experiences than they are in attaining valuable outcomes. This argument is consistent with previous research that underscored that innovators are more likely to search for novel solutions outside a given framework and exhibit the need for novel stimuli (Goldsmith, 1984). In contrast, individuals who are less innovative are expected to show a weaker need to search for novelty and a preference for maintaining the status quo (Oreg, 2003). Individuals with low degree of innovativeness are more likely to perform routinized behaviors that are not compatible with the new situation, here the introduction of a new technology, thus limiting the likelihood of performing exploratory behaviors (Tichy, 1983). Furthermore, Thatcher and Perrewe (2002) argued that highly innovative individuals are more likely to search for new mentally stimulating experiences when interacting with a new technology. Thus, we posit:

**Hypothesis 2.** *Personal innovativeness will be positively related to intention to explore the technology.*

### 3.2. Instrumental factors: extrinsic motivation and intention to explore

*Performance expectancy.* This construct was proposed by Venkatesh et al. (2003) to represent a synthesis of various instrumentality-oriented constructs that they argued had significant conceptual and empirical overlap: perceived usefulness (Davis et al., 1989; Konradt et al., 2006), job-fit (Thompson et al., 1991), relative advantage (Rogers, 1995) and outcome expectations (Carswell and Venkatesh, 2002; Compeau and Higgins, 1995). They defined performance expectancy as the "degree to which an individual believes that using the system will help him or her to attain gains in job performance" (p. 447). Past research has demonstrated the impact of individuals' instrumental expectations on a variety of behavioral intentions, such as intention to use a technology (Davis et al., 1989; Venkatesh and Davis, 2000) and intention to shop online (Koufaris, 2002). Extant prior research on innovations suggests that individuals' expectations about the outcomes generated by the innovation process are directly related to their likelihood of searching for innovative uses of a particular technology (e.g., Li and Hsieh, 2007; Von Hippel, 1988). Hence, we argue that individuals who perceive that using a technology will enhance their job performance are likely to explore new ways of exploiting its functionalities. Thus, we posit:

**Hypothesis 3.** *Performance expectancy will be positively related to intention to explore the technology.*

*Image enhancement.* The motivational importance of individuals' desire for image enhancement has been recognized in prior research. For example, Rogers (1995) found that individuals' willingness to adopt an innovation was driven by their motivation to gain social status. Similarly, we argue that image enhancement, defined as the extent to which an individual's use of a technology is seen to increase his or her status within the social system (Venkatesh and Davis, 2000), is a key predictor of technology-related exploratory behavior. Further, we reason that when members of a social community own the *same* technology, individuals who are able to find innovative applications for a technology are more likely to increase their social status within their community. This is also supported by Amabile's (1988) proposal that the desire to gain social status serves as motivation to explore creative pathways. Thus, we posit:

**Hypothesis 4.** *Image enhancement will be positively related to intentions to explore the technology.*

### *3.3. Time as a moderator: role of experience*

Despite the growing recognition of the importance of time in organizational theory development (George and Jones, 2000), few IS studies (e.g., Venkatesh et al., 2006) have examined its role in shaping individual intentions and behaviors toward a technology. In the present study, we focus on a particular facet of time: individuals' experience with the technology in question. In this case, experience reflects the extent to which a behavior has been performed in the past (Venkatesh et al., 2000, 2006). The importance of experience in shaping individuals' behavior is explained by the arguments of George and Jones (2000) who emphasize a strong connection between behaviors performed in the past and individuals' present behavior. Thus, in this research, we examine the role of time, as it works through experience, in differentially shaping the strength of hedonic and instrumental factors on individuals' intentions across the stages of technology introduction. We hypothesize a moderating effect of experience on the relationship between hedonic and instrumental factors on the intention to explore a technology.

*Hedonic factors*. Prior research in the area of marketing has found that consumers' first reactions to a new product are driven by their feelings, rather than by their expectations about the utility of the product (Creusen and Schoormans, 2005). This result is consistent with the arguments of Greif and Keller (1990) who noted that the early stages of exploring an object are driven by pleasure and enjoyment. However, after investigating a new object or situation for a while, individuals tend to terminate their inspection of it, perhaps because their uncertainty about how it operates has been resolved through the attainment of new information (Berlyne, 1960). With the passage of time and gain in associated experience, the effect of individuals' hedonic factors on exploratory behaviors tends to decrease because the interaction becomes more routinized and automatic (Jasperson et al., 2005; Venkatesh et al., 2000), decreasing the sense of arousal through which hedonic factors foster individuals' willingness to explore (Hirschman and Holbrook, 1982). Thus, as individuals' experience with a new technology increases, their initial sense of pleasure derived from the sake of exploration is likely to decrease, thus having a moderating effect on the relationships between hedonic factors and individuals' intention to display exploratory behaviors. Based on this, we expect that individuals' increasing experience interacting with a technology will decrease the effect of cognitive absorption on their intention to explore. Moreover, we argue that in the post-adoption stage, when interaction with a given technology becomes fairly habitual (Venkatesh et al., 2000), individuals high in innovativeness toward technology will be more likely to shift their cognitive efforts toward new, unexplored products that can better satisfy their intrinsic need to experiment with new technologies. This logic is consistent with Berlyne's theoretical arguments stating that individuals are attracted by novel stimuli that satisfy their need for curiosity. Indeed, individuals who are high in innovativeness are more likely to explore the environment in search of stimuli that may create a sense of arousal and generate positive feelings of interest (Berlyne, 1960). Therefore, with the passage of time and users gaining more information about a new object, i.e., increasing experience, they begin to become bored with its diminishing level of novelty in their eyes and subsequently, become increasingly motivated to seek out stimulation from more novel—i.e., other—objects in their environment (Litman, 2005). Thus, we posit:

**Hypothesis 5a.** *Experience with a technology will moderate the relationship between cognitive absorption and intention to* *explore the technology such that the relationship will become weaker in the post-adoption stage.*

**Hypothesis 5b.** *Experience with a technology will moderate the relationship between personal innovativeness and intention to explore the technology such that the relationship will become weaker in the post-adoption stage.*

*Instrumental factors*. We also propose that time moderates the relationship between instrumental factors and users' intention to explore a technology, but one in the direction opposite to what was proposed in the case of hedonic factors. Consistent with the findings by Karahanna et al. (1999) that individuals begin to better understand the instrumental potential of a technology as they move through the stages of technology adoption, we propose that individuals are likely to be more motivated to explore a technology by instrumental considerations in the post-adoption stage, compared to the drivers in the adoption stage. This argument is consistent with other research that suggests that increasing experience with a technology yields a better understanding of its instrumental value and thereby, enhances the likelihood of reaping advantages by experimenting with different uses that will enhance the fit between technology and organizational context (Saga and Zmud, 1994; Venkatesh et al., 2006). Thus, we argue that once users have acquired new knowledge about the technology in the adoption stage and moved to the post-adoption stage, they are more likely to engage in exploratory behaviors as a means of searching for new applications that go beyond the uses delineated by the designers in order to enhance their performance (Boudreau and Robey, 2005). Support for our reasoning also comes from Amabile (1988) who proposed that creative behaviors motivated by the desire for future benefits, rather than by the challenge or enjoyment of the task itself, often develop from individuals' enhanced knowledge of the specific environment in which the exploration occurs. Thus, we posit:

**Hypothesis 5c.** *Experience with a technology will moderate the relationship between performance expectancy and intention to explore the technology such that the relationship will become stronger in the post-adoption stage.*

**Hypothesis 5d.** *Experience with a technology will moderate the relationship between image enhancement and intention to explore the technology such that the relationship will become stronger in the post-adoption stage.*

## 4. Method

### 4.1. Sample, data collection and design

Full-time MBA students at a large public university located in the eastern United States voluntarily participated in this study as a part of a larger school-wide initiative to provide MBA students with a personal digital assistant (PDA). This setting is appropriate for our study for two reasons. First, both practitioners and academics have recognized that the device has several characteristics that make it a high potential tool for technological exploration (Sarker and Wells, 2003), including malleability (Nambisan et al., 1999) and interpretive flexibility (Orlikowski, 1992). Second, individuals' use of PDAs in this research was voluntary. We underscore that although they received the same PDA as a gift from the business school at the beginning of the academic year, its use for course assignments or personal work was voluntary.

We chose to test the hypotheses in a year-long study in order to provide sufficient time for students to gain significant experience. The data were collected at two points in time—i.e., adoption and post-adoption. The first wave of questionnaires for assessing individuals' initial responses during the adoption stage was distributed approximately three weeks after they received their PDAs. The second wave of questionnaires for assessing individual perceptions during the post-adoption phase was administered approximately one year later, as the users' experience in interacting with the technology increased. Of the 258 total individuals involved in the study, 94 provided responses for both measurement points, yielding a response rate of 37%, and constituting 188 usable observations (94 individuals $\times$ 2 time waves), which is deemed acceptable in this stream of research (Pilke, 2004; Lewis et al., 2003). Sixty-eight percent of the respondents were men, and 86% were between 26 and 35 years of age. Sixty-three percent had between four and ten years of prior work experience. As an incentive for participation, one lottery prize, i.e., a popular MP3 player, was awarded.

### 4.2. Measurement

We used scales validated in prior research to measure various constructs. We used a 5-point Likert agreement scale in conjunction with various items. The items related to the constructs reported in this paper are shown in the Appendix. *Intention to explore* was assessed using the three-item scale developed by Nambisan et al. (1999). *Cognitive absorption* was measured using ten items adapted from Agarwal and Karahanna (2000). This measure tapped into all five dimensions of cognitive absorption: temporal dissociation, focused immersion, enjoyment, control and curiosity. *Image enhancement* was measured using three items adapted from Venkatesh and Davis (2000). *Performance expectancy* was assessed by adapting three items from the scale developed and validated by Venkatesh et al. (2003). *Personal innovativeness* was measured using three items adapted from Agarwal and Prasad (1998). Following the method of Venkatesh et al. (2006), we measured time, our surrogate for experience level as an ordinal variable that represented the point of measurement: 0 = adoption; 1 = post-adoption (see also Venkatesh et al., 2000, 2003).

## 5. Results

### 5.1. Measurement model

We used partial least squares (PLS) and followed the approach outlined in Chin (1998) and other exemplars (e.g., Agarwal and Karahanna, 2000). First, we conducted a confirmatory factor analysis in PLS (Chin, 1998). Next, we tested our hypotheses. We tested the psychometric properties of measurement scales by examining convergent and discriminant validity as well as internal consistency reliability. We assessed the convergent and discriminant validity of all items by running a confirmatory factor analysis (Table 3). As can be seen from these results, all items had higher loadings than they had cross-loadings. Moreover, as cognitive absorption is a second-order factor reflected by its five dimensions, we ran a confirmatory factor analysis to verify that the five dimensions converged on cognitive absorption. According to Chin (1998), the convergent validity of the first order factors (the five dimensions of cognitive absorption) is determined by the strength of loadings of the first order factors on the second-order factor (cognitive absorption). Table 4 shows that the loadings for each first order construct on cognitive absorption were high and significant. To provide additional evidence of discriminant validity, the square root of the average variance extracted (AVE) should be higher than the inter-construct correlations. As indicated in Table 5, all the constructs share more variance with their indicators than they do with other constructs. We examined the internal consistency reliability for all scales. As shown in Table 5, all scales had acceptable internal consistency reliabilities (ICRs) as they were greater than .70 (Nunnally, 1967).

Table 4
Cognitive absorption loadings (second-order).

| Cognitive absorption dimension | PLS outer model loading |
|---|---|
| Temporal dissociation | 0.80 |
| Enjoyment | 0.91 |
| Focused immersion | 0.73 |
| Control | 0.86 |
| Curiosity | 0.82 |

All loadings are significant at $p < .01$.

Table 5
Descriptive statistics, correlations, reliabilities and AVEs.

| | Mean | S.D. | ICR | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|
| 1 Intention to explore | 3.32 | 0.88 | 0.77 | **0.83** | | | | |
| 2 Personal innovativeness | 3.44 | 0.84 | 0.79 | 0.18** | **0.84** | | | |
| 3 Cognitive absorption | 3.29 | 0.51 | 0.72 | 0.42*** | 0.33*** | **0.83** | | |
| 4 Image enhancement | 3.50 | 0.79 | 0.80 | 0.50*** | 0.09 | 0.41*** | **0.84** | |
| 5 Performance expectancy | 2.64 | 0.91 | 0.83 | 0.36*** | 0.17** | 0.38*** | 0.31*** | **0.86** |

$N = 188$ ($94 \times 2$). AVEs are reported on the diagonal.
**$p < .01$.
***$p < .001$.

Table 3
Confirmatory factor analysis.

| | PIIT | Time | Control | Perf | Enjoy | Immers | Curios | Image | Explore |
|---|---|---|---|---|---|---|---|---|---|
| PIIT1 | **.915** | .122 | .150 | .228 | .380 | .103 | .316 | .145 | .289 |
| PIIT2 | **.622** | −.073 | .107 | −.049 | .184 | −.070 | .022 | −.065 | .029 |
| PIIT3 | **.882** | .184 | .165 | .205 | .331 | .162 | .278 | .146 | .246 |
| Time1 | .155 | **.976** | −.081 | .195 | .190 | .240 | .194 | .149 | .156 |
| Time2 | .113 | **.745** | −.040 | .138 | .169 | .308 | .217 | .102 | .051 |
| Control1 | .161 | −.199 | **.985** | −.030 | .170 | −.130 | .050 | .205 | .052 |
| Control2 | .159 | −.044 | **.578** | −.001 | .244 | −.018 | .171 | .332 | .249 |
| Perf1 | .224 | .203 | −.089 | **.866** | .396 | −.026 | .395 | .236 | .266 |
| Perf2 | .207 | .144 | −.112 | **.859** | .284 | .049 | .401 | .251 | .283 |
| Perf3 | .176 | .168 | .129 | **.869** | .416 | .067 | .441 | .339 | .390 |
| Enjoy1 | .408 | .181 | .248 | .366 | **.921** | .180 | .513 | .290 | .399 |
| Enjoy2 | .324 | .191 | .222 | .426 | **.932** | .090 | .623 | .337 | .428 |
| Immers1 | .098 | .271 | −.005 | .111 | .164 | **.726** | .187 | .085 | .024 |
| Immers2 | .133 | .257 | −.047 | .019 | .126 | **.984** | .145 | .108 | .092 |
| Curios1 | .296 | .187 | .175 | .411 | .583 | .195 | **.892** | .388 | .452 |
| Curios2 | .283 | .203 | .123 | .454 | .529 | .108 | **.911** | .339 | .495 |
| Image1 | .168 | .229 | .162 | .424 | .325 | .128 | .416 | **.830** | .417 |
| Image2 | .078 | .064 | .319 | .235 | .207 | .085 | .336 | **.839** | .385 |
| Image3 | .137 | .087 | .376 | .181 | .322 | .071 | .276 | **.874** | .456 |
| Explore1 | .138 | .118 | .229 | .311 | .344 | −.015 | .379 | .442 | **.709** |
| Explore2 | .232 | .102 | .218 | .327 | .383 | .078 | .461 | .429 | **.893** |
| Explore3 | .344 | .133 | .141 | .290 | .383 | .140 | .465 | .368 | **.876** |

PIIT = personal innovativeness; Perf = performance expectancy; Image = image enhancement; Explore = intention to explore; Temp = temporal dissociation; Enjoy = enjoyment; Immers = focused immersion; Control = control and Curios = curiosity.

Overall, we conclude that the scales displayed good psychometric properties.

### 5.2. Generalized estimating equations

As our research design comprised repeated measures within individuals, the GEE method was used to test the hypotheses (Zeger et al., 1988). Indeed, according to Ballinger (2004), not incorporating the correlation of responses may lead to incorrect estimation of regression model parameters. The use of the GEE analytical technique overcomes this problem as it takes into account the correlation among responses given by the same participant (Ballinger, 2004). Moreover, the effectiveness of GEE is demonstrated by studying users' behaviors over time, and specifically by testing main effects, interactions and including both categorical and continuous variables (e.g., Venkatesh et al., 2006). Table 6 presents the results of the GEE regression analysis.

Model 1 contains the main effects of hedonic predictors (personal innovativeness and cognitive absorption) and it explains 18% of the variance. Results provide support for Hypothesis 1, i.e., the positive effect of cognitive absorption on intention to explore ($\beta = 0.35$, $p < .001$), while Hypothesis 2, i.e., the positive effect of personal innovativeness on intention to explore, is not supported. Model 2 introduces the instrumental predictors (image enhancement and performance expectancy) and explains 31% of the variance. Results support Hypotheses 3 and 4, i.e., predicting positive effects of both performance expectancy and image enhancement on intention to explore ($\beta = 0.08$, $p < .05$; $\beta = 0.25$, $p < .001$, respectively).

Table 6
GEE model results.

| | **β coefficients** | | |
|---|---|---|---|
| *DV: Intention to explore* | **Model 1** | **Model 2** | **Model 3** |
| *Main effects* | | | |
| Experience (time) | $-.12^{+}$ | $-.13^{*}$ | .35 |
| *Hedonic factors* | | | |
| Personal innovativeness | .05 | .06 | $.15^{**}$ |
| Cognitive absorption | $.35^{***}$ | $.18^{**}$ | $.19^{*}$ |
| *Instrumental factors* | | | |
| Performance expectancy | | $.08^{*}$ | $-.02$ |
| Image enhancement | | $.25^{***}$ | $.26^{***}$ |
| *Two-way interaction terms* | | | |
| Personal innovativeness × experience | | | $-.15^{*}$ |
| Cognitive absorption × experience | | | $-.12$ |
| Performance expectancy × experience | | | $.20^{**}$ |
| Image enhancement × experience | | | $-.01$ |
| $R^2$ | .18 | .31 | .33 |
| $\Delta R^2$ | | $.13^{***}$ | $.02^{**}$ |

$N = 188$ (94 × 2).
$^{+}p < .10$.
$^{*}p < .05$.
$^{**}p < .01$.
$^{***}p < .001$.

Model 3 introduces the 2-way interaction terms related to the moderating effects of time on the relationship between hedonic and instrumental factors, and intention to explore, and explains 33% of the variance. The introduction of the interaction terms increased the explained variance by 2%. This increment is consistent with previous research that reports that interactions in field settings typically account for about 1–3% of the variance (Hofmann et al., 2003). The results supported Hypothesis 5b predicting that time will weaken the relationship between personal innovativeness and intention to explore ($\beta = -0.15$, $p < .05$). The results also provided support for Hypothesis 5c that time will strengthen the relationship between performance expectancy and intention to explore ($\beta = 0.20$, $p < .01$). Our findings do not support either the moderating effect of time on the relationship between cognitive absorption or image enhancement on individuals' intention to explore (Hypotheses 5a and 5d, respectively). Consistent with the recommendations of Aiken and West (1991), we plotted the two significant two-way interactions. Fig. 2 presents the personal innovativeness × experience interaction plot. The slope for the adoption period is steepest, confirming our hypothesis that the relationship between personal innovativeness and intention to explore would be strongest during the adoption period. Fig. 3 shows the plot of the performance expectancy × experience interaction. Given the steeper slope in the post-adoption period, the results supported our hypothesis.

We conducted a post-hoc analysis to assess whether the results derived from using a higher-order construct (cognitive absorption) were consistent with the results obtained from using the five dimensions of cognitive absorption separately. The results were indeed similar. The only difference was a lack of a significant direct impact of time and immersion on intention to explore and a decrease in the significance performance expectancy and experience interaction. Quite likely, this difference can be traced back to the relatively small sample size in our study.

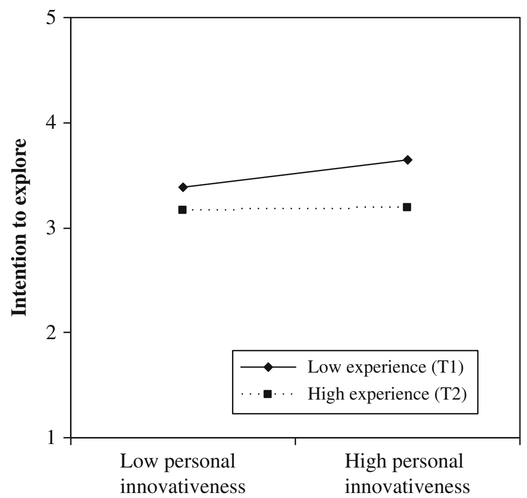


Fig. 2. Two-way interaction effect: experience and personal innovativeness.

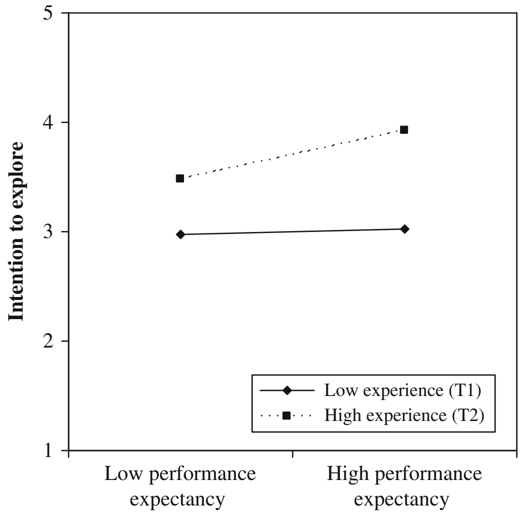


Fig. 3. Two-way interaction effect: experience and performance expectancy.

## 6. Discussion

This research examines users' intention to proactively explore new technologies. Specifically, we examined the effects of hedonic, i.e., personal innovativeness and cognitive absorption and instrumental, i.e., performance expectancy and image enhancement, factors on individuals' intentions to explore a newly introduced technology over time. Our findings contribute both to IS and HCI research.

### 6.1. Theoretical contributions

This study contributes to the extant research on TAM and technology acceptance in several ways. First, although prior TAM research has conceptualized individuals' interaction with the system as frequency (Venkatesh and Davis, 2000), duration or breadth (Saga and Zmud, 1994), it can be argued that none of these conceptualizations really examine the active role of users in interacting with a technology over time. Rather, they simply assess individuals' use of the technology. Conversely, by examining individuals' intention to explore a new technology's functionalities rather than simply their overall intention to use a technology; the present research complements prior TAM studies. Indeed, by theorizing about individual exploration and users' intentions to explore, we underscore its potential importance to better understand the performance in the long run, rather than limiting our study to the antecedents of technology use alone. Thus, our results offer new avenues for future research that should provide a better understanding of the relationship between exploratory technology use and individual performance over time. Given that previous research on the relationship between system use and performance is inconclusive, it would be particularly worth understanding the conditions under which individual exploration of technology may lead to an increase in individual performance.

Second, our study complements the extant literature on technology acceptance by including a temporal lens that explored potential moderation effects of individuals' experience with a newly introduced technology. Thus, we respond to the call of Venkatesh et al. (2006) regarding the need for more research incorporating time in the study of individuals' interaction with technology. Our study, with data collected over time, allowed us to examine how the relative strength of hedonic and instrumental factors change from the adoption to the post-adoption stages of technology adoption. While there are TAM-based studies that take a longitudinal perspective in examining individuals' use of technology (e.g., Venkatesh and Davis, 2000; Venkatesh et al., 2008), prior work has not examined individuals' intention to explore a newly introduced technology over time. Grounding our study in exploration theory, our research contributes to the existing literature on technology acceptance by focusing on differential effects of hedonic and instrumental factors on the intention to explore a technology over time.

Our results offer partial support for the moderating effects of experience on the relationships between intention to explore and factors related to both hedonic and instrumental perspectives. During the post-adoption stage, when a technology tends to become more deeply embedded within individuals' day-to-day work activities, the relationship between intention to explore and performance expectancy is stronger than it is during the adoption stage. Thus, performance expectancy becomes more important moving from the adoption to the post-adoption stage of technology introduction presumably as the instrumental payoffs of a technology continue to increase. It is possible that users may be trying to keep pace with the organizational pressures on them to enhance their productivity or with their own desires to recoup the investment of learning new functionalities of a technology.

Our results on the effect of performance expectancy over time differs from the findings based upon TAM framework highlighted by Venkatesh et al. (2003) in studying the role of performance expectancy in technology acceptance domain. Indeed, rather than the effect of performance expectancy changing over time, Venkatesh et al. (2003) found that performance expectancy is fairly stable over time in predicting overall individuals' intentions to use. Our results, however, point out that experience moderates the role of performance expectancy on individuals' intentions to explore. The differences in the findings may be due to the fact that intention to use reflects a user's willingness to use a technology (Davis et al., 1989), reflecting how one intends to use the technology. In contrast, intention to explore reflects a user's intention to actively survey various features of a new technology (Nambisan et al., 1999), involving a discovery based on a sensemaking process that users experience as they attempt to incorporate the technology into their work lives. This is consistent with the framework we adopted that relies on exploration theory. The framework posits that individuals engage in exploratory behaviors in an attempt to develop an object's meaning and potential use (Voss and Keller, 1983), and that such a sensemaking process is facilitated by their experience in interacting with the object over time. Our findings are also consistent with the arguments of Karahanna et al. (1999) who found that instrumental beliefs play a pivotal role in the post-adoption stage.

Conversely, experience negatively influenced the effect of personal innovativeness on intention to explore a technology such that an increase in users' experiences tend to diminish the effect of individual personal innovativeness on this intention. This result is consistent with arguments developed by Venkatesh (2000) who posits that during the post-adoption stage individuals with a high level of personal innovativeness attempt to overcome the emergence of habit in interacting with a focal technology and in doing so, reallocate their time and cognitive efforts to seek out other intrinsic challenges in their environment.

Somewhat surprisingly, our results do not support the moderating effects of experience on the relationship between cognitive absorption or image enhancement and intention to explore. Instead, both cognitive absorption and image enhancement influence individuals' intentions to explore at both the adoption and post-adoption stages. The lack of a moderating effect of experience on the relationship between cognitive absorption and intention to explore may be traced back to two reasons. On the one hand, such an effect can be caused by an addiction-like phenomenon (Charlton, 2002) toward the technology. We speculate that, as time goes by, individuals develop a sense of dependence that comes from their personal pleasure in interacting with the technology. On the other hand, this result can be traced back to the nature of mobile technologies that have been studied in the present study. Indeed, according to Hong and Tam (2006), mobile devices differ from traditional desktop systems because they offer ubiquitous services and access independent from users' location and time, and they are designed for satisfying both utilitarian and hedonic needs (see Venkatesh and Ramesh, 2006). Therefore, the possibility to interact with the technology anytime and anywhere may lead individuals to be constantly engaged during the day in interacting with the technology exploiting either its utilitarian or hedonic functions. Therefore, users may feel cognitively involved in the exploration of the technology to fill free time (e.g., while waiting for a plane) just to play around with the technology or in the attempt to find new ways and workarounds for increasing their convenience and productivity in using the technology. Thus, it is important to study the longitudinal effects of cognitive absorption on intention to explore even for those technologies that are designed to primarily provide a utilitarian purpose. For example, it would be interesting to study if there is any effect of cognitive absorption and other hedonic factors on the exploration of ERP systems and even so, how such effects vary over time.

Concerning the failure to find support for the moderating role of experience on the relationship between image enhancement and intention to explore, we argue that this may be explained by the highly competitive social landscape and the rapid development of new technologies. Indeed, in a world that relies on competition for scarce resources, such as social status, individuals may consistently come to view and explore a technology as a path to enhance their social status independent of the specific stage of adoption—early vs. late.

### 6.2. *Practical implications*

Our work has important practical implications as well. It has long been recognized that the introduction of new technologies is, in and of itself, insufficient for the realization of gains in performance. Instead, users' tendency to substantially under-utilize new technologies and being limited to the use of only basic functionalities often undermines expected gains in organizational performance (Venkatesh et al., 2008). Therefore, one of the key challenges of new IS research is in assisting managers to identify factors that promote users' exploration of a new technology in order to fully grasp its potential. Our research suggests that it will be important to implement interventions that may foster individuals' willingness to explore a technology during different stages of adoption. For example, they can design a training session that focuses on intrinsic motivation by attempting to stimulate individuals' curiosity in interacting with a technology during the initial stages of adoption and stimulating the utilitarian facets of a technology in the post-adoption stage. One suggestion for the initial stage would be the use of game-based training (Venkatesh, 1999). Indeed, game-based training is likely to foster cognitive absorption, thus helping users cope with the initial obstacles associated with their technology interactions (Agarwal and Karahanna, 2000; Venkatesh and Speier, 1999). In the post-adoption stage, one of the main challenges is maintaining willingness to explore the technology by fostering more task-oriented discovery given that the novelty would have worn off. Therefore, we suggest that during the post-adoption stage, managers should identify ways of demonstrating the value of the technology by providing hands-on information and tips for using the technology, as well as organizational support that may help users in interacting with those features that they discover. Alternatively, the identification of power users could help users find new uses for the technology in the post-adoption stage (see Sykes et al., 2009; Venkatesh and Bala, 2008).

From a design perspective, developers should be aware of the critical role of cognitive absorption in the initial phases of users' experiences and they should design a product that meets users' hedonic needs. For example, the design of information-dense screens that are difficult to read would hamper individuals' willingness to engage in exploratory behaviors (Sun and Zhang, 2008). Moreover, the positive impact of instrumental factors on individuals' intentions to explore supports the pivotal role played by extrinsic motivation in stimulating individuals to fully exploit the potential of a technology. Thus, from a design point of view, there is the need to design devices that give users the immediate perception that the system is valuable in supporting their tasks and creating favorable outcomes. While some of these aspects have been studied in the literature related to the technology adoption of traditional systems, it is overlooked in the context of mobile technologies and it represents a critical issue (Venkatesh and Ramesh, 2006). We argue that such attention to designing interfaces that are able to stimulate cognitive absorption and which transfer the instrumental value to the end-user are pivotal for mobile technologies because of their aim to support individual task accomplishment independent of time and space. Indeed, through a personalization strategy, designers can stimulate users' hedonic interaction with a technology and provide a higher instrumental value by allowing them access to relevant and timely content. Building on our earlier suggestions, designers could follow the suggestions by Edwards et al. (2008) who highlight the importance of involving two disparate evaluation groups during a development project. In particular, the two groups should be used at different stages of experience in using the target product. By adopting this best practice and dovetailing it with the findings from our work, designers may be able to balance both the hedonic and instrumental aspects of technologies that in turn will maximize adoption in the short- and long-term.

### *6.3. Strengths, limitations and future research directions*

The strengths of this study include: (1) the collection of data in a field setting that allowed for the observation of user experience as it developed naturally and (2) the use of a longitudinal, rather than a more typical cross-sectional design, thus allowing us to gain insights of how the theorized relationships differed in different stages of adoption. These strengths notwithstanding, our research is not without limitations that may constrain its theoretical and practical implications. First, our sample consisted of full-time MBA students, rather than full-time employees, potentially calling into question the generalizability of findings to employed professionals. Nevertheless, the MBA students sampled had substantial extensive work experience and had only recently left the workforce. Second, the additional variance explained by the interaction terms formed by time and both the hedonic and instrumental factors may represent a weakness from a practical standpoint. Despite being statistically significant, the incremental variance explained resulting from the interactions was small, raising questions about their practical meaningfulness. Further, one of the dimensions of cognitive absorption, "immersion," assessed by this research differs somewhat from Agarwal and Karahanna's (2000) original conceptualization. Future research should adopt a version of the scale more similar to the original one.

An important avenue for future research can be related to the effects of various aspects of social factors in affecting individuals' exploratory behaviors. While we focused on a particular type of social factor, namely image enhancement, future research should investigate the effects of normative pressure and social information processing in shaping individuals' willingness to explore a technology. Also, the role of computer palyfulness in the nomological network of individuals' willingness to explore a technology should be taken into account. Indeed, Webster and Martocchio (1992) argued that computer playfulness may affect users' exploratory behavior via a high cognitive involvement in their interaction with technology.

Moreover, future research is needed to replicate these findings in the absence of the methodological weaknesses identified above and also to address other important questions. One such issue concerns whether the types of innovation that result from users' experiences in a hedonic context and thus, their intense focus on and involvement with the technology itself is qualitatively the same as that resulting from an instrumental focus. Future research that expands the scope of the model proposed here is important. For instance, it would be worth understanding how organizational actions can stimulate the occurrence of exploratory behaviors among users. Indeed, as exploratory behaviors present a certain level of risk, individuals should find an environment that is supportive of such kind of behaviors. Therefore, we think that the development of an organizational environment and the adoption of organizational practices that tolerate an acceptable level of risk may favor the occurrence of exploratory behaviors. For example, the IT department may support individuals in exploring a new technology via performance expectancy by providing directions and suggestions that stimulate individuals to have a better understanding of how a technology may be helpful above and beyond their routine uses.

Future research should study individuals' exploratory behaviors over time by taking into account the role of habit and other individual characteristics. Indeed, previous studies underscored that the extent to which people tend to use a technology automatically exerts a moderating effect on the relationship between intentions and continuance behaviors (Limayem et al., 2007). Therefore, future studies may consider habit as a moderating variable, especially of the relationship between intention to explore and exploratory behaviors over time. While investigating the antecedents of cognitive absorption was beyond the scope of our study, in a post-hoc analysis, we found a partial mediation of cognitive absorption on the relationship between personal innovativeness and intention to explore. This result suggests that future research should investigate other individual predispositions and traits for inclusion into the nomological network as antecedents of cognitive absorption.

## 7. Conclusions

This study contributes to the growing body of work examining end users' intentions to explore novel and value-added uses for newly introduced technologies. Our results suggest that both hedonic and instrumental factors affect users' intentions to explore but that the effects of these factors vary across stages of technology adoption. Our findings signal the theoretical importance and practical utility of further research both in IS and HCI on the determinants of users' exploratory behavior during different stages of a technology's diffusion. Indeed, only through a deep understanding of the factors that affect users' proactive and exploratory behaviors is it possible to fully exploit the potential of technologies. Further, by taking into account the evolution of users' experiences in interacting with the technology, designers can build technology solutions that create favorable outcomes for users.

## Appendix. Questionnaire

INTENTION TO EXPLORE

I intend to explore how the (technology) can be used for other tasks.

I intend to explore other ways that the (technology) may enhance my effectiveness.

I intend to spend time and effort in exploring the (technology) for potential applications.

COGNITIVE ABSORPTION

*Temporal dissociation*

When using the (technology):

I generally end up spending more time than I had planned.

Sometimes I lose track of time.

*Control*

I have no ability to make the (technology) do what I want.

I feel in control of what I am doing with the (technology).

*Enjoyment*

I have fun interacting with the (technology).

I get a lot of enjoyment interacting with the (technology).

*Immersion*

While in class I'm distracted by the (technology).

While I'm performing my MBA assignments, I get distracted by the (technology).

*Curiosity*

The (technology) excites my curiosity.

The (technology) arouses my creativity.

IMAGE ENHANCEMENT

Recruiters think that MBAs who use the (technology) have a more positive image.

Using the (technology) is a sign of status within my MBA class.

Using the (technology) improves my reputation within my MBA class.

PERSONAL INNOVATIVENESS

If I heard about a new technology, I would look for ways to experiment with it.

In general, I am hesitant to try out new technologies.

Among my peers, I am usually the first to try out new technologies.

PERFORMANCE EXPECTANCY

Through interacting with the (technology):

I improve my performance in the MBA program.

I am better at performing MBA-related activities.

I enhance my productivity.

## References


Agarwal, R., Karahanna, E., 2000. Time flies when you're having fun: cognitive absorption and beliefs about information technology usage. MIS Quarterly 24 (4), 665–694.

Agarwal, R., Prasad, J., 1998. The antecedents and consequents of user perceptions in information technology adoption. Decision Support Systems 22 (1), 15–29.

Agarwal, R., Venkatesh, V., 2002. Assessing a firm's web presence: a heuristic evaluation procedure for the measurement of usability. Information Systems Research 13 (2), 168–186.

Ahuja, M., Thatcher, J.B., 2005. Moving beyond intentions and toward the theory of trying: effects of work environment and gender on post-adoption information technology use. MIS Quarterly 29 (3), 427–459.

Aiken, L.S., West, S.G., 1991. Multiple Regression: Testing and Interpreting Interactions. Sage Publications, Thousand Oaks, CA.

Amabile, T.M., 1988. A model for creativity and innovation in organizations. In: Staw, B.M., Cummings, L.L. (Eds.), Research in Organizational Behavior, 10. J.A.I. Press, Greenwich, Connecticut, pp. 123–167.

Amabile, T.M., 1997. Motivating creativity in organizations: on doing what you love and loving what you do. California Management Review 40 (1), 39–58.

Amabile, T.M., Barsade, S.G., Mueller, J.S., Staw, B.M., 2005. Affect and creativity at work. Administrative Science Quarterly 50 (3), 367–403.

Ballinger, G.A., 2004. Using generalized estimating equations for longitudinal data analysis. Organizational Research Methods 7 (2), 127–150.

Barrick, M.R., Mount, M.K., 1991. The big five personality dimensions and job performance: a meta-analysis. Personnel Psychology 44 (1), 1–26.

Berlyne, D.E., 1950. Novelty and curiosity as determinants of exploratory behavior. British Journal of Psychology 41 (1), 68–80.

Berlyne, D.E., 1960. Conflict, Arousal, and Curiosity. McGraw-Hill Companies.

Berlyne, D.E., 1966. Curiosity and exploration. Science 153 (3731), 25–33.

Berlyne, D.E., 1978. Curiosity and learning. Motivation and Emotion 2 (2), 97–175.

Boudreau, M.C., Robey, D., 2005. Enacting integrated information technology: a human agency perspective. Organization Science 16 (1), 3–18.

Brown, S.A., Venkatesh, V., 2005. Model of adoption of technology in the household: a baseline model test and extension incorporating household life cycle. MIS Quarterly 29 (3), 399–426.

Burton-Jones, A., Straub, D.W., 2006. Reconceptualizing system usage: an approach and empirical test. Information Systems Research 17 (3), 228–246.

Carswell, A.D., Venkatesh, V., 2002. Learner outcomes in an asynchronous distance education environment. International Journal of Human–Computer Studies 56 (5), 475–494.

Chamberlain, D., 2006. In-depth analysis: 3G and mobile multimedia. INSTAT Report.

Charlton, J.P., 2002. A factor-analytic investigation of computer addiction and engagement. British Journal of Psychology 93 (3), 329–344.

Chin, W.W., 1998. Issues and opinion on structural equation modeling. MIS Quarterly 22 (1), 1–12.

Compeau, D.R., Higgins, C.A., 1995. Application of social cognitive theory to training for computer skills. Information Systems Research 6 (2), 118–143.

Condry, J., 1977. Enemies of exploration: self-initiated versus other-initiated learning. Journal of Personality and Social Psychology 35 (7), 159–177.

Constantiou, I.D., Damsgaard, J., Knutsen, L., 2007. The four incremental steps toward advanced mobile service adoption. Communications of the ACM 50 (6), 51–55.

Creusen, M.E.H., Schoormans, J.P.L., 2005. The different roles of product appearance in consumer choice. Journal of Product Innovation Management 22 (1), 63–81.

Csikszentmihalyi, I., Csikszentmihalyi, M., 1988. Optimal Experience: Psychological Studies of Flow in Consciousness. Cambridge University Press, New York, NY.

Csikszentmihalyi, M., 1990. Flow: the Psychology of Optimal Experience. Harper Collins, New York, NY.

Csikszentmihalyi, M., 1996. Creativity: Flow and the Psychology of Discovery and Invention. Harper Collins, New York, NY.

Davis, F.D., Bagozzi, R.P., Warshaw, P.R., 1989. User acceptance of computer technology: a comparison of two theoretical models. Management Science 35 (8), 982–1003.

Davis, F.D., Bagozzi, R.P., Warshaw, P.R., 1992. Extrinsic and intrinsic motivation to use computers in the workplace. Journal of Applied Social Psychology 22 (14), 1111–1132.

Deci, E.L., 1975. Intrinsic Motivation. Plenum Press, New York, NY.

Edwards, P.J., Moloney, K.P., Jacko, J.A., Sainfort, F., 2008. Evaluating usability of a commercial electronic health record: a case study. International Journal of Human-Computer Studies 66 (10), 718–728.

Elliot, A.J., Reis, H.T., 2003. Attachment and exploration in adulthood. Journal of Personality and Social Psychology 85 (2), 317–331.

George, J.M., Jones, G.R., 2000. The role of time in theory and theory building. Journal of Management 26 (4), 657–684.

Ghani, J.A., Deshpande, S.P., 1994. Task characteristics and the experience of optimal flow in human–computer interaction. Journal of Psychology 128 (4), 381–391.

Goldsmith, R.E., 1984. Personality characteristics associated with adaption–innovation. Journal of psychology 117 (2), 159–165.

Goldsmith, R.E., Hofacker, C.F., 1991. Measuring consumer innovativeness. Journal of the Academy of Marketing Science 19 (3), 209–221.

Gottschalg, O., Zollo, M., 2007. Interest alignment and competitive advantage. Academy of Management Review 32 (2), 418–437.

Greif, S., Keller, H., 1990. Innovation and the design of work and learning environments: the concept of exploration in human-computer interaction. In: West, M., Farr, J. (Eds.), Innovation and Creativity at Work. Wiley & Sons, Chichester, GA, pp. 231–249.

Gupta, S., Karahanna, E., 2004. Technology adoption in complex systems. Paper presented at Southern Association of Information Systems Conference, Savannah, GA, USA.

Hirschman, E.C., Holbrook, M.B., 1982. Hedonic consumption: emerging concepts, methods and propositions. Journal of Marketing 46 (3), 92–101.

Hofmann, D.A., Morgeson, F.P., Gerras, S.J., 2003. Climate as a moderator of the relationship between leader–member exchange and content specific citizenship: safety climate as an exemplar. Journal of Applied Psychology 88 (1), 170–178.

Hong, S.J., Tam, K.Y., 2006. Understanding the adoption of multipurpose information appliances: the case of mobile data services. Information Systems Research 17 (2), 162–179.

Inman, J.J., 2001. The role of sensory-specific satiety in attribute-level variety seeking. Journal of Consumer Research 28 (1), 105–120.

Jasperson, J., Carter, P.E., Zmud, R.W., 2005. A comprehensive conceptualization of post-adoptive behaviors associated with information technology enabled work systems. MIS Quarterly 29 (3), 525–557.

Joachimsthaler, E.A., Lastovicka, J.L., 1984. Optimal stimulation level-exploratory behavior models. Journal of Consumer Research 11 (3), 830–835.

Kamis, A., Koufaris, M., Stern, T., 2008. Using an attribute-based decision support system for user-customized products online: an experimental investigation. MIS Quarterly 32 (1), 159–177.

Karahanna, E., Straub, D.W., Chervany, N.L., 1999. Information technology adoption across time: a cross-sectional comparison of pre-adoption and post-adoption beliefs. MIS Quarterly 23 (2), 183–213.

Kegerreis, R.J., Engel, J.F., Blackwell, R.D., 1970. Innovativeness and diffusiveness: a marketing view of the characteristics of early adopters. In: Kollat, D., Biackwell, R., Engels, J. (Eds.), Research in Consumer Behavior. Holt, Rineholt, and Winston, New York, pp. 671–689.

Konradt, U., Christophersen, T., Schaeffer-Kuelz, U., 2006. Predicting user satisfaction, strain and system usage of employee self-services. International Journal of Human-Computer Studies 64 (11), 1141–1153.

Koufaris, M., 2002. Applying the technology acceptance model and flow theory to online consumer behavior. Information Systems Research 13 (2), 205–223.

Lewis, W., Agarwal, R., Sambamurthy, V., 2003. Sources of influence on beliefs about information technology use: an empirical study of knowledge workers. MIS Quarterly 27 (4), 657–678.

Li, X., Hsieh, J.J., 2007. Impact of transformational leadership on system exploration in the mandatory organizational context. In: Proceedings of the 28th International Conference on Information Systems, Montreal, pp. 1–20.

Limayem, M., Hirt, S.G., Cheung, C.M., 2007. How habit limits the predictive power of intention: the case of information systems continuance. MIS Quarterly 31 (4), 705–737.

Litman, J., 2005. Curiosity and the pleasures of learning: wanting and liking new information. Cognition and Emotion 19 (6), 793–814.

Malone, T.W., 1981. Toward a theory of intrinsically motivating instruction. Cognitive Science 5 (4), 333–369.

Maner, J.K., Gerend, M.A., 2007. Motivationally selective risk judgments: do fear and curiosity boost the boons or the banes? Organizational Behavior and Human Decision Processes 103 (2), 256–267.

McCreary, L., 2008. My blackberry ate my accountability. Harvard Business Review 86 (2), 38.

Morrison, E.W., 1993. Newcomer information seeking: Exploring types, modes, sources, and outcomes. Academy of Management Journal 36, 557–589.

Nah, F.F., Zhang, P., McCoy, S., Yi, M.Y., 2006. Human–computer interaction research in the management information systems discipline. International Journal of Human-Computer Studies 64 (9), 787–788.

Nambisan, S., Agarwal, R., Tanniru, M., 1999. Organizational mechanisms for enhancing user innovation in information technology. MIS Quarterly 23 (3), 365–395.

Novak, T.P., Hoffman, D.L., Yung, Y.F., 2000. Measuring the customer experience in online environments: a structural modeling approach. Marketing Science 19 (1), 22–44.

Nunnally, J.C., 1967. Psychometric Theory. McGraw-Hill, New York, NY.

Oreg, S., 2003. Resistance to change: developing an individual differences measure. Journal of Applied Psychology 88 (4), 680–693.

Orlikowski, W.J., 1992. The duality of technology. Organization Science 3 (3), 157–186.

Ozanne, J.L., Brucks, M., Grewal, D., 1992. A study of information search behavior during the categorization of new products. Journal of Consumer Research 18 (4), 452.

Pettey, C., Tudor, B., 2010. Competitive landscape: mobile devices, worldwide, 4Q09 and 2009. Gartner Report.

Pierce, J.S., Mahaney, H.E., 2004. Opportunistic annexing for handheld devices: opportunities and challenges. Paper presented at the Human Computer Interaction Consortium (HCIC), Fraser, CO, USA.

Pilke, E.M., 2004. Flow experiences in information technology use. International Journal of Human-Computer Studies 61 (3), 347–357.

Rai, A., Sambamurthy, V., 2006. The growth of interest in services management: opportunities for Information Systems scholars. Information Systems Research 17 (4), 327–331.

Rai, A., Lang, S.S., Welker, R.B., 2002. Assessing the validity of IS success models: an empirical test and theoretical analysis. Information Systems Research 13 (1), 50–69.

Raju, P.S., 1980. Optimum stimulation level: its relationship to personality, demographics, and exploratory behavior. Journal of Consumer Research 7 (3), 272–282.

Rogers, E.M., 1995. Diffusion of Innovations. Free Press, New York, NY.

Rogers, Y., Muller, H., 2006. A framework for designing sensor-based interactions to promote exploration and reflection in play. International Journal of Human-Computer Studies 64 (1), 1–14.

Saadé, R., Bahli, B., 2005. The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: an extension of the technology acceptance model. Information & Management 42 (2), 317–327.

Saga, V.L., Zmud, R.W., 1994. The nature of IT acceptance, routinization, and infusion. In: Levine, L. (Ed.), Diffusion, Transfer, and Implementation of Information Technology. North Holland, Amsterdam, pp. 67–86.

Sarker, S., Wells, J.D., 2003. Understanding mobile handheld device use and adoption. Communications of the ACM 46 (12), 35–40.

Spender, J.C., Kessler, E.H., 1995. Managing the uncertainties of innovation: Extending Thompson (1967). Human Relations 48, 35.

Spielberger, C.D., Starr, L.M., 1994. Curiosity and exploratory behavior. In: O'Neil, H.F., Drillings, M. (Eds.), Motivation: Theory and Research. Lawrence Erlbaum Associates, Hillsdale, NJ, pp. 221–244.

Steenkamp, J.B.E.M., Baumgartner, H., 1992. The role of optimum stimulation level in exploratory consumer behavior. Journal of Consumer Research 19 (3), 434–448.

Sun, H., Zhang, P., 2006. The role of moderating factors in user technology acceptance. International Journal of Human–Computer Studies 64 (2), 53–78.

Sun, H., Zhang, P., 2008. An exploration of affect factors and their role in user technology acceptance: mediation and causality. Journal of the American Society for Information Science and Technology 59 (8), 1–12.

Sykes, T.A., Venkatesh, V., Gosain, S., 2009. Model of acceptance with peer support: a social network perspective to understand employees' system use. MIS Quarterly 33 (2), 371–393.

Te'eni, D., Carey, J., Zhang, P., 2007. Human–Computer Interaction: Developing Effective Organizational Information Systems. John Wiley & Sons, New York, NY.

Thatcher, J.B., Perrewe, P.L., 2002. An empirical examination of individual traits as antecedents to computer anxiety and computer self-efficacy. MIS Quarterly 26 (4), 381–396.

Thompson, R.L., Higgins, C.A., Howell, J.M., 1991. Personal computing: toward a conceptual model of utilization. MIS Quarterly 15 (1), 125–142.

Thong, J.Y.L., 1999. An integrated model of information systems adoption in small businesses. Journal of Management Information Systems 15 (4), 187–214.

Thong, J.Y., Hong, S., Tam, K.Y., 2006. The effects of post-adoption beliefs on the expectation-confirmation model for information technology continuance. International Journal of Human–Computer Studies 64 (9), 799–810.

Tichy, N.M., 1983. Managing Strategic Change: Technical, Political, and Cultural Dynamics. Wiley.

Trevino, L.K., Webster, J., 1992. Flow in computer-mediated communication: electronic mail and voice mail evaluation and impacts. Communication Research 19 (5), 539–573.

Vallerand, R.J., 1997. Toward a hierarchical model of intrinsic and extrinsic motivation. In: Zanna, M.P. (Ed.), Advances in Experimental Social Psychology. Academic Press, New York, pp. 271–360.

Van der Heijden, H., 2004. User acceptance of hedonic information systems. MIS Quarterly 28 (4), 695–704.

Venkatesh, V., 2000. Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model. Information Systems Research 11 (4), 342–365.

Venkatesh, V., 1999. Creation of favorable user perceptions: exploring the role of intrinsic motivation. MIS Quarterly 23 (1), 239–260.

Venkatesh, V., Agarwal, R., 2006. From visitors to customers: a usability-centric perspective on purchase behavior in electronic channels. Management Science 52 (3), 367–382.

Venkatesh, V., Bala, H., 2008. Technology acceptance model 3 and a research agenda on interventions. Decision Sciences 39 (1), 273–315.

Venkatesh, V., Brown, S.A., 2001. A longitudinal investigation of personal computer adoption in homes: adoption determinants and emerging challenges. MIS Quarterly 25 (1), 71–102.

Venkatesh, V., Brown, S., Maruping, L., Bala, H., 2008. Predicting different conceptualizations of system use: the competing roles of behavioral intention, facilitating conditions, and behavioral expectation. MIS Quarterly 32 (3), 483–502.

Venkatesh, V., Davis, F.D., 2000. A theoretical extension of the technology acceptance model: four longitudinal field studies. Management Science 46 (2), 186–204.

Venkatesh, V., Maruping, L.M., Brown, S.A., 2006. Role of time in self-prediction of behavior. Organizational Behavior and Human Decision Processes 100 (2), 160–176.

Venkatesh, V., Morris, M.G., Ackerman, P.L., 2000. A longitudinal field investigation of gender differences in individual technology adoption decision making processes. Organizational Behavior and Human Decision Processes 83 (1), 33–60.

Venkatesh, V., Davis, F.D., Morris, M.G., 2007. Dead or alive? The evolution, trajectory, and future of technology adoption research. Journal of the AIS 8 (4), 267–286.

Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D., 2003. User acceptance of information technology: toward a unified view. MIS Quarterly 27 (3), 425–478.

Venkatesh, V., Ramesh, V., 2006. Web and wireless site usability: understanding differences and modeling use. MIS Quarterly 30 (1), 181–206.

Venkatesh, V., Speier, C., 2000. Creating an effective training environment for enhancing telework. International Journal of Human–Computer Studies 52 (6), 991–1005.

Venkatesh, V., Speier, C., 1999. Computer technology training in the workplace: a longitudinal investigation of the effect of mood. Organizational Behavior and Human Decision Processes 79 (1), 1–28.

Venkatraman, N., 1991. IT-induced business reconfiguration. In: Scott Morton, M.S. (Ed.), The Corporation of the 1990s: Information Technology and Organizational Transformation. Oxford University Press, New York, NY, pp. 122–158.

Von Hippel, E., 1988. The Sources of Innovation. Oxford University Press, New York, NY.

Voss, H.G., Keller, H., 1983. Curiosity and Exploration: Theories and Results. Academic Press, New York.

Watson, D., Clark, L.A., 1984. Negative affectivity: the disposition to experience aversive emotional states. Psychological Bulletin. 96 (3), 465–490.

Webster, J., Hackley, P., 1997. Teaching effectiveness in technology-mediated distance learning. Academy of Management Journal 40 (6), 1282–1309.

Webster, J., Martocchio, J., 1992. Microcomputer playfulness: development of a measure with workplace implications. MIS Quarterly 16 (1), 201–226.

Webster, J., Trevino, L.K., Ryan, L., 1993. The dimensionality and correlates of flow in human-computer interactions. Computers in Human Behavior 9 (4), 411–426.

Yi, M.Y., Hwang, Y., 2003. Predicting the use of web-based information systems: self-efficacy, enjoyment, learning goal orientation, and the technology adoption model. International Journal of Human–Computer Studies 59 (4), 431–449.

York, J., Pendharkar, P.C., 2004. Human–computer interaction issues for mobile computing in a variable work context. International Journal of Human–Computer Studies 60 (5–6), 771–797.

Zeger, S.L., Liang, K.Y., Albert, P.S., 1988. Models for longitudinal data: a generalized estimating equation approach. Biometrics 44 (4), 1049–1060.

Zhang, P., Li, N., 2005. The importance of affective quality. Communications of the ACM 48 (9), 105–108.

Zhang, P., Shelly, A., Sun, H., 2008. Two types of attitudes in ICT acceptance and use. International Journal of Human–Computer Interaction 24 (7), 628–648.

Zuckerman, M., 1969. Theoretical formulations. In: Zubek, J.P. (Ed.), Sensory Deprivation: Fifteen Years of Research. Appleton-Century-Crofts, New York, NY, pp. 407–432.