ICIS 2008 Proceedings

International Conference on Information Systems (ICIS)

2008

Adaptive System Use; An Investigation at the System Feature Level

Heshan Sun
University of Arizona, hsun@email.arizona.edu

Ping Zhang
Syracuse University, pzhang@syr.edu

ADAPTIVE SYSTEM USE: AN INVESTIGATION AT THE SYSTEM FEATURE LEVEL

Usage adaptatif d'un système: une investigation des caractéristiques du système

Completed Research Paper

Heshan Sun
School of Information Resources
and Library Science
University of Arizona
1515 East First Street
Tucson, AZ 85719
United States
hsun@email.arizona.edu

Ping Zhang
School of Information Studies
Syracuse University
Hinds Hall 328
Syracuse University
Syracuse, NY 13244
United States
pzhang@syr.edu

Abstract

System use has been simply defined and measured. In this research, we investigate the dynamics of system use at the individual level. A new concept called adaptive system use is developed to capture user modifications to their use of system features. A causal model including antecedents of adaptive system use is developed. Three antecedents of adaptive system use are identified. Using a sample of 282 users of MS Office, our study examines the psychometric properties of adaptive system use and confirms the research model. Four types or dimensions of adaptive system use are trying new features, feature substitution, feature combination, and feature repurposing. Triggers are found to be the most important antecedent of adaptive system use. Facilitating conditions also affect adaptive system use significantly. Research and practical implications are offered.

Keywords: Adaptive system use, triggers, features in use, survey, formative construct

Résumé

Dans cette recherche, nous traitons de la dynamique d'usage au niveau individuel. Un nouveau concept intitulé usage adaptatif des systèmes est développé pour rendre compte des modifications d'usage des caractéristiques du système par les utilisateurs. Mobilisant un échantillon de 282 utilisateurs de MS Office, notre étude examine les propriétés psychométriques de l'usage adaptatif du système et confirme le modèle de recherche.

Introduction

After decades of extensive work on individuals' acceptance of new technology, attention is paid to individuals' system use behavior at the post-adoptive stages (Jasperson et al. 2005). Post-adoptive system use is believed to help organizations enhance their employees' job performance and thereby reap the full benefit from high costs of IT infrastructure (Cooper et al. 1990). Researchers have observed how individual users---after initial acceptance of information systems---use these systems dynamically at the post-adoptive stage, as vividly demonstrated in the two scenarios below. Some concepts related to the dynamics of post-adoptive system use include "unanticipated use" (Singletary et al. 2002 p.1135), "feature extension" (Jasperson et al. 2005), "the nature of IS use" (Jain et al. 2004), "trying to innovate" (Ahuja et al. 2005), coping behaviors (Beaudry et al. 2005), and task-technology adaptation behaviors (Barki et al. 2007), among others. These concepts contribute greatly to our understanding of how users can explore the potential of information systems to enhance their job performance. Despite the differences, those concepts share one belief: users can form their own ways of using information system. This happens to almost all types of information systems---even the ERP systems, which are notorious for their inflexibility (Boudreau et al. 2005).

Scenario I: *"I tried the 'Track Changes' function in MS Word because it is something my boss used and we shared files. I never used it before." [rationale: new task (sharing files)→ using new feature]*
Scenario II: *"I use PowerPoint to draw figures for my research papers" [repurposing: using PowerPoint in a way different from its original intent].*

To date, however, there exist two issues that inhibit our understanding of the dynamic nature of post-adoptive system use. First, the conceptualization of post-adoptive system use seems still scant, especially with regard to the appropriate level of analysis (Burton-Jones et al. 2006). One would expect that once a particular system is accepted, examining use should go beyond the whole system level and be more refined at a lower level, such as functions or features levels---the building blocks of information systems (Jasperson et al. 2005). Yet, post-adoptive system use at the feature level has not yet received sufficient theoretical and empirical examinations. Second, little is known about what triggers people to modify their use of information systems at the post-adoptive stage. Understanding these two issues is critical to understanding the dynamics of post-adoptive system use.

The current research addresses the above two issues. For the conceptualization and empirical testing of post-adoptive system use at the feature level, we develop a new concept named adaptive system use (ASU). To study what factors may trigger people's modification to their use of information systems, we develop a process model of ASU, based primarily on Louis and Sutton's work on cognitive switching gears (Louis et al. 1991). This model includes three antecedents of ASU and is empirically tested.

This research contributes to the advancement of knowledge and understanding of system use. The new concept of adaptive system use provides a new vehicle for studying post-adoptive system use. The process model, on the other hand, depicts the conditions for adaptive system use to occur. Adaptive system use opens "windows of opportunity" for users to exploit and extend the potential of information systems (Jasperson et al. 2005; Tyre et al. 1994). Therefore, understanding what triggers adaptive system use is beneficial (Tyre et al. 1994). It is especially true when we consider the fact that adaptive system use is not always desirable. Errors may occur when a necessary adaptive system use is not activated or when it is mistakenly activated (Louis et al. 1991). When adaptive system use is not activated when necessary, people miss the opportunity to expand their abilities of using the system to support their work. When adaptive system use is mistakenly activated, on the other hand, people unnecessarily assign their mental resources to learn something that is not necessarily needed for their work. Understanding the antecedents of ASU can help us identify the mechanisms to either encourage or constrain adaptive system use behaviors and subsequently avoid above errors.

Conceptual Development

A Review on Prior Conceptualizations of Post-adoptive System Use

Table 1 summarizes existing conceptualizations of post-adoptive system use. Several researchers have touched what we believe is the defining characteristic of post-adoptive system use --- modifications in using system features. For instance, it has been noticed that users may modify --- "extend," "adapt to,"or "cope with" --- information systems or system features (Barki et al. 2007; Beaudry et al. 2005; Jasperson et al. 2005; Saga et al. 1994; Singletary et al. 2002).

Also in Table 1, one can see that there is no agreed upon definition of post-adoptive system use. Researchers have studied it from various perspectives and at different levels of analysis (whole system versus system features). This manifests a deeper problem: the systematic theoretical treatment to system usage has been scant and studying post-adoptive system use is still at a very early stage (Burton-Jones et al. 2006). In this study, we conceive the feature level of analysis as important and critical in studying post-adoptive system use. As argued by Jasperson and colleagues (2005):

> *… [A] feature-centric view of technology is valuable because the set of IT application features recognized and used by an individual likely changes over time, and it is the specific features in use at any point in time that influence and determine work outcomes. (p. 529)*

Although many IS researchers realized the importance and necessity of analyzing post-adoptive system use at the feature level (e.g., Bhattacherjee 1998; Ginzberg 1981; Hiltz et al. 1981; Kay et al. 1995; Straub et al. 1995), few have theorized post-adoptive system use at the feature level or tested it empirically.

In addition, little is known about what trigger people's modifications to their system use behaviors. Some conceptualizations have implied conditions in which people change their current use of information systems. For instance, several conceptualizations include tasks as an essential part of system use (e.g., Barki et al. 2007; Beaudry et al. 2005; Saga et al. 1994; Singletary et al. 2002 p.1135). This actually implies that tasks could be a factor that triggers users to change their current ways of use system features. Beaudry and colleagues (2005) further argued that such changes in system use are also constrained by the consequence of the IT event and control over the change, which implies the importance of individual and contextual factors. Yet, no systematic treatments of the triggers and contextual constraints of user modifications in post-adoptive system use have been conducted.

Table 1. Existing Conceptualizations of Post-adoptive System Use

Article ID	Concepts	Definitions	Technical level
Ahuja, et al. (2005)	Trying to innovate	An individual's goal of finding novel uses of information technologies, and is considered to be a particularly suitable volitional post-adoption measure.	Whole system
Barki, et al. (2007)	Task-technology adaptation behaviors.	Task-technology adaptation includes all behaviors directed at changing or modifying an IT and its deployment and use in an organization. Specifically, this category includes improving functionality, improving interface, improving hardware, modifying tasks, and modifying systems. Reinvention underlies this category.	Feature
Beaudry, et al. (2005)	IT related coping behaviors	system users choose different adaptation strategies based on a combination of primary appraisal (i.e., a user's assessment of the expected consequences of an IT event) and secondary appraisal (i.e., a user's assessment of his/her control over the situation). Users will perform different actions in response to a combination of cognitive and behavioral efforts, both of which have been categorized as either problem- or emotion-focused.	Whole system
Burton-Jones and Straub (2006)	Deep structure use	The extent to which ICT is used to carry out a task. Deep structure use indicates the extent to which these features have actually been used by a user.	Feature
Jain and Kanungo (2004)	Nature of IS use	Measured by three descriptors: "organized," "different," and "efficient" use of IT.	Whole system
Jasperson, et al. (2005)	Feature adoption, Feature use Feature extension	Users adopt, use and extend system features.	Feature
Saga, et al. (1994)	Extended use	Using more of the technology's features in order to accommodate a more comprehensive set of work tasks.	Feature / Whole system
	Integrative use	Using the technology in order to establish or enhance work flow linkages among a set of work tasks	
	Emergent use	Using the technology in order to accomplish work tasks that were not feasible or recognized prior to the application of the technology to the work system	
Singletary, et al. (2002)	Unanticipated use[1]	"voluntarily extending the use of a software product to new tasks and new settings after mandatory adoption for a specific task in a specific setting" (p. 1135)	Whole system

[1] In a later paper, they called it "innovative use," but it has the same meaning as "unanticipated use."

Conceptualization of Adaptive System Use (ASU)

As mentioned earlier, there is no agreed upon definition of system use. In this research, we adopt Burton-Jones and Straub's definition and conceive an individual user's system use as "an individual user's employment of one or more features of a system to perform a task" (Burton-Jones et al. 2006 p. 231). This definition fits our research context and can help us distinguish system use from other relevant but distinct constructs such as proxy of use (e.g., intention to use) and evaluation of use (e.g., appropriateness and quality of use) (Burton-Jones et al. 2006).

Understanding system features is the first step of our conceptualization of adaptive system use. For the sake of discussion in this paper, we consider an information system as an application of technology that is targeted toward a particular domain of problems. Examples can be enterprise resource planning systems, enterprise communication systems, computer aided design systems, personal productivity systems, and personal communication systems, among others. System features can be defined as the functional building blocks or functional components of an information system (Griffith et al. 1994; Jasperson et al. 2005). Such components correspond to users' tasks or jobs that the information system is intended to support; thus they are functional features that demonstrate the functionalities of the information system. Features can also be grouped into feature sets. One possible way of characterizing a system feature or a feature set would be to consider a use case scenario where a user has a particular task and s/he needs to work with the system to accomplish the task. Use cases correspond to real world events and needs/tasks. In each use case, a user is not just interacting with the whole system; s/he is actually interacting with a set of features of the system. S/he may not touch other features at all. Information systems can have features at various levels of importance, some of which are viewed as "core features" while others are seen as peripheral or optional (Jasperson et al. 2005). The analysts and designers of the information system normally decide what should be the core features and what should be optional. By doing this, they also imply the use situations or scenarios and the ways the system should be used. Such intentions and designs may not be what happen in the real world once the system is used. The possible difference among a designer's image and a user's image of the system is well recognized (Norman 1988) and can contribute to the difference between intended use and actual use. What makes the actual system use even more dynamic and unpredictable is the unpredictability of the use cases or scenarios. Not all of the scenarios can be anticipated by the designers and subsequently built into the systems.

Features in use

We found Orlikowski's conceptualization of technology in practice very useful for us to understand the role of system features in mediating the interaction between systems and their users. Orlikowski defined technologies-in-practice which involves the set of rules and resources that are reconstituted through an individual's engagement with the technologies at hand (Orlikowski 2000). Specifically, a particular system can mean different things to different users. Users may use different features of the same systems or use features in different ways. It is the features that are currently used by a particular user that define the meaning of the system for him/her.

We further propose that users have what can be called **"features in use."** Features in use refer to the features that are ready to be used by a particular user. Therefore, each user has his/her own features in use. For example, only about ten percept of all features of MS Office — the number can be different from user to user--- are used by a typical user. These features consist of a user's features in use. System features that are not features in use for an individual user include those features that are unknown or unfamiliar to this user and those that have been tried and abandoned by this user. These features are not ready to be used by this user. It is the **features in use that define one's conception of the information systems he or she is using.** Furthermore, features in use are always in flux. Over time, users may modify what features are used and/or the ways they use these features. Developers and users may "use features in a way not only based solely on vendor specifications but also in ways that allow them to best complete work, a condition matching emergent conceptualization" (Harrison et al. 2007 p.314). Therefore, a user's modifications to information systems can be more precisely described as modifications to his/her features in use.

Figure 1 illustrates several points in above discussions. First, features in use mediate the interactions between users and technologies. Again, it is a user's features in use that define the meanings of the information systems to this particular user. Second, over time, people can change their features in use. In Figure 1, from Time 1 to Time 2, a user may have different features in use from the same or different information systems. As an alternative, the user can stick to his/her habitual feature use and keep the features in use unchanged.

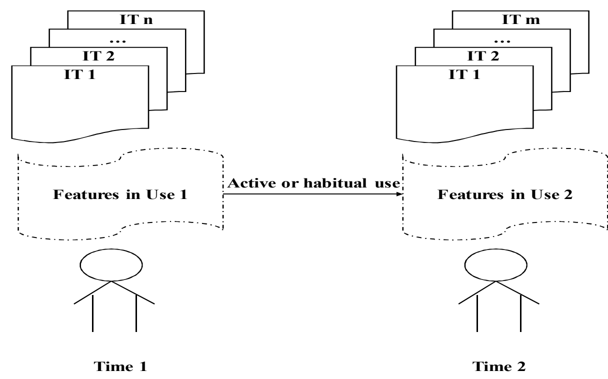

Figure 1. The Concept of Features in Use

Two aspects of features in use

Inspired by the research on social structure of IT (DeSanctis et al. 1994; Orlikowski 2000; Poole et al. 1990), we conceive that there are two aspects of features in use---the system features and the "spirit" of these features. The former can be viewed as the content of features in use, i.e., which features are used by a user. The spirit of system features, on the other hand, refers to the general goals and attitudes these features aim to promote and the general intent with regard to values and goals underlying these features in use (i.e., the way features are used). For instance, most users may conceive PowerPoint as a presentation tool --- as expected by the developers --- because most of its core features are related to creating presentations. It is a pre-existing conception of PowerPoint that is embedded in the system by the developers and is explicit to users. Each feature also has its spirit. For example, most if not all people seeing the small disk button () --- even in new applications --- may think it is the "save file" feature. It is the spirit of this feature: the official way or the purpose of using this feature is "clicking it to save files."

Adaptive system use

Based on the above discussions, we develop a new concept called adaptive system use, which is defined as *user modifications of the content of his/her features in use (what features are used) and/or the way of using these features (how these features are used).* We borrow the word "adaptive" from the adaptive structuration theory (AST, DeSanctis et al. 1994; Poole et al. 1990) to reflect the fact that users constantly adapt to information systems by modifying their use of system features. By definition, adaptive system use can be understood in two ways: modifying the content of features in use and modifying the spirit of the features in use. The former one means a user modifies which features are used. For instance, a user may try a new feature and subsequently he /she expands the scope of his/her features in use. Modifying the spirit of these features, on the other hand, refers to a user behavior of modifying the ways he or she uses his/her features in use. For instance, a user may use a feature he/she used before in a new way, which may not even been thought of by the developers.

A Process Model of Adaptive System Use

Theoretical Foundation

Louis and Sutton's research on Cognitive Gear Switching (Louis et al. 1991) serves as the primary theoretical foundation of the research model. In studying the switching gears from habits of mind to active thinking, they identified a set of situations in which a person deviates from his/her habitual thinking and engages in active thinking. Noteworthy is that these are triggers of active thinking, not behavior per se. However, this active thinking---also conceived as technology sensemaking in the IT context--- is a necessary condition for active use experience (Jasperson et al. 2005). These three conditions include (Louis et al. 1991):

1. Unusual or novel situations.
2. Discrepancies between what is expected, given the schemas in use, and what is observed
3. Deliberate initiative where one is asked to think.

These triggers are similar to the concept of contradictions studied in previous research. A contradiction refers to an unfit within elements [of an activity], between them, between different activities or different development phases of a same activity (Kuutti 1995). Contradictions manifest themselves as problems, ruptures, breakdowns, clashes, etc (Kuutti 1995). For instance, the contradictions in existing work practice may be manifested by an unexpected error in work or work system outcome expectation gap (discrepancy) (Jasperson et al. 2005). Unusual or novel situations are contradictions between current and new situations (e.g., a new system is introduced into an organization). Discrepancies, on the other hand, refer to the contradictions among elements (i.e., task, features, user) of current system use practices (Burton-Jones et al. 2006). Deliberate initiative can be understood as contradictions between two activities, e.g., the boss' and employees' system use activities. For example, the boss may ask employees to use features that he/she is familiar with but are not necessarily known to the employees. This may trigger employees' adaptive feature use behavior, e.g., trying new features.

Furthermore, contradictions are sources of development. For instance, Kuutti (1995) argues that real activities are practically always in the process of working through contradictions. Il'enkov argues that contradictions are the "principle" of activity's self-movement and are the form in which the development is cast (Engeström 1990 p.330). In the same vein, contradictions can be conceived as "the moving force behind disturbances and innovations, and eventually behind the change and development of the [activity] system" (Harrisburg et al. 1999 p.84). Harrisburg and colleagues also pointed out that "new qualitative forms of activity emerge as solutions to the contradictions of the preceding form" (Harrisburg et al. 1999 p.219). In summary, contradictions are the *impetus* behind deviations from current status and give rise to innovations (Harrisburg et al. 1999).

Louis and Sutton (1991) further pointed out that the existence of the above triggers or contradictions does not guarantee active thinking and behavior, depending on individual and contextual factors. For instance, a person, when encountering a trigger, should have the ability or eagerness to notice the trigger. Or more explicitly, adaptive system use is situated in and constrained by both internal and external contexts. External context usually refers to the environment external to an individual, whereas internal context refers to the subject's conditions (individual characteristics) (Dervin et al. 1986). Considering internal and external contexts helps us to get a richer conceptualization of system users, as argued by Lamb and Kling (2003).

Research Model and Hypotheses

A process model of adaptive system use (Figure 2) is developed based on the above discussions. First, triggers are the major impetus of adaptive system use. Second, when encountering triggers, a user may or may not perform adaptive system use; both individual and contextual factors can moderate the impact of triggers on adaptive system use. In this research, we select one IT specific internal contextual factor --- personal innovativeness in IT --- and one external contextual factor---facilitating conditions from previous studies. We believe that they are most closely related to adaptive system use, which is in essence an innovative behavior. These factors have been systematically examined and confirmed to be relevant and important to system use (Agarwal et al. 2000; Venkatesh et al. 2003).

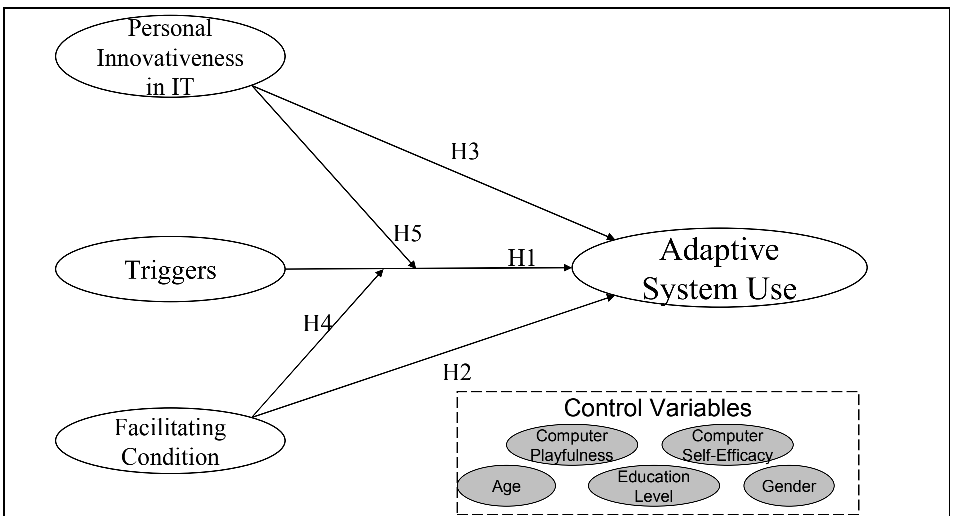

Figure 2. The Process Model of Adaptive System Use

Triggers

A "trigger" is any influence that acts like a mechanical trigger in initiating a process or reaction. Following Louis and Sutton's definition of the three conditions of switching gears, we conceive IT related triggers as a formative high-order construct that are composed of three types of triggers: novel situations, discrepancies, and deliberate initiatives. Examples for novels situations are new tasks, task requirements or the introduction of a new system. For discrepancy, it can be an unsatisfied outcome or error. For deliberate initiatives, the example can be other people's request or demand.

We argue that the existence of triggers is an important antecedent of adaptive system use (ASU). The more triggers one has, the more likely he or she is to change his or her system use. First, novel situations, such as new tasks, new technological environments, and new observations of other people's use, can trigger adaptive system use. For instance, employees in an organization that is introducing a new system are more likely to face novel technical situations and subsequently are likely to change what features they use. Task characteristics are, without a doubt, important components of novel situations and are thus closely related to modifications to system use (e.g., Barki et al. 2007; Beaudry et al. 2005; Saga et al. 1994; Singletary et al. 2002 p.1135). Second, people can also be motivated to change because of discrepancies between expectation and reality. System failure and system limitations exemplify this category. Third, adaptive system use can be triggered by deliberate initiatives, i.e., one is asked to change.

H1: The existence of triggers is associated with adaptive system use.

Internal and external contexts

The facilitating conditions of an system use scenario represent users' external contexts. Facilitating conditions are defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support his or her use of the system (Venkatesh et al. 2003). When people have better facilitating conditions, they are more likely to respond with adaptive system use behaviors. We can also find theoretical support for this hypothesis in the Theory of Planned Behavior (TPB) (Ajzen 1985; Ajzen 1991). TPB includes a construct called "perceived behavioral control." Defined as "perceptions of internal and external constraints on behavior" (Taylor et al. 1995 p. 149), perceived behavioral control represents how people believe they can deal with new situations based on available support and resources. Thus, facilitating conditions can be conceived as similar to perceived behavioral control, but include merely external factors. Or, in other words, facilitating conditions are a "core component of perceived behavioral control" (Venkatesh et al. 2003 p.453).

Prior research has also confirmed that facilitating conditions have a direct influence on system use behavior. For instance, perceived behavioral control has been confirmed to influence actual behavior beyond behavioral intention (Ajzen 1991). When a user believes he or she has control over and necessary support for doing something such as using new system features, he or she is likely to do it. In the same vein, Venkatesh and colleagues empirically confirmed that facilitating conditions were also significant determinants of system use behavior (Venkatesh et al. 2003).

Applying these findings to the study of adaptive system use, we argue that facilitating conditions are an important determinant of adaptive system use. It is reasonable to argue that when facilitating conditions are present, an individual is more likely to change his or her use of information systems. On the other hand, if few or no facilitating conditions are available, changing system use may be risky and time-consuming and therefore not worthwhile. This may lead the user not to change system use behavior at all.

H2: Facilitating conditions is positively associated with adaptive system use.

Personal innovativeness in system use (PIIT), conceptualized as an individual trait reflecting one's willingness to try out any new technology (Agarwal et al. 2000), is a domain-specific innovativeness factor posited to influence users' adaptive system use behaviors. Individuals differ in their potential for coming up with creative ideas or producing innovative outputs (Zhou et al. 2002). Someone who says "I like trying new things" is more likely to experience new technology or new features than someone who is not innovative in nature. Therefore, we argue that:

H3: Personal innovativeness in system use is positively associated with adaptive system use.

Moderating effects

Beyond direct impacts, we also model the constraints of internal and external factors, via moderating effects. When encountering triggers, individuals may not necessarily perform adaptive system use behavior, depending on the internal and external contexts. First, facilitating conditions are argued to have a moderating effect on the trigger-

ASU relationship. An individual is likely to demonstrate ASU behavior when encountering triggers if he or she feels that sufficient facilitating conditions and support are available. When the facilitating conditions are sparse, the user may feel that he or she should not change his or her system use behavior when facing triggers because it is risky and no necessary facilitating conditions are available to act as safeguards if anything goes wrong during the change. Therefore,

H4: Facilitating conditions moderate the effects of triggers on adaptive system use; triggers have a larger effect on adaptive system use for individuals with more facilitating conditions.

We also predict that personal innovativeness in IT (PIIT) can moderate the impact of triggers on adaptive system use. Innovators are believed to look for more external information sources (e.g., mass-media) and rely less on the subjective evaluations of other members of their social systems (e.g., interpersonal channel) when making decisions about innovation adoption (Rogers 1995). While subjected to the same mix of channels, innovative users may develop more positive perceptions of IT innovation than other users (Agarwal et al. 1999). A closely relevant concept is risk-taking. Kirton argues that innovation, by its nature, is associated with risk, uncertainty, and imprecision (Kirton 1976). Innovators are characterized by their willingness to change and to take risks (Rogers 1995). Thus, under the same circumstances, those with high innovativeness are more likely to make the change happen and take the risks associated with the change.

We can expect that the same will happen to adaptive system use behaviors. When facing triggers, individuals with high personal innovativeness in IT are more likely to get positive or encouraging information from the trigger event and are thus more willing to take risks and change their use of the system features embedded in the IT innovation.

H5: Personal innovativeness in IT (PIIT) moderates the effects of triggers on adaptive system use; the triggers have a higher effect on adaptive system use for individuals with higher PIIT.

Control Variables

Controlling for variables that may have potential influence on the dependent variables in a research model provides a stronger test of the theory underlying that research model (Doney et al. 1997). Hence, we identify and control for the following factors that may also influence adaptive system use.

- **Demographic characteristics.** Prior research has showed that demographic characteristics may account for the difference in system use (Sun et al. 2006b). Therefore, we control for the effects of age, gender, and education level.
- **Computer playfulness (CP).** Defined as an individual characteristic representing a type of intellectual or cognitive playfulness (Webster et al. 1992), computer playfulness describes an individual's tendency to interact "spontaneously, inventively, and imaginatively" with microcomputers (Yager et al. 1997 p.202). People who are more playful with information technologies in general are expected to indulge in using a system just for the sake of using it, rather than for the specific positive outcomes associated with use (Barnett 1991). An individual with high computer playfulness would be more likely to change his or her use of an information system because he or she can associate this behavior with play and so does not think of it as difficult.
- **Computer self-efficacy (CSE).** CSE was developed to reflect a user's judgment of his or her capability to use a computer (Compeau et al. 1995b). Since people with high CSE are more likely to use IT (Burkhardt 1990; Compeau et al. 1999; Yi et al. 2003), CSE is thus controlled.

Research Method

An online survey was conducted to test the research model and hypotheses. To control for variance introduced by professions, only administrative workers were invited. This group was chosen because they are likely to have extensive interactions with the target technology used in this research---MS Office suite --- and therefore likely to have various use behaviors.

An online questionnaire was designed using ASP and Access. An invitation letter with the URL of the questionnaire was sent to 1500 randomly selected administrative assistants from a large database. These subjects are from multiple organizations. To boost the response rate, a reminder email was sent one week after the first letter. The final sample consisted of 282 valid responses, indicating a response rate of 19%. The average age of the sample is 37.73 (std.

dev=9.83). 71% of the subjects are female. To test the non-response bias, early and late responses were compared. Specifically, the sample is divided into two sub-samples, representing the early and late responses, respectively, with an equal number of subjects in each. Then, t-tests were conducted to compare these two sub-samples in terms of age, gender, education level, and also the three individual difference factors mentioned above. The results show that other than the education level, these two sub-samples are not significantly different. So in general, the non-response bias should not be a significant issue for this study.

Microsoft Office (including various products such as Word, Excel, PowerPoint, Visio, Outlook, and FrontPage) was used in this research as the target technology. Microsoft Office is a relatively mature technology and the use of it is more likely to be voluntary. Thus, we are likely to observe various use behavior with it.

Incident analysis was applied because people might not be aware of the adaptive system use behaviors they performed previously (Orlikowski et al. 2002). Subjects were asked to report one incident wherein they had changed their use of Microsoft Office features. They then filled out the questionnaire based on that incident.

Operationalization

Measurements for PIIT were drawn from Agarwal and colleagues' work (2000). The seven item Computer Playfulness Scale (Agarwal et al. 2000; Webster et al. 1992; Yager et al. 1997) was used to measure Web-related computer playfulness. Computer self-efficacy was measured by the instruments developed by Compeau and colleagues (Compeau et al. 1995a; Compeau et al. 1995b; Compeau et al. 1999). Measurements for facilitating conditions were adopted from (Venkatesh et al. 2003).

New instruments were developed before the main survey for two constructs in the research model: adaptive system use and triggers. The detailed process is not the focus of this study and has been written in a separate paper (Sun et al. 2006a). In the instrument development process reported in that paper, special attention was paid to content validity because both adaptive system use and triggers are formative constructs and thus content validity is a mandatory practice (Petter et al. 2007). Three measures were taken to ensure the content validity, following Petter et al.'s guideline. First, an extensive literature review was conducted (as presented earlier) to ensures that our conceptualization of adaptive system use covers the entire scope of this concept. Second, exploratory interviews with fourteen typical users of MS Office suite were conducted to seek to capture the entire scope of triggers and adaptive system use, per Diamantopoulos and Winklhofer's suggestions (2001). Third, a two-round Q-sort --- that was considered "one of the best methods to assess content validity for formative constructs" (Petter et al. 2007, p.639)---was deployed, following the detailed guidance by Moore and Benbasat (1991).

The instrument development process resulted in a seventeen-item instrument for adaptive system use and a twelve-item instrument for triggers. Adaptive system use is conceptualized as a formative, second-order construct and the seventeen items belong to four subconstructs: *trying new features, feature substitution* (replacing current features with new ones), *feature combination* (use two features together for the first time), and *feature repurposing* (using features in a way different from their original intent). These four subconstructs jointly form the latent construct of adaptive system use. The former two refer to modifications to the content of the features in use, whereas the latter two reflect modifications to the spirit or the way of using features in use. Some examples include "I tried new features in Microsoft Office" (trying new features), "I replaced some Office features with new features" (feature substitution), "I used some features in Microsoft Office together for the first time" (feature combination), and "I used some features in Microsoft Office in ways that were not intended by the developer" (repurposing). These items are reflective of their own subconstructs and are measured by the seven-point Likert-scale, from 1 (strongly disagree) to 7 (strongly agree).

Triggers is also conceptualized as a formative, second-order construct and has five subconstructs: *new tasks, other people's use, changes in system environments, discrepancy,* and *deliberate initiative*. Examples of the twelve items of triggers include "I saw other people's use of that feature" (other people's use), "The peripheral facilities (e.g., printers, copiers, and scanners) changed in my organization" (changes in system environments), "Some Office features did not work as I thought" (discrepancy), and "Somebody asked me to use some features" (deliberate initiative). Seven-point Likert scale was applied to these items, from 1 (strongly disagree) to 7 (strongly agree).

Data Analysis and Results

Measurement Model

Partial Least Square (PLS) analyses were conducted to examine the measurement model. Being a components-based structural equation modeling (SEM) technique, PLS is similar to regression but simultaneously models structural paths (theoretical relationships among latent variables) and measurement paths (relationships between a latent variable and its indicators)(Chin et al. 2003). PLS allows indicators to vary in how much they contribute to the composite score of the latent variable.

The measurement model was assessed in terms of item loadings and reliability coefficients (composite reliability), as well as convergent and discriminant validity. Individual item loadings greater than 0.7 are considered adequate (Fornell et al. 1981). Interpreted like a Cronbach's alpha for internal consistency reliability estimation, a composite reliability of .70 or greater is considered acceptable (Fornell et al. 1981). The average variance extracted (AVE) measures the variance captured by the indicators relative to measurement error, and it should be greater than .50 to justify using a construct (Barclay et al. 1995). The discriminant validity of the measures (the degree to which items differentiate among constructs or measure distinct concepts) was assessed by examining the correlations between the measures of potentially overlapping constructs. Items should load more strongly on their own constructs in the model, and the average variance shared between each construct and its measures should be greater than the variance shared between the construct and other constructs (Compeau et al. 1999).

Tables 2 and 3 show the results of the measurement model. Specifically, we can see from Table 2 that most loadings are larger than the suggested threshold of 0.70 (Fornell et al. 1981). There are some loadings smaller than 0.70. However, as they are just marginally smaller, we decide to keep them to be consistent with prior research. Table 3 shows that all composite reliabilities are larger than the suggested 0.70, indicating a good convergent validity of the measurement model (Fornell et al. 1981). All AVEs are greater than .50, implying that most variances in the constructs are captured by the indicators rather than denoting measurement errors (Barclay et al. 1995). Both Tables 2 and 3 provide us with evidence for discriminant validities. Table 2 shows that items load much more highly on their own latent constructs than on any other latent constructs (cross-loadings) (Gefen 2002). In addition, the square roots of AVEs (diagonal elements in Table 3) are larger than correlations among constructs (off-diagonal elements in Table 3), indicating a good discriminant validity.

Table 2. Cross-loadings

		CP	PIIT	CSE	FC	Triggers	ASU
Computer Playfulness	CP1	**0.701**	0.590	0.462	0.165	0.125	0.254
	CP2	**0.872**	0.584	0.436	0.187	0.106	0.291
	CP3	**0.760**	0.554	0.535	0.268	0.134	0.304
	CP4	**0.844**	0.589	0.427	0.201	0.170	0.317
	CP5	**0.786**	0.514	0.405	0.115	0.042	0.215
	CP6	**0.829**	0.597	0.421	0.205	0.087	0.255
	CP7	**0.873**	0.671	0.385	0.223	0.180	0.364
Personal Innovativeness in IT	PIIT1	0.738	**0.937**	0.513	0.347	0.283	0.470
	PIIT2 (reverse item)	-0.427	**-0.599**	-0.342	-0.157	0.015	-0.194
	PIIT3	0.593	**0.902**	0.395	0.257	0.283	0.390
	PIIT4	0.648	**0.922**	0.554	0.327	0.311	0.422
Computer Self-Efficacy	CSE1	0.462	0.525	**0.724**	0.288	0.155	0.285
	CSE2	0.477	0.508	**0.769**	0.308	0.212	0.364
	CSE3	0.496	0.556	**0.858**	0.350	0.198	0.358
	CSE4	0.454	0.443	**0.810**	0.330	0.266	0.319
	CSE5	0.214	0.147	**0.566**	0.160	0.122	0.093
	CSE6	0.214	0.106	**0.552**	0.228	0.157	0.131
	CSE7	0.335	0.269	**0.715**	0.215	0.108	0.200
	CSE8	0.374	0.409	**0.768**	0.385	0.272	0.343
	CSE9	0.233	0.113	**0.633**	0.135	0.076	0.102
	CSE10	0.254	0.232	**0.664**	0.153	0.052	0.165

Facilitating Conditions	FC1	0.168	0.258	0.336	**0.924**	0.231	0.433
	FC2	0.276	0.360	0.392	**0.953**	0.308	0.546
Triggers	TR1(New task)	0.160	0.330	0.233	0.319	**0.815**	0.540
	TR2(Others' use)	0.105	0.238	0.253	0.365	**0.768**	0.430
	TR3(System environment)	0.179	0.241	0.159	0.177	**0.854**	0.531
	TR4(Discrepancy)	0.057	0.127	0.164	0.132	**0.777**	0.550
	TR5(Deliberate initiative)	0.117	0.211	0.186	0.207	**0.795**	0.459
Adaptive System Use	ASU1(Trying new features)	0.433	0.479	0.503	0.485	0.241	**0.661**
	ASU2(Feature substitution)	0.321	0.403	0.313	0.382	0.545	**0.865**
	ASU3(Feature combining)	0.331	0.388	0.352	0.467	0.526	**0.857**
	ASU4(Feature repurposing)	0.145	0.252	0.106	0.369	0.612	**0.737**

Table 3. Composite Reliability and Averages Variance Extracted

Constructs	CR	AVE	1	2	3	4	5	6
1. Triggers	n/a	0.642	**0.801**					
2. Personal Innovativeness in IT	0.913	0.729	0.285	**0.854**				
3. Computer Playfulness	0.934	0.670	0.156	0.722	**0.819**			
4. Facilitating Conditions	0.937	0.882	0.291	0.335	0.242	**0.939**		
5. Computer Self-Efficacy	0.914	0.518	0.247	0.538	0.534	0.391	**0.720**	
6. Adaptive System Use	n/a	0.517	0.636	0.454	0.358	0.527	0.375	**0.719**

CR: Composite Reliability; AVE: Average Variance Extracted.

Diagonal Elements are the square roots of the variance shared between the constructs and their measurement (AVE). Off diagonal elements are the correlations among constructs. Diagonal elements should be larger than off-diagonal elements in order to exhibit discriminant validity.

n/a: convergent validity of formative constructs are not tested the way as informative factors

The construct validity of the two formative construct deserves more attention since empirical examinations of formative constructs are scant in IS research. Existing methods for assessing the construct validity for reflective constructs---as demonstrated above---are inappropriate for formative constructs (for a comprehensive review, see Petter et al. 2007). We conduct two procedures to assess the construct validity of triggers and adaptive system use. First, we examine the weights of the formative indicators. Non-significant indicators may be dropped with the content validity in mind, i.e. the rest of indicators should still cover the entire scope of the construct (Diamantopoulos et al. 2001). Second, we assess the multicollinearity of formative indicators. Unlike reflective indicators, where multicollinearity is desirable because it shows that the reflective indicators measure the same construct as expected, excessive multicollinearity in formative constructs can destabilize the model (Petter et al. 2007). Formative indicators are supposed to cover different aspects of the formative construct and thus should have low multicollinearity. To ensure that multicollinearity is not present for the two formative constructs, we examine VIF statistics. VIF of formative indicators should be lower than 3.3 to show a good construct validity (Diamantopoulos et al. 2001). Table 4 shows satisfactory construct validity for both triggers and adaptive system use. All indicator-construct weights are significant. Meanwhile, VIF statistics for all formative indicators are smaller than 3.3, indicating that these indicators are different from each other and measure different aspects of their principle constructs. Therefore, we conclude that the construct validities of the two formative constructs are well observed.

Table 4. Construct Validities of Triggers and Adaptive System Use					
Model	Path Coefficient (from PLS)	t	Sig.	Collinearity Statistics	
				Tolerance	VIF
Formative Construct: Trigger					
TR1(New task)	.376	143285.575	.000	.467	2.141
TR2(Others' use)	.057	21810.977	.000	.477	2.097
TR3(System environment)	.291	105473.516	.000	.424	2.361
TR4(Discrepancy)	.377	160356.560	.000	.581	1.722
TR5(Deliberate initiative)	.116	44827.025	.000	.480	2.084
Formative Construct: Adaptive System Use					
ASU1(Trying new features)	.364	161420.868	.000	.546	1.832
ASU2(Feature substitution)	.185	75733.476	.000	.463	2.160
ASU3(Feature combining)	.202	79640.471	.000	.429	2.331
ASU4(Feature repurposing)	.554	245806.116	.000	.545	1.834

Regression and Hypothesis Testing

We use hierarchical regressions for hypothesis testing per Goodhue et al's suggestions (Goodhue et al. 2007). Chin et al.'s method of using PLS with product indicators for testing interaction effects has been popular in IS research for assessing moderating effects. However, Goodhue and colleagues argued recently that "if sample size or statistical significance is a concern, *regression or PLS with product of the sums should be used instead of PLS with product indicators* for testing interaction effects." (Goodhue et al. 2007 p.211). Furthermore, they compared regression with Chin and colleagues' PLS method (Chin et al. 2003) and argued that regression has greater statistical power.

We use a three-step regression method. First, we regress adaptive system use on the control variables. Then, in Step 2, main effects of triggers, facilitating conditions, and personal innovativeness in IT are introduced [2]. Third, the moderating effects are added into the model. Table 5 shows the results of the regression. The structural model explains a total of 57.6% of the variance in adaptive system use. The addition of moderating effects enhances the R square to 59.7%, and this change in R square albeit small is significant. This confirms Chin et al.'s argument that addition of moderating effects does not contribute to R square (Chin et al. 2003). But this does not deny the importance of studying moderating effects, which can offer us insights into the contingent nature of the research model.

Table 5 shows the results of hypothesis testing. Hypothesis 1 proposes that triggers are a significant antecedent of adaptive system use. Our empirical results show that triggers represent the most significant antecedent of adaptive system use, with the highest path coefficient of 0.458. Hypothesis 2 concerns the relationship between facilitation conditions and adaptive system use. This relationship is also supported: facilitating conditions is a significant

[2] We calculated the latent variable scores from the PLS analysis.

antecedent of adaptive system use. The relationship between personal innovativeness in IT and adaptive system use (H3) is not supported. As for moderating effects, facilitating conditions is found to moderate the impact of triggers on adaptive system use, but in a reverse direction. Specifically, the higher the facilitating conditions, the weaker the relationship between triggers and adaptive system use. This differs from our hypothesis (H4), which posits a positive moderating effect. Thus, H4 is partially supported. Hypothesis 5 about the moderating effect of personal innovativeness in IT on the relationship between triggers and adaptive system use is not supported.

Table 5. Coefficients

Step	IVs	R^2	ΔR^2	Standard Coefficients (Beta)	Significance (t value)	Hypothesis testing
Step 1: control variables	(Constant)	0.234	0.234***		n.s.	
	Gender			.046	n.s.	
	Age			.072	n.s.	
	Education			-.140	n.s.	
	Computer playfulness			.144	n.s.	
	Computer self-efficacy			.358	*** (t=4.550)	
Step 2: main effects		0.589	0.355***			
	Trigger			.458	*** (t=8.766)	H1(√)
	Facilitating Condition			.372	*** (t=7.146)	H2(√)
	Personal Innovativeness in IT			.105	n.s.	H3 (x)
Step 3: moderating effects		0.621	0.032***			
	Facilitating conditions * Triggers			-.196	*** (t=7.146)	H4 (√)
	Personal innovativeness in IT * Triggers			.044	n.s.	H5 (x)

Dependent Variable: adaptive system use
Significant level: *: 0.05; ** 0.01; *** 0.001

Post Hoc Analysis: The Formative Nature of Triggers

The purpose of this analysis is to determine whether triggers are truly a formative construct with five components. Or, in other words, the five types of triggers should not individually have distinct effects on adaptive system use. Instead, they *jointly* influence adaptive system use. In this decomposed model (Figure 3), the first order constructs --- the five types of triggers --- are directly connected to adaptive system use. Table 6 presents the correlations between the components of triggers and adaptive system use. Not surprisingly, all correlations are significant. That is, subconstructs of triggers are significantly correlated with subconstructs of adaptive system use. As we can see from Figure 3, the results show that, excepting discrepancy, the subconstructs of triggers do not have significant distinct impacts on adaptive system use individually. Therefore, the formative nature of triggers is confirmed.

Table 6. Correlations between Components of Triggers and Adaptive System Use

	Trying new	Feature	Feature	Feature

	features	substitution	combination	repurposing
TR_NT	.198(**)	.500(**)	.445(**)	.515(**)
TR_OU	.222(**)	.338(**)	.423(**)	.364(**)
TR_SE	.150(*)	.465(**)	.391(**)	.599(**)
TR_DP	.243(**)	.463(**)	.453(**)	.476(**)
TR_DB	.137(*)	.378(**)	.366(**)	.471(**)
** Significant at the 0.01 level (2-tailed). * Significant at the 0.05 level (2-tailed).				

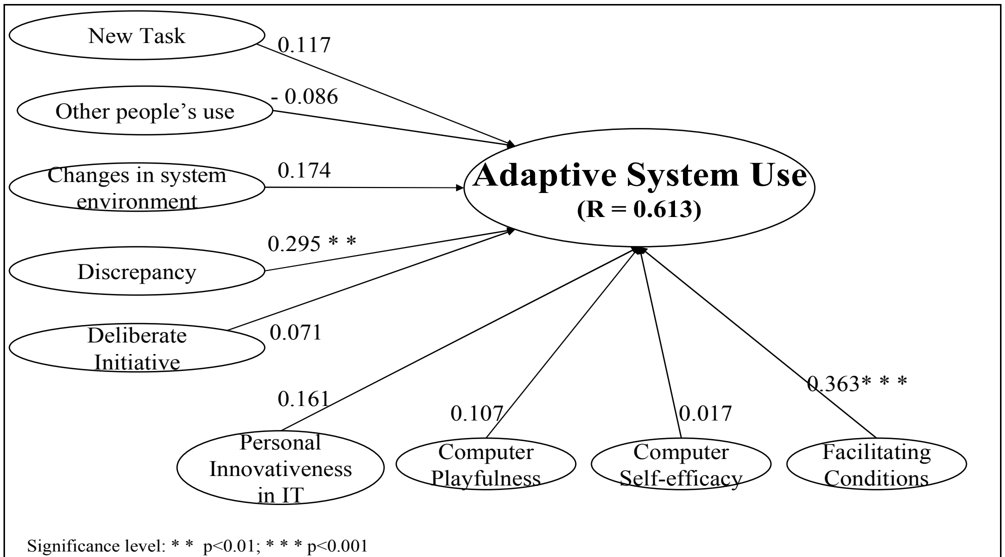

Figure 3. Post-Hoc Analysis: The Model of Decomposed Triggers

Discussions

The current study contributes to the contemporary research on post-adoptive system use on two aspects: how people modify their system use at the feature level and what triggers people to do so. We develop a new concept---adaptive system use---to capture users' modifications to their use of system features. We also develop a process model of adaptive system use to address the "cause" question. An empirical study with a sample of 282 MS Office users confirms our conceptualization and the model.

The empirical study provides several interesting findings. First, adaptive system use has four dimensions: trying new features, feature substitution, feature combination, and feature repurposing. Second, triggers are the most significant antecedent of adaptive system use. This confirms prior arguments that triggers or contradictions are the major impetus of such innovative behavior as adaptive system use. Third, facilitating conditions are an important antecedent of adaptive system use and also moderate the impact of triggers on adaptive system use. The negative moderating effects of facilitating conditions on the relationships between triggers and adaptive system use (i.e., the negative path coefficient of the trigger * FC) are different from our hypothesis and provide unexpected opportunities for further examination. This finding may imply that when users do not have facilitating conditions (e.g., help from the IT support department), they are reluctant to change unless absolutely necessary, because, as mentioned earlier, there are certain risks associated with adaptive system use. In such instances, their adaptive system use is highly dependent on triggers. If facilitating conditions are sufficient, on the other hand, people may rely less on triggers and change their system use even when it is not so necessary because they can easily find support if they need it. Fourth, users' internal context, crystallized by personal innovativeness in IT, neither contributes to adaptive system use nor moderates the impact of triggers on adaptive system use. The working environment in this research may be one reason why personal innovativeness in IT does not have significant impacts. Routine production activities will siphon off the time, energy, and resources needed to adapt the system (Tyre et al. 1994). Therefore, users do not have the necessary time, energy, or resources to apply their internal factors (i.e., personal innovativeness in IT) to initiate changes to their use of the information systems. Instead, they simply react to external forces (i.e., triggers) and rely on organizational support (i.e., facilitating conditions). More empirical studies on the effects of personal innovativeness in IT on adaptive system use in non-work environments are thus warranted.

This research has several contributions. First, this research enriches our understanding of the dynamic nature of post-adoptive system use. The new concept, adaptive system use, includes four dimensions that describe how users can change their use of information systems at the feature level. As far as we know, there are few, if any, prior studies that systematically develop and empirically test such a construct. Also noteworthy is that we develop a new intermediate concept called “features in use.” We argue that this is the proper technical level of analysis for studying post-adoptive system use. Second, the process model of adaptive system use also helps us understand what causes such changes in using system features. Third, we would like to highlight the triggers construct in this research. Based on Louis and Sutton’s work on triggers of active thinking (1991) and the analysis of interview transcripts from our early study, five types of triggers—new tasks, other persons’ use of IT, changes in system environments, discrepancies between what was expected and what is observed, and deliberate initiative—were identified. Further analyses of the decomposed trigger (Figure 3) suggested that "triggers" is a formative latent variable that includes five subconstructs representing five types of triggers respectively. Considering the significant impact of triggers on adaptive system use, these five types of triggers warrant both investigation and potential elaboration. Fourth, methodologically, this research is one of the few empirical studies in IS research that test formative constructs. Traditional methods of testing reflective constructs are inappropriate for formative constructs (Diamantopoulos et al. 2001; Petter et al. 2007). More attention is needed from IS researchers to properly conceptualize and assess formative constructs.

Although we believe the current research makes significant contributions to the field, it is, of course, only a single study and is necessarily limited in its scope and generalizeability. First, this research only examines the research model in working environments. This may constrain our understanding of the impact of internal factors (e.g., personal innovativeness in IT) on adaptive system use. Reexamining the research model in non-working environments or using a sample in different professions would add valuable insights. Second, the context of the survey was not completely controlled. Respondents represented various organizations with different local contexts. Further research should try to minimize this impact. Third, it could be greater if the research model can be examined in different technological environments (Sun et al. 2006b).

As for the practical implications, first of all, IT practitioners should be aware of the importance of users’ active role in reshaping the use of IT. Continually evolving, IT does not determine its own trajectory of development and use. It is users who create and innovate. Specifically, this study shows that users can have four primary behaviors in revising their use of information systems: trying new features, feature substitution, feature combination, and feature repurposing. This reflects the fact that users do not necessarily know what they may need later when adopting information systems. For designers, this means that instead of trying to put everything in the system during the design stage, a more flexible toolkit may be more helpful. Moreover, our findings suggest that triggers are the most important impetus of adaptive system use. Keeping in mind that adaptive system use is not always desirable. IT practitioners can use these factors to either encourage users’ adaptive system use by creating triggers or constraining these behaviors when they are undesirable. An interesting finding is the negative moderating effect of facilitating conditions on the relationship between triggers and adaptive system use. As discussed above, this may imply that when having sufficient facilitating conditions, users may have some unnecessary adaptive system use behaviors. This should get attention from practitioners.

References:

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

Agarwal, R., and Prasad, J. "A conceptual and operational definition of personal innovativeness in the domain of information technology," *Information Systems Research* (9:2) 1999, pp 204-215.

Ahuja, M.K., and Thatcher, J.B. "Moving beyond intentions and toward theory of trying: Effects of work environment and gender on post-adoption information technology use," *MIS Quarterly* (29:3), September 2005, pp 427-459.

Ajzen, I. "From intentions to actions: A theory of planned behavior," in: *Action Control: From Cognition to Behavior,* J. Kuhl and J. Beckmann (eds.), Springer Verlag, New York, 1985, pp. 11-39.

Ajzen, I. "The Theory of Planned Behavior," *Organizational Behavior and Human Decision Processes* (50:2) 1991, pp 179-211.

Barclay, D., Higgins, C.A., and Thompson, R.L. "The Partial Least Squares (PLS) Approach to Causal Modeling: Personal Computer Adoption and Use as an Illustration," *Technology Studies* (2:2) 1995, pp 285-309.

Barki, H., Titah, R., and Boffo, C. "Information system use-related activity: An expanded behavioral conceptualization of individual-level information system use," *Information Systems Research* (18:2), June 2007, pp 173-192.

Barnett, L.A. "The Playful Child: Measurement of a Disposition to Play," *Play and Culture* (4:1) 1991, pp 51-74.

Beaudry, A., and Pinsonneault, A. "Understanding User Responses to Information Technology: A Coping Model of User Adaptation," *MIS Quarterly* (29:3), September 2005, pp 493-524.

Bhattacherjee, A. "Managerial Influences on Intraorganizational Information Technology Use - A Principal-Agent Model," *Decision Science* (29:1) 1998, pp 139-162.

Boudreau, M.C., and Robey, D. "Enacting integrated information technology: A human agency perspective," *Organization Science* (16:1), January-February 2005, pp 3-18.

Burkhardt, M.E.B., Daniel J. "Changing patterns or patterns of change: The effects of a change in technology on social network..." *Administrative Science Quarterly* (35:1), mar. 1990 1990, pp 24, p104.

Burton-Jones, A., and Straub, D.W. "Reconceptualizing System Usage: An Approach and Empirical Test," *Information Systems Research* (17:3) 2006, pp 228-246.

Chin, W.W., Marcolin, B.L., and Newsted, P.R. "A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study," *Information Systems Research* (14:2) 2003, pp 189-217.

Compeau, D.R., and Higgins, C.A. "Application of social cognitive theory to training for computer skills," *Information Systems Research* (6:2) 1995a, pp 118-143.

Compeau, D.R., and Higgins, C.A. "Computer self-efficacy: Development of a measure and initial test," *MIS Quarterly* (19:2), June 1995b, pp 189-211.

Compeau, D.R., Higgins, C.A., and Huff, S. "Social cognitive theory and individual reactions to computing technology: A longitudinal study," *MIS Quarterly* (23:2), June 1999, pp 145-158.

Cooper, R.B., and Zmud, R.W. "Information technology implementation research: A technological diffusion approach," *Management Science* (36:2) 1990, pp 123-139.

Dervin, B., and Nilan, M. "Information Needs and Uses," *Annual Review of Information Science and Technology* (21) 1986, pp 3-33.

DeSanctis, G., and Poole, M.S. "Capturing the complexity in advanced technology use: Adaptive structuration theory," *Organization Science* (5:2) 1994, pp 121-147.

Diamantopoulos, A., and Winklhofer, H.M. "Index construction with formative indicators: An alternative to scale development," *Journal of Marketing Research* (38:2) 2001, pp 269-277.

Doney, P.M., and Cannon, J.P. "An examination of the nature of trust in buyer-seller relationships," *Journal Of Marketing*:61) 1997, pp 35-51.

Engeström, Y. *Learning, working, and imagining: Twelve studies in activity theory* Orienta-Konsultit Oy, Helsinki, 1990.

Fornell, C., and Larcker, D. "Evaluating structural equation models with unobservable variables and measurement error," *Journal of Marketing Research* (18) 1981, pp 39-50.

Gefen, D. "Customer loyalty in e-commerce," *Journal of the Association for Information Systems* (3) 2002, pp 27-51.

Ginzberg, M.J. "Early Diagnosis of MIS Implementation Failure: Promising Results and Unanswered Questions," *Management Science* (27:4) 1981, pp 459-478.

Goodhue, D., Lewis, W., and Thompson, R. "Statistical power in analyzing interaction effects: Questioning the advantage of PLS with product indicators," *Information Systems Research* (18:2), June 2007, pp 211-227.

Griffith, T.L., and Northcraft, G.B. "Distinguishing between the Forest and the Trees - Media, Features, and Methodology in Electronic Communication-Research," *Organization Science* (5:2) 1994, pp 272-285.

Harrisburg, J.-M., Hasan, H., and Ditsa, G. "The impact of culture on the Adoption of IT: An interpretive study," *Journal of Global Information Management* (7:1) 1999, pp 5-15.

Harrison, M.J., and Datta, P. "An empirical assessment of user perceptions of feature versus application level usage," *Communications of the Association for Informaiton Systems* (20) 2007, pp 300-321.

Hiltz, S.R., and Turoff, M. "The Evolution of User Behavior in a Computerized Conferencing Center," *Communications of the ACM* (24:11) 1981, pp 739-751.

Jain, V., and Kanungo, S. "IS value at individual level: Analyzing role of the nature of IS use," the 10th Americas conference on Information Systems, New York, NY, 2004.

Jasperson, J.S., Carter, P.E., and Zmud, R.W. "A comprehensive conceptualization of the post-adoptive behaviors associated with IT-enabled work systems," *MIS Quarterly* (29:3), September 2005, pp 525-557.

Kay, J., and Thomas, R.C. "Studying Long-Term System Use," *Communications of the ACM* (38:7) 1995, pp 61-69.

Kirton, M. "Adaptors and Innovators: A Description and Measure," *Applied Psychology* (61:5) 1976, pp 622-629.

Kuutti, K. "Activity theory as a potential framework for human-computer interaction research," in: *Context and Consciousness: Activity Theory and Human-Computer Interaction,* B.A. Nardi (ed.), MIT Press, Cambridge, Massachusetts; London, England, 1995, pp. 17-44.

Lamb, R., and Kling, R. "Reconceptualizing users as social actors in information systems research," *MIS Quarterly* (27:2), June 2003, pp 197-235.

Louis, M.R., and Sutton, R.I. "Switching cognitive gears: From habits of mind to active thinking," *Human Relations* (44:1) 1991, pp 55-76.

Moore, G.C., and Benbasat, I. "Development of an instrument to measure the perceptions of adopting an information technology innovation," *Information Systems Research* (2:3) 1991, pp 192-222.

Norman, D.A. *The Design of Everyday Things* Doubleday, New York, 1988.

Orlikowski, W.J. "Using technology and constituting structures: A practice lens for studying technology in organizations," *Organization Science* (11:4) 2000, pp 404-428.

Orlikowski, W.J., and Yates, J. "It's about time: Temporal structuring in organizations," *Organization Science* (13:6), Nov-Dec 2002, pp 684-700.

Petter, S., Straub, D., and Rai, A. "Specifying formative constructs in information systems research," *MIS Quarterly* (31:4) 2007, pp 623-656.

Poole, M.S., and DeSanctis, G. "Understanding the Use of Group Decision Support Systems: The Theory of Adaptive Structuration," in: *Organizations and Communication Technology,* J. Fulk and C. Steinfield (eds.), Sage, Newbury Park, CA, 1990, pp. 173-193.

Rogers, E., M. *Diffusion of Innovations*, (Fourth Edition ed.) The Free Press, New York, 1995.

Saga, V.L., and Zmud, R.W. "The nature and determinants of IT acceptance, routinization and infusion," in: *Diffusion, transfer and implementation of information technology,* L. Levine (ed.), Elsevier Science BV, Amsterdam, 1994, pp. 67-86.

Singletary, L.L.A., Akbulut, A.Y., and Houston, A.L. "Unanticipated software use by adolescents following mandatory adoption," 23rd International Conference on Information Systems, Barcelona, Spain, 2002.

Straub, D., Limayem, M., and Karahannaevaristo, E. "Measuring system usage: Implications for IS theory testing," *Management Science* (41:8), August 1995, pp 1328-1342.

Sun, H., and Zhang, P. "Adaptive IT Use: Conceptualization and Measurement," The 5th Pre-ICIS HCI Workshop, Milwaukee, Wisconsin, 2006a.

Sun, H., and Zhang, P. "The role of moderating factors in user technology acceptance," *International Journal of Human-Computer Studies* (64:2) 2006b, pp 53-78.

Taylor, S., and Todd, P.A. "Understanding Information Technology Usage: A Test of Competing Models," *Information Systems Research* (6:2) 1995, pp 144-176.

Tyre, M.J., and Orlikowski, W.J. "Windows of opportunity: Temporal patterns of technological adaptation in organizations," *Organization Science* (5:1) 1994, pp 98-118.

Venkatesh, V., Morris, M.G., Davis, G.B., and Davis, F.D. "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly* (27:3), September 2003, pp 425-478.

Webster, J., and Martocchio, J. "Microcomputer playfulness: Development of a measure with workplace implications," *MIS Quarterly* (16:2) 1992, p 201.

Yager, S.E., Kappelman, L.A., Maples, G.A., and Prybutok, V.R. "Microcomputer playfulness: stable or dynamic trait?," *The DATA BASE for Advances in Information Systems* (28:2), Spring 1997, pp 43 - 52.

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

Zhou, Z., and Bao, Y. "Users Attitudes Toward Web Advertising - Effects of Internet Motivation and Internet Ability," *Advances in Consumer Research* (29) 2002, pp 71-78.