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## UNDERSTANDING USER REVISIONS WHEN USING INFORMATION SYSTEM FEATURES: ADAPTIVE SYSTEM USE AND TRIGGERS<sup>1</sup>

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*Post-adoptive system use is often characterized by cycles of adaptation, in which people actively revise how they use information systems. This paper investigates **how** and **why** individual users revise their system use at the feature level. A new concept, **adaptive system use (ASU)**, is conceptualized as a user's revisions of which and how system features are used. This research identifies four specific ASU behaviors that collectively describe how people revise their use of system features. A model of ASU is developed based on Louis and Sutton's (1991) research on how people switch to active thinking from automatic thinking. The model specifies three antecedents of ASU (novel situations, discrepancies, and deliberate initiatives) and two moderators (personal innovativeness in IT and facilitating conditions). An empirical study of 253 Microsoft Office users largely supported the research model. The findings suggest that triggers—including novel situations, discrepancies, and deliberate initiatives—are a significant impetus to ASU. This research also confirms moderating effects of personal innovativeness in IT. The findings also show the relationships among triggers: in addition to their direct impact on ASU, novel situations and deliberate initiatives exert their influence on ASU indirectly by giving rise to discrepancies in system use. Moreover, a cluster analysis identifies three heterogeneous triggering conditions and reveals that people engage in different ASU behaviors under different triggering conditions.*

**Keywords:** Post-adoptive system use, adaptive system use, triggers, features in use, formative factor, personal innovativeness in IT, facilitating conditions

### Introduction

Scenario 1: I used the "track changes" feature in MS Word at the request of my boss. While I had not used it before, my boss had; and we often share files between us. [Trying a new feature was triggered by the boss's demands.]

Scenario 2: Word does not provide the ability to create high quality figures for my projects. As an alternative, I turned to PowerPoint to draw figures for my research papers then imported the figures back into Word. [Feature substitution was triggered by poor quality features in the initial program.]

The above scenarios<sup>2</sup> illustrate the phenomena of interest to this research. Specifically, when using a system, people can

<sup>1</sup>Mike Morris was the accepting senior editor for this paper. Ron Thompson served as the associate editor.

The appendices for this paper are located in the "Online Supplements" section of the *MIS Quarterly*'s website (<http://www.misq.org>).

<sup>2</sup>Both scenarios are from interviews with Microsoft Office users.

be forced by external triggers, such as a new task or a manager's demand, to engage in adaptation cycles during which they actively revise their system use in order to achieve a better fit between the system and the context in which they are using it (Ahuja and Thatcher 2005; Barki et al. 2007; Boudreau and Robey 2005; Jasperson et al. 2005; Leonard-Barton 1988; Saga and Zmud 1994). The above scenarios illustrate that people revise their system use at the feature level (e.g., trying new features) and that there are triggers for such revisions.

It is important to understand user revisions of system use and what triggers these revisions. When encountering triggers, people may actively reflect on, and then revise, their system use. Such revisions allow them to exploit and extend the potential of an information system, which contributes to enhancing task performance (Jasperson et al. 2005; Tyre and Orlikowski 1994). Nevertheless, active revision of system use may not always be desirable: automatic/habitual system use is sometimes more appropriate since it requires little conscious attention or mental effort on the part of the user (Wood et al. 2002). It is, therefore, necessary to understand how and why people actively revise their system use so that measures (e.g., providing facilitating conditions or imposing system restrictions) can be taken by IT practitioners to either encourage or constrain such behavior. Accordingly, an enriched understanding of people's revisions of system use and triggers is of great value to information systems research and practitioners when studying post-adoptive system use, a topic that is attracting more and more attention from IS researchers (Benbasat and Barki 2007; Ortiz de Guinea and Markus 2009).

Nevertheless, the revisions of system use are often much more complex than illustrated in the above scenarios. Users may encounter several different types of triggers during a single adaptation cycle. They usually go through multiple adaptation sequences (moving from triggers to adaptation behaviors) in an adaptation cycle via feedback loops: the outcome of one adaptation sequence often results in a new sequence (Beaudry and Pinsonneault 2005; Jasperson et al. 2005; Leonard-Barton 1988). Furthermore, people may behave differently in response to different combinations of triggers in terms of how they revise their system use.

Despite the importance and complexity of understanding how people revise system use and what triggers this behavior, systematic, theoretic, and empirical research pertaining to this topic has been limited and piecemeal. Therefore, this research aims to gain insight into this topic by answering two research questions:

- How and why do people revise their system use at the feature level?
  - What behaviors do users perform to revise their use of system features?
  - What triggers and influences user revisions of system use?
- How do users employ different adaptation strategies under different triggering conditions defined by a combination of triggers?

To answer these research questions, two theoretical gaps need to be addressed. First, there is no currently agreed-upon definition of active system use, a manifestation of the fact that systematic theoretical treatment of post-adoptive system use is still in its rudimentary stages (Burton-Jones and Straub 2006). The existing conceptualizations of system use have been considered to be simplistic and unable to capture the richness of system use (Benbasat and Barki 2007; DeLone and McLean 2003). Many prior conceptualizations of post-adoptive system use are evaluative, rather than descriptive, and are focused on the system level (Burton-Jones and Straub 2006). As a result, these conceptualizations are insufficient to accurately describe how people revise their system use, which usually occurs at the feature level. The second issue is that little systematic investigation into the triggers of people's revisions of their system use has been conducted to date.

To address the first gap, and thereby to understand *how* people revise their use of system features, this study develops a new concept of post-adoptive active system use at the feature level, called *adaptive system use (ASU)*. ASU includes four distinct behaviors: trying new features, feature substituting, feature combining, and feature repurposing. These behaviors collectively describe how people actively revise their use of system features. To address the second theoretical gap, and thereby to understand *why* and *under what conditions* people revise their system use, this paper develops and empirically examines a research model of ASU, based primarily on Louis and Sutton's (1991) study of switching cognitive gears. The research model includes three triggers (novel situations, discrepancies, and deliberate initiatives) as antecedents of ASU and two contextual factors (facilitating conditions and personal innovativeness in IT) that are believed to moderate the impact of triggers on ASU.

The identification of specific triggers and ASU behaviors paves the way for answering the second research question. Specifically, this research aims to identify heterogeneous triggering conditions delineated by the triggers and then investigates how people employ different adaptation strategies in these triggering conditions.

## Conceptualizing Adaptive System Use

### Features in Use

System features are the functional building blocks of an information system (Griffith and Northcraft 1994; Jasperson et al. 2005). They correspond to the tasks or jobs that the information system is intended to support and can be grouped into feature groups (e.g., text-editing features in Word) (Harrison and Datta 2007). A person usually uses a large number of features from different information systems to accomplish tasks. Even when using the same information system, different people may still use different features. This research defines a new concept, *features in use* (FIU), as *the basket of system features that are ready to be used by a particular user to accomplish tasks*. System features that do not belong to one's FIU include those features that are not readily usable, such as those features that are unfamiliar or unknown. It is the FIU that defines a user's understanding of the information systems he/she uses. In other words, FIU mediates one's interaction with the systems.

A person's FIU has a large number of features from a variety of systems. These features form an "ecosystem" for this user through which he/she can interact with the surrounding environment. Some of them are selected voluntarily by the user; some are included automatically. For example, while a person may voluntarily choose to use the "track changes" feature in Word to keep a record of his/her revisions of a document, use of the "save file" feature is largely mandatory. Moreover, many features are included in one's FIU even without his/her awareness. For example, many supporting features in Word—such as the "word count" and "automatic line break" features—are functions to help one administrate a document without the user's conscious awareness: while the user may not be aware that the "word count" feature is working, it is nevertheless included in his FIU. Features a user is not aware of are viewed as part of his/her FIU because such features are necessary for the user to finish the tasks, and, accordingly, their inclusion gives a complete picture with regard to how tasks are accomplished. Moreover, the failure of such features to work may make them explicit to the user and can give rise to adaptation behaviors.

Research on the social structure of IT (DeSanctis and Poole 1994; Orlikowski 2000; Poole and DeSanctis 1990) suggests that there are two aspects of FIU: the content and the spirit. The content of FIU pertains to *which features are included in one's FIU*. Over time, people may use different features to cope with changing work and technical environments. This can be viewed as a change of the content of FIU. The spirit

of FIU, on the other hand, relates to *how the features are used, separately or together*. For instance, most users think of PowerPoint as a presentation tool because most of its features are related to making presentation slides. This is a preexisting conception of PowerPoint that is embedded in the system by the developers and is supposed to be explicit to users. Similarly, each feature also has its own goals or intents that can be conceived as its spirit. The spirit of features can be identified by the design metaphor underlying them, their names and presentation, training materials, and online guidance materials, as well as through other training and help sources (DeSanctis and Poole 1994). For example, most, if not all, people seeing the small disk button (📁)—even in new applications—assume it is the "save file" feature. It is the spirit of this feature manifested by its design metaphor: the official way or the purpose of using this feature is "clicking it to save the file."

It is important to note that the spirit of FIU is more than a collection of the spirit of separate features as it also includes how features can be used together to achieve a goal, such as finishing a task. For example, the drawing feature in PowerPoint is designed to produce images and artwork for presentation slides. This is the spirit of the drawing feature. However, a person may use the drawing feature to draw high-quality images and then copy them to Word documents. Accordingly, the spirit of the FIU includes not only the spirit of the drawing feature in PowerPoint alone, but also how it can be used together with features in Word.

### Adaptive System Use

As time passes, a person's FIU is always in flux. This research defines ASU as a user's revisions regarding *what* and *how* features are used. Based on the above discussion on features in use, ASU is argued to have two dimensions: *revising the content of feature in use* and *revising the spirit of features in use*. These two dimensions also have their own sub-dimensions, identified from the prior literature on system use (Table 1). Additional elaboration on the dimensions and sub-dimensions of ASU follows.

#### Revising the Content of FIU

Revising the content of FIU refers to *a user's revisions regarding what features are included in his/her FIU or, more explicitly, what features are used*. Existing literature indicates that people revise the content of their FIU by *trying new features* (Barki et al. 2007; Jasperson et al. 2005) and *substituting features* (Parthasarathy and Bhattacharjee 1998).

Table 1. Dimensions and Sub-Dimensions of Adaptive System Use

Adaptive System Use: A user's revisions regarding what and how features are used		
Construct	Definition	Similar Concepts
<b>Revising the Content of Features in Use:</b> <i>A user's revisions regarding what features are included in his/her FIU: <b>what</b> features are used.</i>		
Trying New Features	Add new features to one's FIU and thus expanding the scope of the FIU.	Extended use (Saga and Zmud 1994) Feature adoption (Jasperson et al. 2005) Independent exploration behaviors (Barki et al. 2007)
Feature Substituting	Replacing features in the FIU with other features with similar functions.	Replacement (Parthasarathy and Bhattacharjee 1998)
<b>Revising the Spirit of Features in Use:</b> <i>A user's revisions regarding <b>how</b> features in his/her FIU are used.</i>		
Feature Combining	Using features in FIU together for the first time.	Mix and match (Rice and Rogers 1980) Reinvention (Boudreau and Robey 2005) Inventions (Desouza et al. 2007)
Feature Repurposing	Using features in one's FIU in a new way.	Emergent use (Saga and Zmud 1994) Unanticipated use (Singletary et al. 2002) Feature extension (Jasperson et al. 2005) Trying to innovate (Ahuja and Thatcher 2005) Exaptation (Desouza et al. 2007)

Trying new features is a commonly observed user adaptation behavior. When a user tries a new feature, he or she expands the scope of his/her FIU. It has also been observed that while beginning users "do indeed see the need for only a relatively small number of features...the more experience they gain, the more they come to feel that a wide variety of...capabilities is necessary" (Hiltz and Turoff 1981, p. 748). As a user gains more experience with an information system, he or she tends to discover unique features that it provides (Hiltz and Turoff 1981). Therefore, users can continue discovering and adopting new features after the system itself has been adopted (Jasperson et al. 2005). Saga and Zmud (1994) studied extended use and defined it as a person's use of more features of a technology in order to accommodate a more comprehensive set of work tasks. Similarly, Barki et al. (2007) proposed that there are

independent exploration behaviors [defined as] the information search behaviors undertaken independently to improve one's knowledge and mastery of an IT, over and above those that are required by an organization's or project's training program (p. 176).

Therefore, trying new features (and, in doing so, expanding the scope of one's FIU) can be viewed as a type of exploratory behavior that enhances one's knowledge and mastery of an information system's features.

As noted, a user can also revise the content of his/her FIU by substituting the features in it. Feature substitution refers to the phenomenon of features in the FIU being replaced by different features with similar functions. Users, especially early adopters, may actively search for alternative features that are thought to be superior to the ones currently used (Parthasarathy and Bhattacharjee 1998). As a result, the features substituted may rarely be used after the new ones are in place. Feature substitution can be done both physically (e.g., the replaced features are no longer accessible on the computer) and psychologically (e.g., the user does not rely on the replaced features any more even if they are still physically available). It is important to note that the user may later go back to the old features if they are again considered helpful or if external factors compel them to (e.g., the substituting features are not compatible with some other features in the FIU). Therefore, the substituted features are not considered to be completely excluded from one's FIU; rather, they are marginalized and are less likely to be used compared to the new features.

### Revising the Spirit of FIU

Revising the spirit of a user's FIU is conceived of as the user's revisions pertaining to *how* features are used. IS users may use existing features in a FIU "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 and Datta 2007, p. 314). The literature suggests that people can revise the spirit of their FIU by *combining features* (using features in the FIU together for the first time) (Boudreau and Robey 2005; Desouza et al. 2007; Rice and Rogers 1980) and *repurposing features* (using features in the FIU in new ways, which may not have been intended by the developers) (Ahuja and Thatcher 2005; Desouza et al. 2007; Jasperson et al. 2005; Saga and Zmud 1994; Singletary et al. 2002).

Users may combine features with which they are already familiar to create new functionality. Rice and Rogers (1980) argued that users can selectively “mix and match” components from various systems to design “locally suitable versions of the innovation.” Boudreau and Robey (2005) found that users can compensate for system deficiencies by using “tweaks” and “work-arounds” to supplement what they are already using. Similarly, Desouza et al. (2007) argued that users can also use add-ons. These tweaks, work-arounds, and add-ons exemplify how people combine what they know with deficient system features to bypass system limitations.

People sometimes repurpose features, using features in new and innovative ways. Ahuja and Thatcher (2005) argued that users may find new and novel uses for information systems. That is, after individuals become familiar with features in an information system, they may “discover ways to apply the feature that go beyond the uses delineated by the application’s designers or implementers” (Jasperson et al. 2005, p. 532). Desouza et al. also argued that users can use existing functions for novel purposes that the developers did not expect, and Singletary et al. (2002) studied people’s behavior of “extending the use of a software product to new tasks and new settings” (p. 651). An example of feature repurposing is when a person uses “user name + date” as the user name so revisions made on different dates appear in different colors when using the “track changes” feature in Word (i.e., to the computer, Smith\_June1 is a different user from Smith\_June2).<sup>3</sup> In this way, this user repurposes the “user name” feature to distinguish between his/her own revisions made at different dates. This is an innovative way of using this feature, which might not have been thought of by the developers (who might have anticipated that people would use their names or nicknames, such as “Smith” in the above example, as the user name).

<sup>3</sup>To help collaborators distinguish each other’s revisions, Word uses different colors to highlight revisions made under different user names.

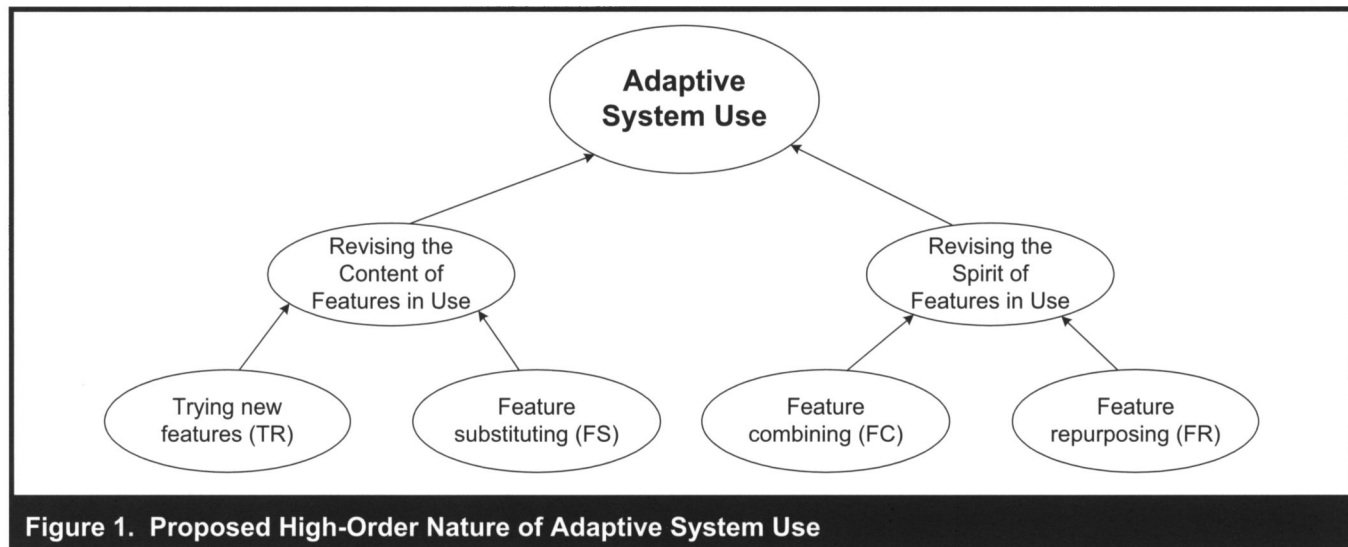
Not all features are revisable, however, as features differ in their restrictiveness: some are more restrictive than others and allow few, if any, revisions. For example, it is hard to imagine how the “save file” feature can be repurposed. In such situations, ASU may be performed on only part of one’s FIU. Many features in one’s FIU, including those of which the user is not aware, may never be substituted, combined, or repurposed.

## Nature of ASU

ASU is a collection of specific behaviors that one performs in order to revise his/her use of IS features. It can be viewed as a high-order construct with two sub-constructs: revising the content of FIU and revising the spirit of FIU. These two sub-constructs have their own sub-constructs (Figure 1). People do not necessarily perform all four types of ASU behaviors simultaneously or to the same degree. Nevertheless, people typically perform various ASU behaviors, probably to different extents. For example, when one tries new features, these new features often need to be combined with other features in order to finish tasks. This implies that trying new features and feature combining can coexist. The user subjectively determines which of, and to what degree, the four ASU behaviors are performed.

ASU manifests as deviations from one’s current mode of use of IS features; such deviations, according to Engeström et al. (1998), are necessarily characterized by innovativeness. The innovative nature of ASU makes it challenging and risky. First, an ASU cycle may not work as anticipated by the user. A new way of using system features may turn out to be less effective than the old way. In addition, users have the potential to make mistakes when changing their system use, and such mistakes may cause greater problems than the ones existing in their previous IS use (Tyre and Orlikowski 1994). Second, ASU involves active cognitive processing and is time and energy consuming (Jasperson et al. 2005). The user may fail to find new features or new ways of using features even after a long search. Third, one’s ASU may involve—or threaten—other people’s efforts and thus runs the risk of creating conflicts with coworkers by challenging the established framework of task relationships, informal norms, and expectations that people have with one another (Janssen 2003).

ASU is different from previous conceptualizations of system use. First, one unique characteristic of ASU is that it focuses on **features in use** as the unit of analysis. Studying system use at the feature level is instrumental for understanding “why different users evolve very differing patterns of feature use and, as a result, extract differential value from an IT applica-



tion” (Jasperson et al. 2005, p. 531). Although several IS studies have recognized the importance of analyzing post-adoptive system use at the feature level (Appendix A), few have theorized and empirically tested feature-level system use. In addition, ASU concerns the individual-specific FIU, rather than the single feature or feature groups that have been addressed in prior research.

Second, ASU is descriptive, rather than evaluative. Burton-Jones and Straub (2006) argued that prior conceptualizations of post-adoptive system use were primarily *evaluations* of system use (e.g., quality of use and effectiveness of use). Such evaluations of system use often make normative value judgments about system use (i.e., the “good” way of using an information system), which reflect the pro-innovation bias (i.e., that innovation is always good) (Abrahamson 1991; Kimberly 1981; Rogers 1995). Developing a descriptive concept like ASU is important as it avoids making normative value judgments about system use: for example, one cannot say that trying new features is a good way of using information systems in all circumstances. Therefore, it helps to address such questions as why technologically inefficient features may be accepted or why features may be used in an inefficient way. After all, people do not always make decisions independently and are not always certain about their goals or how efficient system features will be in attaining these goals (Abrahamson 1991). As a result, one’s FIU may include inefficient features. The descriptive ASU can be flexibly combined with other factors (e.g., contextual factors) to study a wider range of outcomes of system use, both beneficial (e.g., fit) and detrimental (e.g., group conflicts).

## The Research Model

### Theoretical Foundation

Louis and Sutton’s (1991) research on switching gears between habitual and active thinking serves as the primary theoretical foundation of this research model. In that study, they identified three types of triggers that can cause a person to engage in active thinking. The three triggers are *novel situations*, *discrepancies*, and *deliberate initiatives* (Table 2). It is important to note that they are triggers for active thinking, not for behaviors per se. However, such active thinking is a necessary condition for active use behavior (Jasperson et al. 2005).

Triggers are embedded in contradictions or interruptions. A contradiction refers to a lack of fit within elements of an activity (i.e., people, tasks, and tools), between them, between different activities, or between different development phases of the same activity (Kuutti 1995). Contradictions manifest themselves as problems, ruptures, breakdowns, clashes, etc. (Kuutti 1995). Triggers are manifestations of different types of contradictions. Novel situations are contradictions between current and new situations (e.g., when a new system is introduced into an organization or new tasks are required of a user). Discrepancies can be seen as the contradictions among elements (i.e., task, features, user) of the current system use activity (Burton-Jones and Straub 2006). For example, a discrepancy is present when a feature does not generate the expected or desired outcomes (contradiction between the feature and the task) (Jasperson et al. 2005).

Table 2. Types of Triggers

	Definition	Examples in System Use
Novel situations	Situations where a person encounters things that are unfamiliar, previously unknown, unique, or that appear to be out of ordinary.	<ul style="list-style-type: none"> <li>– A new task.</li> <li>– An observation of an unfamiliar feature that is being used by the other person.</li> <li>– An organization system is upgraded.</li> </ul>
Discrepancies	A discrepancy represents situations where an unexpected failure, a disruption, or a significant difference exists between expectations and the reality (Armstrong and Hardgrave 2007, p. 456).	<ul style="list-style-type: none"> <li>– An unexpected failure of a system feature.</li> <li>– The outcome of using a system is different from what was expected.</li> </ul>
Deliberate initiatives	The initiatives one takes in response to a request for an increased level of attention, when asked to think, or while being explicitly questioned.	<ul style="list-style-type: none"> <li>– A user is asked by his or her boss to use system features with which he or she is not familiar.</li> </ul>

Deliberate initiatives can be viewed as contradictions between two system use activities. For example, a boss may ask employees to use features with which he/she is familiar but that are not necessarily known to the employees. This can trigger the employees' adaptive system use behavior (e.g., trying new features) to reconcile the differences between their own and their boss's system use activities.

Active cognitive processing plays an important role in how triggers give rise to innovative behaviors like ASU (Langer 1986; Louis and Sutton 1991; Starbuck and Milliken 1988). People form schemas regarding how to perceive or behave. A schema refers to "an abridged, generalized, corrigible, organization of experience" and serves as "an initial frame of reference for action and perception" (Weick 1979, p. 50). When encountering triggers, people apply their schemas to their context in order to make sense of the triggers. This sense-making process is characterized by "awareness, attention, reflection, by noticing of oneself, one's task, or one's context, in contrast to cognitive processing in a more automatic mode" (Louis and Sutton 1991, p. 58).

Louis and Sutton further pointed out that the existence of triggers does not guarantee active thinking and behavior, rather it is contingent upon *individual* and *contextual* factors. Internal contexts consist of individual factors. For instance, when encountering a trigger, a person needs to have the ability and willingness to notice the trigger (Burke et al. 2006; Langer 1986). External contexts, as suggested by the name, refer to the contextual factors external to a person, such as the support offered by the staff of the IT department.

Although it is easy to imagine a simple scenario where a single trigger leads to a single innovative behavior, multiple triggers often coexist and influence each others. Louis and

Sutton gave an example where "the occasion of joining a company may evoke experiences of both novelty and discrepancy as well as some deliberate requests for conscious engagement" (p. 68). Furthermore, one trigger may be "transformed into another" (p. 68). When a person applies his/her old schemas to a novel situation, inadequacies in the old schemas may lead to errors in interpretation of and responses to the new situation (discrepancies) (Louis 1980; Van Maanen 1977). This illustrates a transformation of a novel situation trigger into a discrepancy trigger.

### Research Model

Following from the above discussion based on Louis and Sutton's work, this study conceives ASU as a function of triggers and internal/external contextual factors. A research model of ASU (Figure 2) was developed based on the above discussions where triggers are proposed to be the impetus behind ASU (hypotheses 1 through 3). This model also includes the transformation of novel situations and deliberate initiatives into discrepancies (hypotheses 4 and 5) as suggested by Louis and Sutton.

Consistent with Louis and Sutton's argument about the influences of individual and contextual factors, the research model includes personal innovativeness in IT (PIIT), defined as *an individual trait reflecting one's willingness to try out any new technology* (Agarwal and Karahanna 2000; Agarwal and Prasad 1999), as the relevant internal factor. There is a long tradition of studying personal innovativeness or similar concepts such as cognitive style (a person's preferred way of gathering, processing, and evaluating information) in innovation research (Amabile et al. 1994; Rogers 1995; Scott and Bruce 1994). This study utilizes PIIT because domain-



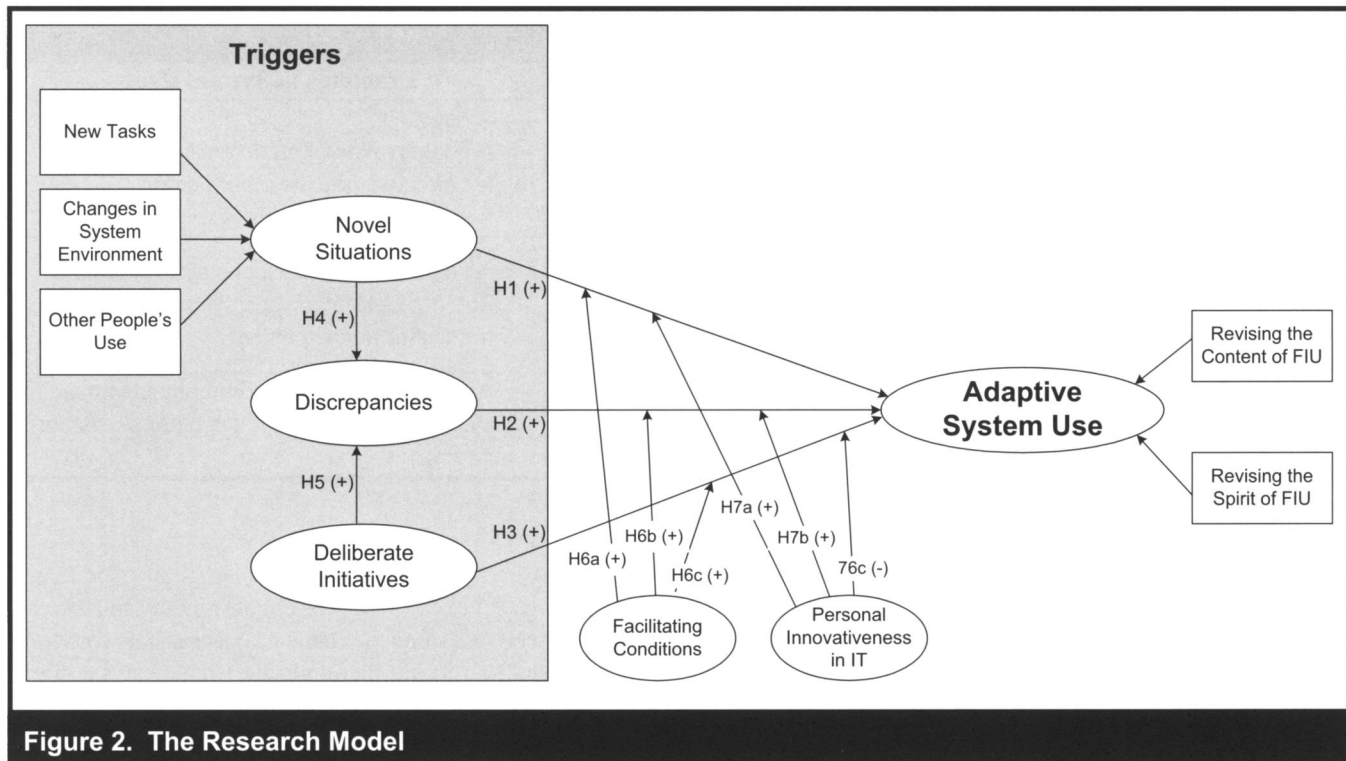


Figure 2. The Research Model

specific variables perform better than general traits in the specific situations being examined (Thatcher and Perrewé 2002; Webster and Martocchio 1992). As for external context, this paper utilizes facilitating conditions, which is defined as *the degree to which an individual believes that an organizational and technical infrastructure exists to support his or her use of a system* (Venkatesh et al. 2003, p. 453). People often seek external support when innovating (Scott and Bruce 1994; Tierney et al. 1999). Facilitating conditions (Fcond) is thus used to represent the external support one can get from his/her environment. According to Venkatesh et al. (2003), facilitating conditions efficiently synthesizes concepts embodied by important prior constructs such as perceived behavioral control (Ajzen 1991; Taylor and Todd 1995) and compatibility (Moore and Benbasat 1996; Rogers 1995).

It is important to emphasize that the research model depicts an ASU episode, which often includes multiple adaptation sequences (Beaudry and Pinsonneault 2005). In an ASU episode, people learn through trial and error. The outcome of an adaptation attempt is evaluated and, if necessary (e.g., the outcome is not up to the person's expectations), may trigger another adaptation sequence through the feedback mechanism (Beaudry and Pinsonneault 2005; Jasperson et al. 2005). In addition, multiple triggers may emerge at the same time, and people may perform an array of ASU behaviors in response

to triggers. As a result, multiple triggers and ASU behaviors are often present in one ASU episode.

## Hypotheses

### Triggers of ASU

Triggers of ASU are forces that drive a person to actively revise his/her use of system features. Consistent with Louis and Sutton, this paper conceptualizes three distinct types of triggers: novel situations, discrepancies, and deliberate initiatives (Table 3).

**Novel Situations.** Novel situations are when a user is experiencing unfamiliar things such as new tasks (Ahuja and Thatcher 2005; Jasperson et al. 2005), new technological environments (Benamati et al. 1997; Shaw 2001), and the observations of others' use of system features (Boudreau and Robey 2005; Compeau and Higgins 1995; Ryu et al. 2005). First, tasks themselves are, without a doubt, important components of novel situations and are thus closely related to user modifications of system use. It has been argued that users try to use system features more innovatively to cope with task overload (Ahuja and Thatcher 2005; Amabile 1997). Modifications of the work tasks/processes can also trigger one to

Table 3. The Definitions of the Sub-Constructs of Triggers

Construct	Definition	Similar Concepts in IS Research
<b>Novel Situations:</b> <i>One is experiencing unfamiliar things.</i>		
• New Task	The user has an unfamiliar task to perform.	Task overload (Ahuja and Thatcher 2005) Modifications of work tasks/processes (Jasperson et al. 2005)
• Others' use	One observes others' system use.	Power users' behavior (Boudreau and Robey 2005) Learning-from-others (Ryu et al. 2005) Others' use (behavioral modeling) (Compeau and Higgins 1995).
• Changes in system environment	One's system environment (the hardware, software, peripherals) changes.	IT Infrastructure Change (Shaw 2001) Changes in IT (Benamati et al. 1997)
<b>Discrepancies</b>	The outcomes of system use are different from what were expected.	Disconfirmation (Bhattacharjee 2001) Misalignment (Leonard-Barton 1988) Work system outcome expectation gaps/disconfirmation (Jasperson et al. 2005) Outcome of coping (Beaudry and Pinsonneault 2005)
<b>Deliberate Initiatives</b>	One is asked to revise his/her use of system features.	Mandatory use (Venkatesh and Davis 2000)

modify how he/she utilizes system features (Jasperson et al. 2005). For example, facing the new task of formatting a document using headings and subheadings, a user may, for the first time, try the "formatting" features in Word. Second, observations of other people's use may also serve as novel situations for the user. Individuals often develop distinct patterns of system use: people use different system features for different purposes or tasks (Burton-Jones and Gallivan 2008). Such different uses of information systems provide a rich context for individuals to learn from each other through observation. Users may learn from "power users" (who work more extensively with the system) (Boudreau and Robey 2005) and peers (Compeau and Higgins 1995; Ryu et al. 2005). Third, changes in system environments can also put one into a novel situation. Changes in hardware, software, or peripherals often put users in novel situations and force them to actively think about their use of information systems (Benamati et al. 1997; Shaw 2001).

**Discrepancies.** People may be motivated to change their behavior because of discrepancies between their expectations and reality (Hastie 1984; Louis and Sutton 1991; Wong and Weiner 1981). Discrepancies occur when one's experiences cannot be readily assimilated into existing cognitive schemas (Wong and Weiner 1981). Discrepancies between beliefs and the reality of the situation can instigate a person's attributional activities of recognizing the discrepancies as well as finding causes and solutions of the discrepancies (Hastie 1984; Wong and Weiner 1981). Prior IS research has studied

concepts similar to discrepancies such as misalignments between an information system and the local conditions (Leonard-Barton 1988) and disconfirmation (Bhattacharjee and Premkumar 2004). Examples of discrepancies abound in system use: failure of the "save file" feature, unexpectedly low quality images generated by Word's drawing feature, a printer not printing out the document, Microsoft's infamous "Blue Screen of Death," and so on.

**Deliberate initiatives.** Adaptive system use can also be triggered when one is *requested* to do so. Langer (1986) argued that mindful thinking may happen "when people are explicitly questioned" (p. 7). Similarly, Hastie (1984) proposed the "explicit question" as one antecedent of people's active recognition of attribution problems. Schön (1983) made a similar argument that, when confronted with demands, a person may demonstrate active thinking and behavior. IS research has shown that one's system use can be explicitly questioned. For example, system use can be mandatory: users in an organization are often required to use specific information systems (e.g., an ERP system) or system features (Hartwick and Barki 1994; Venkatesh and Davis 2000). As for ASU in particular, a typical scenario of deliberate initiatives is when a person is asked explicitly to try new features or use known features in a different way.

The above three triggers are all believed to give rise to adaptive system use behaviors through active cognitive processing (Jasperson et al. 2005; Langer 1986; Louis and Sutton 1991).

People's reactions to triggers are not made from scratch but instead are formed in relation to preexisting schemas (Kim 2009). Such schemas are usually generated from past experiences and are stored in one's memory to provide "situational forecasts on which individuals rely"; this reliance is largely "effortless, such that an individual's attention is free for other tasks" (Louis and Sutton 1991 p. 61). In familiar situations, the schemas are often used subconsciously, leading to habitual/automatic system use. In novel situations, when encountering discrepancies, and when explicitly questioned, people may actively contrast new information with their preexisting cognitive schemas to make sense of the triggering situation (Langer 1986; Louis and Sutton 1991; Orlikowski and Gash 1994). When necessary, such as when there exists a strong inconsistency between the new information and the preexisting cognitive schemas, people may adjust their behavior to reconcile the inconsistency (Jasperson et al. 2005).

H1: Novel Situations—in the form of new tasks, others' use, and changes in system environments—are positively associated with adaptive system use.

H2: Discrepancies are positively associated with adaptive system use.

H3: Deliberate initiatives are positively associated with adaptive system use.

Consistent with Louis and Sutton's argument that one trigger can be transformed into another trigger, this research contends that, in addition to their direct impact on ASU, novel situations and deliberate initiatives can also exert their influences on ASU indirectly by provoking discrepancies. This suggested mediating effect of discrepancies on the impact of novel situations and deliberate initiatives on ASU is consistent with the Jasperson et al. (2005) model of post-adoption system use. In that model, users make sense of their situations through the technology sense-making process. This sense-making process involves users' reflections on their own system use and may trigger user-initiated learning interventions (e.g., ASU) *through* disconfirmation, a concept similar to discrepancies.

In particular, this research posits that novel situations and deliberate initiatives can have indirect effects on ASU by giving rise to discrepancies through *the feedback mechanism* (Beaudry and Pinsonneault 2005; Jasperson et al. 2005). ASU is a cyclical process. It is usually done through trial and error. Novel situations (e.g., new tasks or changes in system environments) may stimulate one to start an ASU process. In the early rounds of trials, people tend to apply existing schemas regarding the use of system features to the new

situations and may soon find that the current schemas are inadequate to deal with the new situations. The assessment of output from the early rounds of trials, provided by feedback from the task itself or from others (e.g., coworkers), may not meet the expectation and thus generate discrepancies, which subsequently lead to the following rounds of trials. This means that novel situations can start an ASU process and are often accompanied or followed by unexpected outcomes (i.e., discrepancies). The more novel the situation one is in, the more trial and error may be experienced, and thus the more likely unexpected outcomes will be encountered. This has been described in previous research. For example, Benamati et al. (1997) showed that the implementation of a new system can put users in a novel situation where unexpected failure and errors (i.e., discrepancies) can often be found.

The same rationale applies to the transformation of deliberate initiatives into discrepancies. Being asked to change one's system use may force a user to employ ASU behaviors with his/her current schema of system use. The early ASU behaviors, however, may result in outcomes that are unsatisfactory to the user or to other people (e.g., the boss or coworkers), leading to discrepancies. In this way, deliberate initiatives introduce discrepancies. The more deliberate initiatives one has, the more likely he/she will experience unexpected outcomes from early rounds of trials.

H4: Novel situations are positively associated with discrepancies.

H5: Deliberate initiatives are positively associated with discrepancies.

#### **Influence of the External Context: Facilitating Conditions**

Prior research has suggested that in a novel situation, a person is more likely to respond to the new situation by performing ASU behaviors when sufficient facilitating conditions are available. For example, Armstrong and Hardgrave (2007) showed that existing knowledge bases moderate how IT professionals respond to learning novel concepts. Similarly, Baer and Oldham (2006) showed that when having work pressure, employees who receive high levels of support (including such things as tangible assistance and encouragement) are more likely to persist in their creative endeavors and thus exhibit higher creativity in response to work pressure than those who receive low levels of support. In the same vein, Zhou (2003) found that support from supervisors interacts with the presence of creative coworkers to affect creativity, indicating a moderating effect of facilitating conditions on the relation-

ship between novel situations (e.g., the presence of creative coworkers or observations of others' use) and creativity.

The rationale for the moderating effect of facilitating conditions on the relationship between novel situations and ASU is that facilitating conditions are closely related to how much control one perceives that he/she has over what he/she is doing (Ajzen 1985, 1991; Taylor and Todd 1995; Venkatesh et al. 2003). As mentioned earlier, ASU is time and energy demanding and requires intensive active cognitive processing. In addition, to perform ASU, people encounter impediments and thus face uncertainties about performing ASU. Accordingly, one often calculates the probability of successfully performing the ASU to respond to a novel situation (Venkatesh et al. 2008). Facilitating conditions provide necessary resources and support and thus make ASU behavior more controllable and achievable. They help one to overcome the uncertainties associated with ASU and thus increase the perceived probability of succeeding in performing ASU (Venkatesh et al. 2008). The increased perceived probability of success means that one is more likely to respond to novel situations.

Novel situations (e.g., the implementation of a new organizational information system) often lead to frustration and worries (Morris and Venkatesh 2010). Boudreau and Robey (2005) showed that employees usually react to a new information system with inertia because of the complexity of the new system, employees' contentment with the status quo, and their frustration from early trials of the new system. The frustration with the new system environment can be evoked by the changes to the nature of one's job caused by the implementation of the system (Morris and Venkatesh 2010). The presence of sufficient facilitating conditions (e.g., timely assistance and training) can encourage one to explore and experiment with novel ideas and be more persistent in their innovative endeavors (Baer and Oldham 2006; Zhou and George 2001).

H6a: The effect of *novel situations* on ASU will be moderated by facilitating conditions such that this effect will be stronger when facilitating conditions are sufficient than when they are scarce.

Similarly, upon encountering discrepancies, a person with facilitating conditions can leverage the support of the facilitating conditions to explore more of the discrepancies and thus is more likely to take action to respond to the discrepancies. To develop a model of PC utilization, Thompson et al. (1991, p. 129) argued that facilitating conditions can assist users "when they encounter difficulties" by reducing or eliminating potential barriers so that users are more likely to

use PCs. This actually implies a moderating effect of facilitating conditions on the relationship between "difficulties" and PC use.

In addition, facilitating conditions can help ease the feeling of being overloaded that often accompanies discrepancies. Different from novel situations, which are often expected to be part of the work (e.g., employees are expected to spend some of their work time to learn how to use a new information system), discrepancies may often be conceived of as additional—and to some extent unnecessary—workload and may cause one to perceive that he/she is overloaded. Feeling overloaded often leads to negative reactions such as anxiety or burnout and subsequently less willingness to innovate (Ahuja and Thatcher 2005; Jackson et al. 1987). Feeling overloaded means one perceives that he/she cannot do something because of the limitations imposed by the environment such as time or accessibility to a resource or that the work exceeds his/her capability or skill level (Ahuja and Thatcher 2005; Sales 1970). It is reasonable to believe that facilitating conditions can ease the feeling of being overloaded that is often accompanied by discrepancies by providing access to resources and the knowledge and assistance one may need for performing ASU behaviors that would otherwise be impossible based on skills alone.

H6b: The effect of *discrepancies* on ASU will be moderated by facilitating conditions such that this effect will be stronger when facilitating conditions are sufficient than when they are scarce.

An autonomous climate is crucial for innovative behavior such as ASU (Feist 1999; Feist and Gorman 1998). It means that one can determine what procedures and at what pace ASU behaviors are to be carried out (Ahuja and Thatcher 2005; Breaugh 1985). Previous IS research showed that autonomy positively influences a person's effort to innovate with IT (Ahuja and Thatcher 2005). Similarly, users need an autonomous climate regarding how and at what pace to adapt their system use.

By nature, deliberate initiatives mean that one is instructed to use certain system features or to use features in different ways. It has been argued that controlling behavior as somewhat captured by deliberate initiatives gives people a pressure that they are constantly watched, evaluated, and controlled (Barnowe 1975; Deci 1975; Ryan 1982; Ryan and Grolnick 1986; Scott and Bruce 1994). As a result, people may feel that they do not have the desired autonomous climate for change and thus may resist the deliberate initiatives, indicating a weakened relationship between deliberate initiatives and ASU.

Facilitating conditions can help ease the pressure from deliberate initiatives on ASU by giving people more options and a flexible schedule regarding how to adapt their system use. Facilitating conditions represent a broad range of knowledge regarding the use of information systems and can inspire a particular user about how to adapt his/her system use. For example, when being asked to use the “track changes” feature in MS Word, one may consult with the IT department. The IT staff in turn may give instructions regarding how to use the “track changes” feature and even point out some other alternatives such as using the “comment” feature or the “font color” feature to highlight the changes. Such knowledge may ease the pressure from being asked to use particular features and make one feel that he/she still has the freedom and flexibility regarding how to adapt his/her system use. In addition, while assisting one to accomplish more within the same period of time, sufficient facilitating conditions can give one a feeling that he/she has the freedom of scheduling the change to adapt his/her system use at a pace he/she is comfortable with. Therefore, it is hypothesized that

H6c: The effect of *deliberate initiatives* on ASU will be moderated by facilitating conditions such that this effect will be stronger when facilitating conditions are sufficient than when they are scarce.

### **Influence of the Internal Context: Personal Innovativeness in IT**

ASU is by nature innovative, making personal innovativeness in IT (PIIT) a closely related internal contextual factor. PIIT indicates one’s willingness to try out new technology and reflects one’s disposition to engage in innovative behaviors (Agarwal and Karahanna 2000; Agarwal and Prasad 1999). This paper posits that PIIT positively moderates the impact of novel situations and discrepancies on ASU by making an individual more sensitive to triggers. A trigger does not necessarily stand out as a trigger unless a person can recognize it (Louis and Sutton 1991; Schutz 1964). Individuals differ in their sensitivity to new ideas and in their potential for coming up with creative ideas or producing innovative outputs (Zhou 2003). Innovative people are more likely to be receptive to new information or to ideas that are needed for innovative behavior (Rogers 1995). Thus, a novel situation or discrepancy is more salient for innovative people than for less innovative people. That is, an individual with high PIIT is more likely to sense the novel situations or discrepancies and subsequently engage in ASU behaviors, indicating a stronger relationship between novel situations/discrepancies and ASU for individuals with high PIIT.

PIIT can also help an individual to perceive encouraging information from novel situations and discrepancies and subsequently be more likely to respond to triggers with ASU behaviors. Innovative users generally develop more positive perceptions of IT innovation than other users (Agarwal and Prasad 1999). Accordingly, they are more likely to be excited about the new ASU activity and to stay focused and work longer on it (Amabile et al. 1994; Oldham and Cummings 1996). Also, innovators are typically characterized by their willingness to attempt change and to take risks (Kirton 1976; Rogers 1995). Therefore, when encountering triggers, innovative individuals are more likely to accept the risks, uncertainties, and imprecision associated with ASU and are subsequently more likely to engage in ASU.

H7a: The effect of *novel situations* on ASU will be moderated by personal innovativeness in IT such that this effect will be stronger for individuals with high personal innovativeness in IT.

H7b: The effect of *discrepancies* on ASU will be moderated by personal innovativeness in IT such that this effect will be stronger for individuals with high personal innovativeness in IT.

Unlike novel situations and discrepancies, the impact of deliberate initiatives on ASU is hypothesized to be moderated by PIIT *negatively*. That is, innovative people are less responsive to demands from others with ASU behaviors than less innovative people. Individuals with low creative personality are generally more uncertain about appropriate behaviors and accordingly are more likely to be influenced by behavioral standards and guidance (e.g., orders) from others (Zhou 2003). In contrast, highly creative people—often characterized by high autonomy, self-confidence, and flexibility—are less likely to follow the orders or behavioral standards and guidance (Feist 1999; Feist and Gorman 1998). Oldham and Cummings (1996) empirically demonstrated that creative people enjoy non-controlling supervision more than less creative people in generating creative ideas. Mumford et al. (2002) also suggested that for innovative people, leaders should not focus on the conduct of a specific piece of work (e.g., how to use specific features), but instead, focus more generally on the progress and the goal.

Controlling behavior as somewhat captured by deliberate initiatives is often resisted by innovative people who often have a strong orientation toward autonomy (Deci and Ryan 1987; Feist and Gorman 1998; Greenberg 1992; Oldham and Cummings 1996). Controlling supervision causes people to feel pressure that they are constantly controlled; this pressure

may be especially detrimental for innovative people because it conflicts with the autonomy that they are pursuing (Feist 1999; Feist and Gorman 1998; Oldham and Cummings 1996). In this paper, explicitly requesting to revise the use of system features may be conceived of as a highly detailed work plan and thus may cause resistance from innovative people because it can be viewed as a challenge to the autonomy of system use, indicating a negatively moderating effect of PIIT on the relationship between deliberate initiatives and ASU.

H7c: The effect of *deliberate initiatives* on ASU will be moderated by personal innovativeness in IT such that this effect will be weaker for individuals with high personal innovativeness in IT.

## Research Methodology

### Research Design

To test the research model, an online survey of Microsoft Office (hence forth MS Office) users was conducted. An online questionnaire was designed using active server pages and tables driven by a Microsoft Access database. The questionnaire included demographic questions and items for measuring ASU, triggers, PIIT, and facilitating conditions. The questionnaire webpage was in HTTP protocol and was hosted on a nonprofit server. No advertisements or other pop-ups appeared when the questionnaire page was launched.

At the beginning of the survey, a simple task was designed to help situate subjects in ASU contexts, considering that people might not be aware of ASU behaviors they had performed previously (Orlikowski and Yates 2002). That task asked subjects to report one incident wherein they changed their use of MS Office features. They then filled out the questionnaire based on that incident. Appendix B shows the details of the situating task.

The MS Office suite, which contains Word, Excel, Power Point, Outlook, and FrontPage, among others, is a mature technology that has a large number of features which enhance the likelihood of observing a wide spectrum of ASU behaviors with it. Similar types of technology—word processors (Adams et al. 1992; Davis et al. 1989; Davis and Venkatesh 1996), spreadsheets (Jackson et al. 1997; Mathieson 1991), e-mail systems (Gefen and Straub 1997; Karahanna and Straub 1999), and graphics software (Adams et al. 1992; Davis et al. 1992)—have been used in prior research, demonstrating that MS Office is a valid technological context for this study.

### Measures

Appendix C lists the measures used in this study. Measures for personal innovativeness in IT were from Agarwal and Karahanna's (2000) work; measures for facilitating conditions were from Venkatesh et al.'s (2003) research. ASU and the three types of triggers are new constructs and this research systematically developed measures for them, following the procedure suggested by Moore and Benbasat (1991). The instrument development is described in Appendix D. Special attention was paid to the content validity of the instrumentation. To do so, a comprehensive literature review, 14 interviews, 2 Q-sort experiments, and a pretest survey were conducted to ensure that the domains of ASU and three types of triggers are fully covered by their items. The instrument development process resulted in 17 items for ASU, 8 for novel situations (NS), 2 for discrepancies (DP), and 2 for deliberate initiatives (DI).

Jarvis et al. (2003) proposed four criteria for deciding whether a construct is formative or reflective: (1) causal direction from construct to indicators, (2) interchangeability of indicators, (3) covariation among the indicators, and (4) nomological net of the construct indicators. Based on these criteria, ASU and NS were modeled as formative factors (Table 4). ASU is a third-order formative latent construct that has two second-order formative factors and four first-order formative factors. Each of the four first-order factors/indicators has several reflective items. NS, on the other hand, is a second-order formative construct that has three formative first-order factors. Each of the first-order factors were measured by reflective items.

### Survey Administration and Participants

The survey was administered by StudyResponse, a nonprofit academic service that attempts to match researchers in need of samples with individuals willing to complete surveys. It has a database of voluntarily registered survey participants. As of August 2005 (the most recent update prior to the survey), 95,574 individuals had registered with the StudyResponse service. Empirical studies using data collected from StudyResponse have appeared in prestigious social science journals (e.g., Piccolo and Colquitt 2006; Staples and Webster 2008; Van Ryzin 2006).

To control for the potential impact of the nature of position, tasks, and culture, recruits were limited to employed administrative workers in the United States. The StudyResponse staff sent out the recruitment e-mails with the URL to the online questionnaire to 1,500 individuals that were randomly

**Table 4. Measurement of High-Order Constructs**

Latent Construct	Level	Type	Sub-constructs				Number of Items
			Second-Order Sub-construct	Type	First-order Sub-construct	Type	
Adaptive System Use	Third-order	Formative	Revising the Content of FIU	Formative	Trying new features	Reflective	4
					Feature substituting	Reflective	3
			Revising the Spirit of FIU	Formative	Feature combining	Reflective	4
					Feature repurposing	Reflective	6
Novel Situations	Second-order	Formative			New tasks	Reflective	1
					Other people's use	Reflective	3
					Changes in system environment	Reflective	4

**Table 5. Demographic Characteristics of the Sample**

Variables	Sample Composition	
Age	Mean = 37.73; std. dev = 9.83; range 22-63	
Gender	Female	71%
	Male	29%
Highest Education Level Attained	Graduate Degree	13%
	Some Graduate Work	5%
	University or College Degree	37%
	Some University of College	38%
	Secondary School or Less	9%

selected from the 2,455 people registered in the "Administration" occupation category. Respondents signed on to the online survey using their StudyResponse ID number. To boost the response rate, a reminder e-mail was sent one week after the first letter. Participants were told that the research was voluntary and that they would automatically be entered in a drawing for Amazon.com gift cards of 50 U.S. dollars. The incentives of Amazon.com gift cards were administered by StudyResponse, in accordance with its Institutional Review Board's protocols.

This research received 282 responses, indicating a response rate of 19 percent. Twenty-nine responses were deleted; they (1) were completed within 5 minutes (since the survey was estimated to take 15 to 20 minutes), and/or (2) had the same answer to all questions (e.g., all 7's). Accordingly, the final

sample consisted of valid 253 responses. Table 5 shows the demographic characteristics of the final sample. To test the nonresponse bias, a wave analysis was conducted to compare the first and last quartile of respondents in terms of demographic characteristics and key study variables (Armstrong and Overton 1977). The results indicated that the later respondents were quite similar to the early ones. Thus, the nonresponse bias is not a concern for this study.

## Data Analysis and Results

### Measurement Model

Partial least square (PLS) was utilized to accommodate the exploratory nature of the research model and the presence of

a large number of variables (Jöreskog and Wold 1982; Liang et al. 2007). An advantage of PLS over covariance-based SEM techniques (e.g., LISREL) is that PLS can readily handle formative factors and can avoid the problem of identification of such factors (Chin 1998a; Petter et al. 2007). Moreover, Wetzels et al. (2009) recently argued that “PLS path modeling can also be used for hierarchical models with formative constructs or a mix of formative and reflective constructs” (p. 189), as is the case in the present study.

The reliability, convergent validity, and discriminant validity of the instrument were first examined. Appendix E shows that all but one of the loadings are larger than the suggested threshold of 0.707 (Chin 1998b). One item for facilitating conditions (Fcond3) has a loading of 0.47, lower than 0.60, and was dropped.<sup>4</sup> Table 6 shows that all composite reliabilities are larger than the suggested 0.70 and all AVE values are greater than the suggested .50, indicating a good convergent validity of the measurement model (Barclay et al. 1995; Fornell and Larcker 1981). For sufficient discriminant validity to be present, items should load more strongly on their own constructs, 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). Appendix E shows that items load much more highly on their own latent constructs than on any other latent constructs (cross-loadings). In addition, the AVE square roots are larger than correlations among constructs (Table 6). Therefore, discriminant validity was achieved.

To assess the common method bias, this study employed Harman’s single-factor test (Podsakoff et al. 2003). All of the variables were loaded into an exploratory factor analysis (EFA) and the unrotated factor solution was examined. Common method bias may exist if (1) a single factor emerges from the unrotated factor solution, or (2) one general factor accounts for the majority of the covariance in the variables (Podsakoff et al. 2003), although neither occurred in this study: no single factor accounted for a majority of the covariance. This suggests that the common method bias is not an issue in this study.

### **Structural Model**

The research model includes two high-order constructs: ASU (a third-order construct) and NS (a second-order construct). They were each modeled as a formative construct consisting

of its sub-construct as indicators. The latent variable scores were utilized for the three formative indicators of NS and two formative indicators of ASU, as suggested by prior research (Rai et al. 2006; Rozeboom 1979). Bootstrapping analysis was performed to test the structural model (Chin 1998b). To test the moderating effects of Fcond and PIIT, this research employed the PLS-PS (product of sums) approach recommended by Goodhue et al. (2007). Specifically, the sums of the two moderating factors (i.e., Fcond and PIIT) and three independent variable (i.e., NS, DP, and DI) were multiplied to generate the product of sums.<sup>5</sup> Six single-indicator interaction terms representing the six moderating effects respectively were added to the model and linked to the dependent variable, ASU.

The weights of the formative indicators are similar to the beta coefficients in a standard regression model and indicate the relative importance of formative indicators (Cenfetelli and Bassellier 2009). The two formative indicators of ASU both had significant weights: revising the content of FIU ( $b = 0.59, t = 5.68, p < 0.001$ ) and revising the spirit of FIU ( $b = 0.52, t = 4.75, p < 0.001$ ). The four first-order factors of ASU are also significant at the 0.01 level. Among the three formative indicators of novel situations, new tasks ( $b = 0.65, t = 4.39, p < 0.001$ ) and changes in system environment ( $b = 0.57, t = 3.89, p < 0.001$ ) had significant weights. The weight of others’ use (OU) was not significant ( $b = -0.11, t = 0.56$ ), indicating that it does not contribute significantly to forming novel situations, and was thus dropped. It is important to note that the content validity could be an issue when dropping OU (Bollen and Lennox 1991; Petter et al. 2007). Therefore, future research should retest the nonsignificant OU in different contexts before making the conclusion that it is not an important factor of NS.

To assess the multicollinearity of ASU and novel situations, variance inflation factor (VIF) statistics were examined; these should be lower than 3.3 for formative factors (Diamantopoulos and Winklhofer 2001). The VIF values for the three first-order formative indicators of NS are 1.90 (new tasks), 2.38 (other people’s use), and 1.95 (changes in system environment). As for ASU, the VIF is 1.71 for both revising the content of FIU and revising the spirit of FIU. At the first order, the four ASU behaviors have VIF values ranging from 1.22 to 1.26. Hence, desired low multicollinearity was observed.

<sup>4</sup>The loadings after Fcond3 was dropped were very similar; they are not shown here due to space constraints.

<sup>5</sup>Since NS is a second-order constructs, its latent factor scores exported from PLS were utilized.



**Table 6. Composite Reliability, Averages Variance Extracted, and Correlations of First-Order Constructs**

Construct	No. of Items	Mean*	Std Dev.	CR	AVE	Square Roots of AVEs and Correlations †												
						1	2	3	4	5	6	7	8	9	10	11		
1. ASU (trying new features)	4	5.58	1.45	0.93	0.76	0.87												
2. ASU (feature substituting)	3	4.53	1.91	0.91	0.79	0.42	0.89											
3. ASU (feature combining)	4	4.57	1.79	0.90	0.71	0.49	0.54	0.84										
4. ASU (feature repurposing)	6	3.53	1.89	0.94	0.73	0.42	0.48	0.45	0.85									
5. Triggers (new task)	1	3.96	1.80	1.00	1.00	0.09	0.50	0.41	0.45	1.00								
6. Triggers (other people's use)	3	4.16	1.94	0.88	0.70	0.08	0.34	0.32	0.39	0.67	0.84							
7. Triggers (changes in system environment)	4	3.74	1.92	0.91	0.72	-0.02	0.36	0.27	0.52	0.57	0.68	0.85						
8. Triggers (discrepancy)	2	4.06	1.79	0.96	0.92	0.12	0.22	0.39	0.39	0.42	0.34	0.51	0.96					
9. Triggers (deliberate initiative)	2	3.54	1.88	0.89	0.80	0.02	0.34	0.32	0.42	0.46	0.57	0.53	0.41	0.89				
10. Facilitating Conditions	2	4.61	1.78	0.90	0.82	0.31	0.28	0.31	0.30	0.18	0.21	0.00	-0.08	0.10	0.91			
11. Personal Innovativeness in IT	4	4.63	1.71	0.92	0.74	0.42	0.40	0.40	0.30	0.39	0.34	0.26	0.13	0.28	0.32	0.86		

CR: Composite Reliability;

AVE: Average Variance Extracted.

\*The mean is the average of the item scores. Scale ranges from 1 (Strong Disagree) to 7 (Strongly Agree).

†The diagonal elements (shaded) 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.

The results of the structural model are presented in Table 7. The results of hypotheses testing are summarized in Table 8. A structural model with only the direct effects of the three triggers and moderators on ASU was first examined (Aiken and West 1991). NS and DP had significant impact on ASU, thus supporting hypotheses 1 and 2. The path coefficient of DI was not significant. Therefore, hypothesis 3 was not supported. NS and DI had significant effects on DP, rendering support for hypotheses 4 and 5. Then, a model including both direct effects and moderating effects was examined. Fcond did not have moderating effects on the relationships between triggers and ASU; hypotheses 6a, 6b, and 6c were thus not supported. PIIT positively moderated the impact of NS on ASU and negatively moderated the impact of DI on ASU, supporting hypotheses 7a and 7c. PIIT did not moderate the relationship between DP and ASU. Therefore, hypothesis 7b was not supported. Note that the significant main effects were observed; however, these main effects are not interpretable due to the presence of moderating effects (Aiken and West 1991).

The main effects-only model shows that the triggers explained 47 percent of the variance in ASU. When moderating effects were included, the  $R^2$  increased to 50 percent ( $\Delta R^2 = 3\%$ ), indicating an effect size of 0.06, using Cohen's (1988) formula; this represents a small-medium effect size. NS and DI, on the other hand, explained 32 percent of the variance in DP.

Two Preacher and Hayes's bootstrapping tests were conducted to examine the mediating effects of DP on the impact of NS and DI on ASU.<sup>6</sup> The first test examined the mediating effects of DP on the relationship between NS and ASU. Without DP, a significant total effect of NS on ASU was observed ( $b = 0.50$ ,  $t = 7.94$ ,  $p < 0.001$ ). When DP is introduced as the mediator, NS still has a significant direct influence on ASU ( $b = 0.41$ ,  $t = 6.02$ ,  $p < 0.001$ ). At the same time, DP has a mediating effect of 0.09 with a 95 percent confidence interval (CI) of 0.02 to 0.17. This CI does not contain zero, implying a significant mediating effect. It is thus concluded that DP *partially* mediates the impact of NS on ASU. The second test examined the mediating effects of DP on the relationship between DI and ASU. DI did not have a significant overall effect on ASU ( $b = 0.11$ ,  $t = 1.75$ ). However, a significant total effect of the independent variable on the dependent variable is not a prerequisite for mediation to occur (Collins et al. 1998; MacKinnon et al. 2000; Shrout and Bolger 2002). So DP was introduced as the mediator. Accordingly, DI did show a significant indirect effect on ASU via DP ( $b = 0.04$ , with a 95% CI of 0.01 to 0.10), indicating that DP *fully* mediates the impact of DI on ASU.

<sup>6</sup>An SPSS script developed by professors Preacher and Hayes was utilized to calculate the bootstrap statistics (<http://www.afhayes.com/spss-sas-and-mplus-macros-and-code.html>).

**Table 7. Results of the Structural Models**

	Direct Effects Only	Direct Effects + Moderating Effects <sup>†</sup>
<b>a. Dependent Variable: ASU</b>		
R <sup>2</sup>	.47	.50
ΔR <sup>2</sup>		.03 ( $f^2 = .06^{\ddagger}$ )
Novel Situations (NS)	.23**	.24**
Discrepancies (DP)	.31**	.26**
Deliberate Initiatives (DI)	.04 (n.s.)	.08 (n.s.)
Facilitating Conditions (Fcond)	.28**	.30**
Personal Innovativeness in IT (PIIT)	.23**	.24**
NS × Fcond		.09 (n.s.)
DP × Fcond		-.13 (n.s.)
DI × Fcond		-.03 (n.s.)
NS × PIIT		.14 <sup>†</sup>
DP × PIIT		-.03 (n.s.)
DI × PIIT		-.14 <sup>†</sup>
<b>b. Dependent Variable: Discrepancies</b>		
R <sup>2</sup>	.32	.32
NS	.41**	.41**
DI	.23**	.23**

n.s.: nonsignificant; \*p < 0.05; \*\*p < 0.01

<sup>†</sup>Main effects in the moderated model are included for parameter estimation. They should not be interpreted because of the presence of interaction items (Aiken and West 1991).

<sup>‡</sup>Effect size ( $f^2$ ) is calculated by the formula  $(R^2_{full} - R^2_{partial}) / (1 - R^2_{full})$  (Mathieson et al. 2001). Cohen (1988) suggested 0.02, 0.15, and 0.35 as operational definitions of small, medium and large effect sizes respectively.

**Table 8. Summary of Hypotheses Testing**

Hypotheses	Supported?
H1: Novel Situations → ASU	Y
H2: Discrepancies → ASU	Y
H3: Deliberate initiatives → ASU	N
H4: Novel situations → Discrepancies	Y
H5: Deliberate initiatives → Discrepancies	Y
H6: Facilitating conditions moderate the impact of (6a) novel situations, (6b) discrepancies, and (6c) deliberate initiatives, on ASU.	N
H7: Personal innovativeness in IT positively moderates the impact of (7a) novel situations and (7b) discrepancies, and negatively moderates the impact of (7c) deliberate initiatives, on ASU.	Partially. As hypothesized, PIIT positively moderated the relationship between novel situations and ASU and negatively moderated the relationship between deliberate initiatives and ASU. However, PIIT did not moderate the relationship between discrepancies and ASU.

A cluster analysis was conducted to identify heterogeneous triggering conditions and to examine ASU behavioral patterns in these conditions. The details of the cluster analysis can be found in Appendix F. The analysis revealed three distinct triggering conditions delineated by the three types of triggers: *intensive triggering conditions* (high levels for all three of the triggers), *discrepancy triggering conditions* (high levels of discrepancies and low levels of novel situations and deliberative initiatives), and *non-intensive triggering conditions* (low levels of all the three types of triggers). Moreover, the cluster analysis yielded several interesting findings regarding ASU behavior under these triggering conditions. First, people perform ASU behaviors differently under the three triggering conditions. In both intensive triggering conditions and discrepancy triggering conditions, levels of feature substituting, feature combining, and feature repurposing were significantly higher than in non-intensive triggering conditions. Intensive triggering conditions have a higher level of feature repurposing than discrepancy triggering conditions. Second, in all three of the triggering conditions, trying new features has the highest means, while feature repurposing has the lowest means. Third, trying new features does not seem to define any cluster: the means of trying new features did not differ significantly across the three clusters. Feature substituting and feature combining distinguish between non-intensive triggering conditions and the other two triggering conditions, but not between discrepancy triggering conditions and intensive triggering conditions. The three triggering conditions are significantly different in terms of feature repurposing. In other words, feature repurposing is a definitive characteristic that distinguishes between the three triggering conditions.

## Discussion

People reap the benefit of information systems through system use in the post-adoptive stage. Accordingly, information system researchers have begun to pay a great deal of attention towards understanding individuals' system use behavior in this stage (e.g., Burton-Jones and Straub 2006; Jaspersen et al. 2005). This growing interest in post-adoptive system use is "one of the most welcome developments in recent Information Systems scholarship" (Ortiz de Guinea and Markus 2009, p. 433). This paper has investigated *how* and *why* people revise their system use at the feature level in post-adoptive stages. This paper has developed the concept of adaptive system use to describe users' adaptations of system use, and also identified three triggers and internal/external contextual factors to explain why and under what conditions people revise their use of system features. The results of the empirical study show that people revise their use of system features in response to triggers, under the influence of contextual factors. Moreover, the identification of the three

types of triggers led to the identification of different types of triggering conditions. The results also show that people perform different ASU behaviors under different triggering conditions.

## Major Findings

As expected, novel situations (NS) and discrepancies (DP) are significant antecedents of ASU. Deliberate initiatives (DI), by contrast, do not have a significant effect on ASU. One explanation for the insignificant direct influence of DI on ASU is that the hypothesized positive impact of DI on ASU may be offset by reduced autonomous climate for innovation, which discourages ASU behavior. Deliberate initiatives somewhat represent controlling situations. When asked to change, people may feel that the autonomous climate needed for innovation is lacking; such a perception of reduced autonomy may accordingly reduce ASU behavior. At the same time, the results show that DI can exert its influence on ASU indirectly through DP. The findings regarding DI suggest that demands/suggestions from others regarding the use of features alone are not sufficient to motivate one to revise his/her system use; they have to create a perception of discrepancies in order for them to influence ASU.

DP also needs to receive special attention. It turned out to be the most important trigger of ASU, with the highest path coefficient in the structural model (Table 7). This is somewhat in line with the expectation–confirmation theory, which suggests that the disconfirmation of expectations is a salient factor influencing people's behavior (Bhattacharjee 2001; Oliver 1980; Oliver 1993). Moreover, it is important to highlight that NS and DI can exert influence on ASU by evoking DP. The results show that DP partially mediates the impact of NS, and fully mediates the impact of DI, on ASU. Such transformation of NS and DI to DP has not yet been systematically investigated.

The findings confirm that PIIT positively moderates the impact of NS on ASU. In new situations such as changes in system environment or having new tasks, innovative people are more likely to tolerate the risk associated with change and perform ASU behaviors. PIIT also, as hypothesized, negatively moderates the impact of DI on ASU. Innovative people are more likely to resist the demand from others because it poses a threat to the autonomy of system use.

The analyses did not confirm the hypothesized moderating effects of facilitating conditions on the relationships between triggers and ASU. Interestingly, Amabile (1997) also found that the resources available in an organization played a surprisingly less prominent role in organizational creativity

than expected. In a later article (Amable 1998), she suggested that adding resources above a “threshold of sufficiency” does not boost creativity; below that threshold, however, a restriction of resources can dampen creativity. In the current study, facilitating conditions may generally be perceived to be sufficient for performing ASU behavior with MS Office. First, MS Office is a mature technology and has a lot of built-in help information, so people may not need many external facilitating conditions. Second, facilitating conditions are largely captured within the effort expectancy construct (the ease with which an IS can be applied) (Venkatesh et al. 2003). Therefore, facilitating conditions may not matter in the current study because MS Office is a mature tool and is generally considered easy to use.

The cluster analysis yielded a fine-grained understanding of the distinct triggering conditions and how people behave differently in these conditions. Three triggering conditions were identified: *intensive triggering conditions*, *discrepancy triggering conditions*, and *non-intensive triggering conditions*. Past research has studied distinct types of triggers such as task overload (Ahuja and Thatcher 2005), modifications of tasks (Jasperson et al. 2005), and disconfirmation (Bhattacharjee 2001), among others. This research showed that triggers may collectively define distinct triggering conditions.

The results of the cluster analysis suggest that people do not choose ASU behaviors indiscriminately; rather, people employ different adaptation strategies, contingent largely upon which triggering conditions they are faced with. In non-intensive triggering conditions, trying new features is likely to be the main behavior people will perform when adapting their system use. When relatively intensive triggers are present (e.g., in discrepancies-triggering conditions), people may also substitute and combine features and, to some extent, repurpose features. In the most intensive triggering conditions, people are likely to perform all forms of ASU behaviors including feature repurposing. These findings seem to suggest that the four types of ASU behaviors differ in the degree to which people are willing to perform them. While trying new features is the most basic ASU behavior that people are willing to perform in all triggering conditions, feature repurposing is more likely to be performed only in highly intensive triggering conditions.

Several factors exist to explain why people may be reluctant to repurpose features. First, compared to other types of ASU behaviors such as trying new features, feature repurposing is highly innovative and demands more time, energy, and innovativeness. This may explain why feature extension (a similar concept to feature repurposing) has been found to be rare (Jasperson et al. 2005; Mabert et al. 2001). Second, feature repurposing also requires familiarity with a system. Jasperson

et al. (2005) argued that feature extension in a system occurs only when individuals gain some experience in using the system. Not surprisingly, a person can innovatively repurpose some features only when he/she knows how system features can be used and to what tasks they can be applied as well as relevant system restrictions. Third, people try innovation to cope with the stress from work (Ahuja and Thatcher 2005). In intensive triggering situations, people may be overwhelmed by the stress from the appearance of multiple triggers and accordingly are more willing to invest time and energy in repurposing features as a coping strategy. When the intensity is low, people are less willing to risk repurposing features.

### Contributions

This study has conceptual and theoretical contributions to IS literature. Conceptually, this research systematically developed four new concepts. The first concept, **adaptive system use** (ASU), describes how users revise their use of information systems at the feature level. There are few, if any, prior studies that systematically develop and empirically test such a concept. The second new concept is **features in use** (FIU). FIU is individual-specific and consists of features from different information systems. An FIU can be viewed as a user's ecosystem that can change over time. This paper suggests that features in use is an appropriate level of analysis for IS researchers when studying post-adoption system use. The third concept is **triggers**. This study identified and refined three types of triggers for adaptive system use. These clearly distinguished triggers were utilized to identify heterogeneous **triggering conditions**.

Theoretically, a model of ASU was developed to describe how a person may change (often through multiple adaptation sequences, encountering different triggers, and performing various ASU behaviors), which features are chosen, and in what way they are used. Moreover, this research hypothesized and empirically confirmed, probably for the first time, the transformation of certain triggers into other triggers. This model can also benefit research on automatic/habitual system use, indicating under what conditions people deviate from their automatic/habitual system use and engage in active system use.

### Limitations

The sample itself offers some important limitations. Because this research utilized the third-party StudyResponse service, little is known about who the respondents were and why they chose to participate. Although the subjects registered with StudyResponse using the “Administration” category as their

occupation, it is unclear what type of administrative work they did. In addition, the participants were from different organizations and little knowledge was available about their specific organizational contexts. Considering the limitations of the sample, the author can make no claims as to the generalizability of the results.

The use of MS Office also has its limitations. To ensure that as many ASU behaviors as possible were observed, this research utilized MS Office as the research subject. MS Office is a system with few restrictions that gives users a lot of freedom to revise what and how systems are utilized. However, one's revisions to his/her FIU are often bounded by the system. A simple example is that system restrictiveness may influence how frequently people perform ASU behaviors (Boudreau and Robey 2005; Silver 1990). Future research should examine the research model in different technological contexts to investigate how system restrictiveness (Silver 1990; Speier and Morris 2003)—or related concepts such as integration level of a system into a larger system (e.g., an organization working system; Orlikowski 2000) and tightness of system components (Rice and Rogers 1980)—influences ASU behavior.

Most constructs used in the study have been developed in this research for the first time and, therefore, need more refinement. For example, while this research includes new tasks as a sub-component of triggers, the nature of the tasks was not considered. One thing that warrants attention is the question of task complexity, which has been proven to influence individuals' creativity (Oldham and Cummings 1996; Speier and Morris 2003; Vessey and Galletta 1991). Future research may investigate the interplay between ASU behavior and task complexity.

Also, the use of formative factors in this research is risky. Formative factors are relatively new and are attracting growing interest in IS research. However, it is important to be aware of the ongoing debate regarding the use of formative factors (e.g., Diamantopoulos et al. 2008; Edwards 2011; Kim et al. 2010; Polites et al. 2012; Shin and Kim 2011). The two formative factors in this research, ASU and NS, have been carefully conceptualized and operationalized to somewhat address the problems that have been identified with formative factors, such as the problematic assumption of formative measures causing construct (Edwards 2011). The use of multiple reflective measures for the first-order factors (except new tasks) of ASU and NS can also help overcome the identification problem. Nevertheless, it is still unclear, in general, under what conditions and in what ways formative factors should be specified (Kim et al. 2010). This is a concern for high-order formative factors with reflective first-

order factors (e.g., Shin and Kim 2011). Therefore, if necessary, future research may need to reconceptualize the two formative constructs proposed in this research, when a better understanding of formative measurement is achieved.

The conceptualizations and operationalizations of internal and external contexts could be more robust. For external contexts, future research should investigate how different facilitating conditions, such as time, monetary resources, and technology compatibility issues (Taylor and Todd 1995), influence ASU. Also, the support from other people (e.g., help desk, supervisors, and colleagues) is, although important, not covered sufficiently by the measures for facilitating conditions utilized in this research. The only measurement item related to the support from others (FCond3) was dropped due to its low loading. The limitations of the measures for facilitating conditions may somewhat account for the observed non-significant moderating effects of facilitating conditions. Thus, future research should address this limitation by developing a more comprehensive and robust measurement for facilitating conditions. In addition, the concept of "threshold of sufficiency" is worth further investigation because it has been suggested that adding resources above a threshold of sufficiency does not boost creativity (Amabile 1998). As for internal contexts, more systematic studies on other personal factors, such as cognitive style (Kirton 1976; Scott and Bruce 1994) and computer self-efficacy (Compeau and Higgins 1995; Marakas et al. 2007), are necessary for a better understanding of the internal context of ASU behaviors.

Finally, as mentioned earlier, the research model describes an ASU episode, which often involves multiple feedback loops. The notion of feedback loops is important in that it helps explain the coexistence of multiple triggers and ASU behaviors in an ASU episode. However, the less controllable research context did not allow observations of the feedback loops people may experience when adopting their system use, although the expected coexistence of triggers and ASU behaviors was observed. Future research can address this limitation by defining and delineating the boundary (i.e., beginning and end) of a feedback loop and using a more controllable research context where the researcher can observe and test for the feedback loops.

## **Research Implications**

One important implication of the conceptualization of ASU is the necessity to make a distinction between modifications to the system itself and the modifications to a user's own features in use. While modifications to the system itself may be reasonably constrained to the early stages of system imple-

mentation (Tyre and Hauptman 1992), modifications to one's own FIU may be more persistent and can be observed well after the initial shakedown phase. It is thus important to reiterate the necessity of using FIU as the unit of analysis when studying post-adoptive system use. The notion of FIU also is helpful for better modeling post-adoptive system use since the use of multiple technologies simultaneously to finish a task is becoming more and more popular (Lyytinen 2010; Yoo 2010). For instance, one item for measuring feature combining ("I combined features in MS Office with features in other applications to finish a task") reflects the fact that people can use features from different applications simultaneously in order to finish a task.

The traditional view of a single trigger leading to adaptive behavior may be too simplistic. People can encounter multiple triggers from different sources simultaneously; one trigger may be transformed into another; an adaptation cycle may have several adaptation sequences and early adaptation sequences may provoke more triggers for the following sequences. Moreover, the triggers can collectively form heterogeneous boundary-spanning triggering conditions. Therefore, future research should study triggers in a more holistic manner.

The inherent riskiness of ASU necessitates additional research on the impact of trust on ASU behavior. As mentioned earlier, the outcomes of ASU behavior are not always certain. People must overcome their perceptions of risk and uncertainty before they will feel comfortable enough to initiate ASU behaviors. Future research can address how trust, both cognitive and affective (Komiak and Benbasat 2006; Lewis and Weigert 1985; Mayer et al. 1995), influences people's ASU behavior. For example, a user's trust in a technology (that it has the potential or capability for adaptation) and trust in the facilitating conditions (that the facilitating conditions are capable of, and care about, helping his/her adaptation efforts) may determine if he/she will actually risk engaging in ASU behaviors (Thatcher et al. 2011).

Future research may consider the time issue when studying ASU and triggers. The relative importance of the four ASU behaviors may change over time. For instance, it is reasonable to predict that feature repurposing is rare in the early stages of system implementation when the user is not yet familiar with the system. Later, when he/she has direct experience with the system and encounters intensive triggers, the user may employ feature repurposing (Jaspersen et al. 2005). Similarly, people may encounter different types of triggers at different stages of system implementation and use.

A promising future topic will be the impact of ASU on job performance. Studying how system use influences job per-

formance has been a topic of great interest to IS researchers and practitioners. Prior research has argued that existing conceptualizations of system use—such as the frequency, duration, or variety of system functionalities used—are too simplistic and are, therefore, inadequate for capturing the relationship between system use and the realization of expected outcomes (Benbasat and Barki 2007; DeLone and McLean 2003). Future research can investigate how the conceptually rich ASU is related to job performance. Again, the descriptive nature of ASU makes it convenient to study both beneficial and detrimental outcomes of system use.

### **Practical Implication**

The findings from this research have important practical implications as well. First of all, IT practitioners should be aware of the importance of users' active roles in reshaping the use of IT. That is, IT is continually evolving and does not determine its own trajectory of development and use; it is the users who create, innovate, and demand. Users display various types of adaptive behavior to explore and exploit technology for higher performance (Griffith and Northcraft 1996; Markus and Silver 2008; Tyre and Orlikowski 1994). The hierarchy of ASU behaviors provides a guideline for practitioners to recognize how users revise their system use.

IT practitioners should seek to better understand the transformation of triggers. For example, the results indicate that deliberate initiatives influence ASU behavior indirectly via discrepancies. Therefore, IT managers cannot expect that their demands will immediately instigate users' ASU behaviors. Instead, they should create a perception of discrepancies for the users by pointing out explicitly to users the inadequacies in their system use. In addition, highly innovative people may resist the demand to use specific features. Rather, they prefer autonomy pertaining to how to achieve clearly specified goals. Therefore, it is better to give them the goal instead of directly asking innovative people to use specific features.

The results suggest that the intensity of the triggers is a factor determining what ASU behaviors one will perform. In intensive triggering conditions, people may perform all of the four types of ASU behaviors. IT practitioners should monitor the intensity of triggers and accordingly provide facilitating conditions to help users deal with different ASU behaviors. It is important to note that different types of triggers often appear simultaneously and together form heterogeneous triggering conditions. IT practitioners should distinguish different types of triggering conditions and accordingly take different measures to facilitate users' ASU behaviors.

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