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THEORY AND REVIEW

THE EMBEDDEDNESS OF INFORMATION SYSTEMS HABITS IN ORGANIZATIONAL AND INDIVIDUAL LEVEL ROUTINES: DEVELOPMENT AND DISRUPTION[1]

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Despite recent interest in studying information system habits, our understanding of how these habits develop and operate in an organizational context is still limited. Within organizations, IS habits may develop over long periods of time and are typically embedded within larger, frequently practiced, higher-level work routines or task sequences. When new systems are introduced for the purpose of at least partially replacing incumbent systems, existing IS habits embedded in these routines may inhibit adoption and use of the new systems. Therefore, understanding how work-related IS habits form, how they enable and inhibit behavior, and how they can be disrupted or encouraged requires that we examine them within the context of organizational and individual level work routines. The current study integrates psychology and organizational behavior literature on cognitive scripts and work routines to examine IS habits as they occur embedded within larger, more complex task sequences. The objective of the paper is to contribute to the IS habit literature by (1) situating IS habits within the context of their associated work routines and task sequences, and (2) providing a theoretical understanding of how incumbent system habits can be disrupted, and how development of new system habits can be encouraged, within this context. We draw from extant research in psychology, organizational behavior, and consumer behavior to offer propositions about context-focused organizational interventions to break, or otherwise discourage, the continued performance of incumbent system habits and to encourage the development of new system habits. Specifically, our theoretical development includes script disruption techniques, training-in-context, and performance goal suspension as organizational interventions that disrupt incumbent system habits. We further theorize how stabilizing contextual variables associated with modified work routines can facilitate the development of new system habits. The paper concludes by discussing the importance of combining intervention strategies to successfully disrupt incumbent system habits and encourage development of new system habits and thus facilitate adoption of new systems.

Keywords: IS habit, automaticity, organizational routines, cognitive scripts, environmental triggers, context change, habit disruption, incumbent system

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Introduction

The psychological construct of habit has attracted much attention in recent research on technology acceptance and continuance (e.g., Cheung and Limayem 2005b; Gefen 2003; Jasperson et al. 2005; Kim and Malhotra 2005; Kim et al. 2005; Limayem and Hirt 2003; Limayem et al. 2003b, 2007; Wu and Kuo 2008). These studies generally argue that continued use of an information system (IS) over time is largely a function of habit rather than conscious intentions, and therefore encouraging the development of new IS habits can play a key role in the successful implementation of newly introduced systems. Given that new systems are often introduced to only partially replace incumbent systems, IS researchers have also begun to investigate how incumbent system habits may *inhibit* adoption and use of new systems (Polites and Karahanna 2012). Due to the potentially inhibiting nature of incumbent system habits, interventions to disrupt these habits can also play a key role in the successful implementation of new systems. Yet, our understanding of how to disrupt incumbent system habits, and replace them with new ones, is limited.

Further, within organizations, IS use is almost always embedded within larger, frequently practiced, higher-level routines or task sequences. As such, the "choice" of a particular IS for a particular task, and in fact the entire task sequence in which this choice is embedded, may, over time, reach the point that it is triggered automatically, without conscious thought and outside the individual's awareness, any time a higher-level work goal is encountered (Ashforth and Fried 1988; Bargh 1990; Norman 1981; Ortiz de Guinea and Markus 2009). Therefore, understanding how *work-related* IS habits develop and how they can be disrupted requires that we examine them within the context of organizational and individual level work routines.

The objective of the current paper is to contribute to the IS habit literature by (1) situating IS habits within the context of their associated work routines and task sequences; and (2) providing a theoretical understanding of how incumbent system habits can be disrupted, and how development of new system habits can be encouraged, within this context. The ultimate goal of intervention strategies to disrupt incumbent system habits and replace them with new system habits is to improve the acceptance and use of new systems.

We focus on IS habits in contexts where both the new and incumbent systems are available. For example, many organizations invest in business intelligence (BI) tools in part to replace analyses via spreadsheet software. The spreadsheet software and BI tools coexist and many employees continue to utilize spreadsheets despite a strong organizational push toward the BI tools. This is partly due to the deep embeddedness of spreadsheet software in employees' work routines and the habitual nature of the choice of spreadsheet software to perform analyses. Similarly, in financial services there is a strong push to replace analyses created via spreadsheet software with analyses using proprietary or open source tools that employ Internet era data standards (e.g., XBRL).[2] These examples highlight the importance to new system acceptance of disrupting incumbent system habits so that users no longer automatically engage in use of the incumbent system but actively consider use of the new system.

We begin our paper with a section titled "IS Habit and Technology Acceptance Research," which situates our work within the context of prior technology acceptance research, and highlights the gaps that the current study addresses in our understanding of the role of IS habits. The next section, "Definition of Habit," focuses on the nature and formation of IS habits, since a clear understanding of IS habits is important in deriving the various interventions that can lead to their development and disruption. The third section, "Studying IS Habits Embedded Within Work Routines," integrates the psychology and organizational behavior literature on scripts and work routines. We highlight the importance of studying IS habits embedded within larger, more complex task sequences, as this work routine context itself plays an important role in both the development and disruption of IS habits. The fourth section, "Context Stability, Work Routines, and Habits," elaborates on how contextual variables discussed in prior research manifest when IS habits are embedded within work routines.

The next two sections review and integrate the literature on the development and disruption of habits. In "Manipulating Work Routines to Disrupt Incumbent System Habits," we propose organizational interventions to eliminate or modify contextual triggers embedded in work routines that may lead to action slips,[3] in order to encourage more conscious control over behavior and thus break incumbent system habits. In "Stabilizing Work Routines to Encourage New Habit Development," we propose additional organizational interventions to leverage contextual variables associated with work routines in order to encourage the development of new system habits. The propositions introduced in these two sections are designed to direct the study of IS habits in organizations in the future. We conclude the paper with a discussion of implications for IS research.

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[2]We thank the SE for providing this example.

[3]Action slips are defined as "the performance of an action that was not what was intended" (Norman 1981, p. 1).

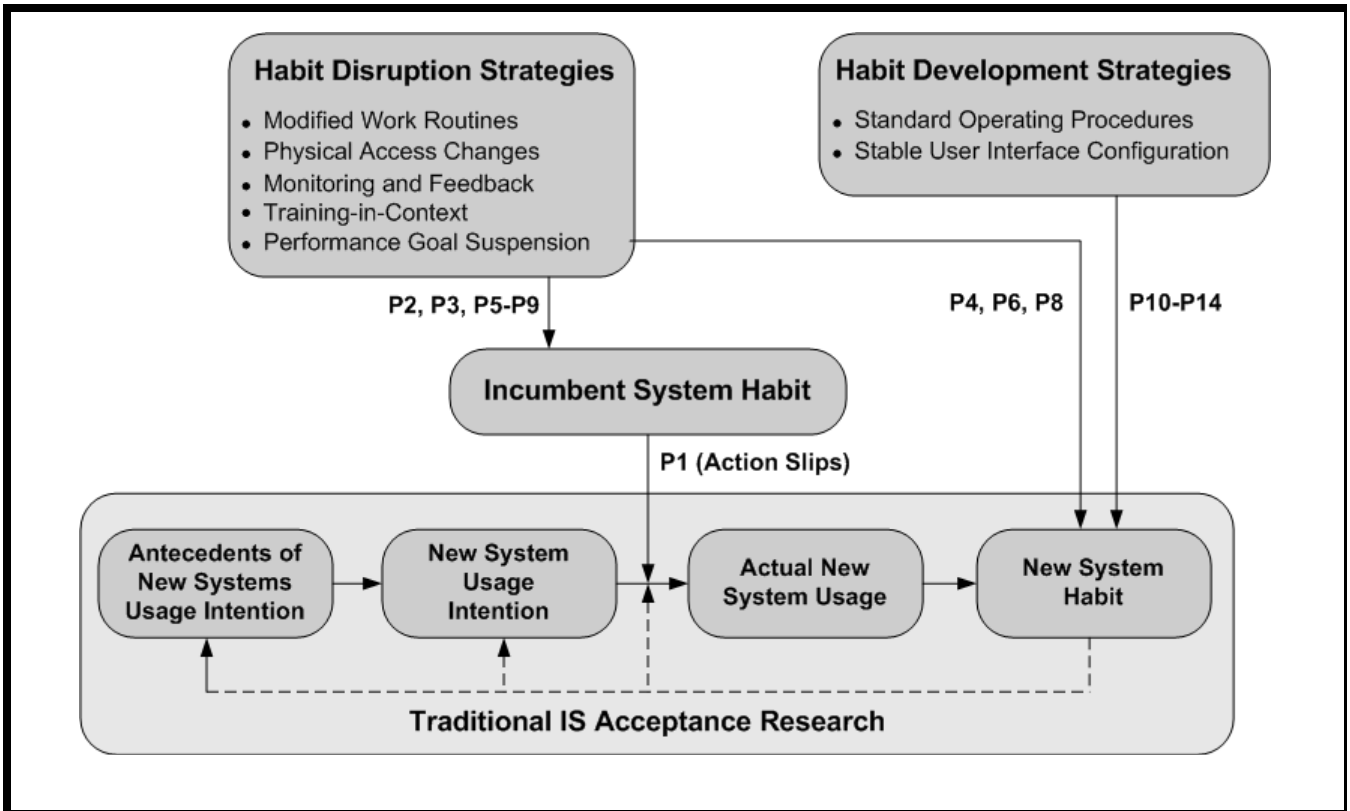

Figure 1. Overview of Propositions vis-à-vis Extant IS Acceptance Research

IS Habit and Technology Acceptance Research

Figure 1 presents a high level overview of extant technology acceptance research, showing how each proposition developed in the current study fits into existing work. At the bottom of the figure ("Traditional IS Acceptance Research") is a typical technology acceptance model, where various behavioral and normative beliefs, as well as individual differences, lead to intentions to use a new system which in turn lead to actual new system usage (Venkatesh et al. 2003). Over time, use of the new system may become habituated if an individual selects the system frequently enough, in a stable context, and with satisfactory results (Limayem et al. 2007). In turn, new system habit has an effect on perceptions of that system, on intentions to continue using it, and, through moderating the intention–behavior relationship, on actual continued usage (see dotted arrows at the bottom of Figure 1) (Gefen 2003; Kim and Malhotra 2005; Limayem and Hirt 2003; Limayem et al. 2007).

The primary objective of these prior studies is to demonstrate the importance of developing *new system habits* for continued system usage. An objective of this paper is to demonstrate how *incumbent system habits* (i.e., habits that have developed in the past with respect to an incumbent system) may lead individuals to "slip up" and continue using the incumbent system, even when they have voiced intentions to use the new one. This phenomenon, which we discuss in detail later, is known as "action slips" (Norman 1981), and indicates that incumbent system habit is a moderator of the intention–usage relationship for new systems.

The first box at the top of Figure 1 ("Habit Disruption Strategies") represents organizational interventions that can be used to disrupt incumbent system habits, by preventing action slips and occasionally by also simultaneously facilitating the development of new system habits. These intervention strategies are proposed as impacting different dimensions of the habit construct, but when used in combination, they seek to either interfere with automatic script performance so that the user cannot continue to use the incumbent system, distract the user to pursue a new performance goal (i.e., use of the new system), or provide supports that will aid users in reprogramming their usage behaviors. The second box at the top of Figure 1 ("Habit Development Strategies") represents

additional organizational interventions that focus solely on encouraging the long-term development of new system habits. Each of the intervention strategies in these two boxes draws on the embeddedness of IS usage in organizational and individual level work routines and is highly dependent on changing (or stabilizing) some aspect of the user's performance context—the situational triggers that lead to automatic selection of the incumbent (or new) system. Therefore, the contribution of the current study lies in understanding the role of organizational context (and specifically the context that derives from IS habit embeddedness in work routines) in habit development and disruption.

Definition of Habit

To understand how to disrupt incumbent system habits and encourage the development of new ones, it is important to first have a clear understanding of what habit is. Therefore, in this section we first elaborate on the definition of habit and how habits form. Next, we distinguish between *general* and *specific* IS habits—a distinction that is important when discussing IS habits embedded in work routines where the focus is typically on *specific* IS habits. Finally, we clarify our focus on IS habit as representing habitual IS choice of a specific system.

While habit has been defined and operationalized in many different ways (see Tables A1 and A2 in Appendix A), we follow recent advances from the social psychology literature (e.g., Aarts and Dijksterhuis 2000b; Bargh and Ferguson 2000; Sheeran et al. 2005; Verplanken and Orbell 2003; Wood and Neal 2007) in viewing habit as a form of *goal-directed automaticity*, where goals represent "desired, or anticipated, outcomes or end states" (Aarts and Dijksterhuis 2000b, p. 54) or the "anticipated, desired effect guiding the performance of behaviour" (Sheeran et al. 2005, p. 48). We thus define habit as "learned sequences of acts that have become automatic responses to specific cues, and are functional in obtaining certain goals or end-states" (Verplanken and Aarts 1999, p. 104). Viewing habits as being associated with entire, sometimes lengthy, behavioral sequences is particularly appropriate in understanding habitual IS use in organizations, where selection of a given IS may be just one step within a much larger automatized sequence of work activities.

As goal-directed automaticity, habit consists of the four dimensions of *intentionality*, *awareness*, *controllability*, and *mental efficiency* (Bargh 1989, 1994; Verplanken and Orbell 2003).[4] Intentionality does *not* refer to planned or conscious decisions to take action (see Ortiz de Guinea and Markus 2009; Verplanken and Orbell 2003; Wood et al. 2005), as intention has been defined in both the psychology and IS literature (e.g., Ajzen 1991). Rather, habits are *intentional* in that they are functional or goal-oriented in nature. Nevertheless, habits occur outside of awareness, in that the individual may be unaware of the situational trigger leading them to perform the behavior, or unaware of how the trigger is interpreted at the moment it occurs. This is particularly true when a highly scripted sequence of activities is involved. Further, habits are difficult to control, in that it may be difficult to resist the urge to perform a task in a particular way, especially if it is part of a larger automatized work routine. Finally, habits are mentally efficient, meaning that they free the individual's attentional resources to do other things at the same time (Bargh 1994; Verplanken and Orbell 2003). This savings of memory space and processing time is particularly useful when one must perform a complex yet programmable sequence of actions on a frequent, ongoing basis (Schank and Abelson 1977). It is worth noting that as a psychological construct with features of automaticity, habit should not simply be equated with frequency of past behavior as in some extant research, since not all frequently practiced behavior is indicative of the presence of a habit.

Historically, there have been two popular yet conflicting ways of conceptualizing habit as automaticity. The first approach has its foundation in behaviorism, and views habit from a stimulus–response perspective that does not examine the importance of psychological states and mental processes in habit formation. From this perspective, "the more often performance of the behaviour in response to the situation has been positively reinforced, the stronger the situation-behaviour link (i.e. the stronger the habit)" (Sheeran et al. 2005, p. 48). The second approach, known as the cognitive–motivational view, focuses on the importance of *goals* in habit development, and views goals as mediating the relationship between the environmental context and response. Thus, habits are mental associations between these goals and the resulting behavior (Aarts and Dijksterhuis 2000a, 2000b; Sheeran et al. 2005; Verplanken 2006; Verplanken and Orbell 2003). From this perspective,

[4]While Ortiz de Guinea and Markus (2009) have indicated a preference for the term *automatic behavior* rather than *habit* in studying IS continuance, as the former term has broader connotations, we focus solely on habit while recognizing it is only one of many forms of automaticity. This focus has important implications for our proposition development, since habit can be distinguished from other forms of automaticity based on its characteristics in regard to these four dimensions (see Bargh 1994). Dimension-based interventions to disrupt IS habits may not necessarily be effective for other types of automatic behavior.

> situational features become associated with a particular goal, and activation of that goal leads to performance of the behaviour. Positive reinforcement strengthens the link between the goal and the behaviour as one learns that the behaviour leads to the goal or expected result. Furthermore, recurrent instigation of the goal in the same situation increases the link between situation and goal.…Because the situation, goal, and action are assumed to be mentally represented, it follows that perception of the situation is capable of automatically activating the representation of the goal and the resultant action.… This way, habitual action may be initiated and subsequently executed without much awareness of the goal driving the action (Sheeran et al. 2005, p. 48).

A newer approach to conceptualizing the relationship between goals and habits seeks to reconcile the behaviorist and cognitive–motivational views by drawing from recent research in neuroscience, cognitive psychology, and animal learning studies. Specifically, it acknowledges that while habitual behavior may have had its *origin* in attaining certain goals, over time that goal link may be lost, and thus an individual may continue performing a habit long after it has lost its original meaning simply due to triggering stimuli (Wood and Neal 2007; Wood and Quinn 2004; Wood et al. 2005). Thus, this approach does not view habit as a form of goal-*dependent* automaticity (Bargh 1989, 1994), where automatic activation of goals is *necessary* to bring about performance of the habit. Rather, it views habit as goal-*independent* yet goal-*directed* automaticity. Specifically, it posits that goals play an important role in an individual learning to associate situational cues with behavioral responses that then become automatic over time, and that these goals continue to interact with habits in determining future behavior performance, but *without* the goals necessarily being automatically activated each time. Wood and Neal (2007) view this distinction as critical because research indicates that not all automatically activated goals lead to immediate action being taken, and some do not lead to habitual responses at all (Bargh and Ferguson 2000).

Given the fact that this debate is not yet settled in the psychology literature and requires further experimental testing, we will follow the conceptualization of habits as being goal-directed (which few experts today dispute) in the remainder of our paper, while deferring on the issue of whether goals must be automatically activated in order to trigger habit performance. In other words, we recognize that situational features are capable of automatically activating goals outside of a person's awareness, and that this goal activation *may* lead to habitual behavior performance, *if* that goal has been "pursued habitually in that situation in the past" (Bargh and Ferguson 2000, p. 937). However, in following both Wood and Neal (2007) and Bargh and Ferguson (2000), we also recognize that not all automatically activated goals lead to habit performance, and that situational features may, on occasion, continue to trigger habits even when the original goal is no longer relevant. In an organizational context where work behaviors are largely instrumental in nature and focused on task completion, viewing habit as goal-directed makes sense, since "the tasks individuals need to accomplish [in a work setting] have the same function as goals in nonwork contexts" (Ohly et al. 2006, p. 259; see also Ortiz de Guinea and Markus 2009). Given the importance of goals in guiding habitual IS behaviors, we include a more detailed discussion of goal hierarchies and their relationship to IS habits in Appendix B.

Habit Formation

Habits form when behaviors that are initially carried out consciously and intentionally are "overlearned" as a consequence of being *repeated frequently* over time in a *stable context* (Deci 1980) and with *satisfactory experience* (Limayem et al. 2007). We focus our present discussion on frequency of repetition and satisfactory experience, and discuss context stability later in the paper since it is a key element of our theoretical development.

Researchers have long argued that *frequent repetition of a behavior* is a necessary precursor to habit formation. Through repetition, individuals learn to associate situational cues with particular behavioral responses. In addition, behaviors that are repeated more frequently (e.g., daily tasks) are believed to lead to stronger habits than less frequently practiced behaviors (e.g., weekly or monthly tasks) (Limayem et al., 2007; Ouellette and Wood, 1998). One factor that has been associated with increased repetition in an IS context is *comprehensiveness of use*, defined as "the extent to which an individual uses the various features of the IS system in question" (Limayem et al. 2007, p. 714). Comprehensiveness of use may strengthen IS habits through simply increasing opportunities for repetition by using the system across various tasks. Limayem et al. (2007, pp. 715-716) posit that

> people who use an information system in many *different* ways, will tend to develop *stronger* habits with respect to the usage of that IS than others who use the IS in more limited ways. In other words, users who take full advantage of an IS's overall functionality will not confine their IS usage to specific situations only.

Limayem et al. also suggest that *satisfaction with performance of a behavior* is a key enabler of habit formation. If an individual is satisfied with using a particular IS to complete a work task, they will tend to choose that IS again in the future when faced with the same task, and eventually (in many cases) develop a habit of always choosing that IS for that task.

General Versus Specific IS Habits

While there are doubtless cases where organizations want individuals to stop using an incumbent system altogether for *all* tasks, on other occasions the use of that system may only be considered a problem for *particular* tasks. For example, it is unlikely that an organization would want its employees to stop using spreadsheet software altogether; rather, it may be desirable to use spreadsheet software for some tasks and BI tools for others. Thus, it is important to briefly discuss the difference between general and specific IS habits, and their relationship to one another. *General IS habits* have been defined as those characterized by high usage comprehensiveness, that is, where the same system is selected for many different purposes or tasks. For example, Limayem et al. (2007) describe how some individuals may develop a general habit of selecting the World Wide Web (WWW) when faced with any number of tasks, including searching for information, shopping, managing finances, telephony, and chatting. *Specific IS habits*, on the other hand, have been defined as being associated with limited usage comprehensiveness; that is, the system is selected for only one or a relatively small number of tasks, such as an individual only using the WWW to search for information (Limayem et al. 2007). Perhaps a simpler way to distinguish between the two types of habits is to view a specific IS habit as relating to a specific system–task usage pattern that has developed over time.

Given our focus on IS habits that are embedded within larger organizational and individual level work routines, we are only concerned with the habitual selection of a particular IS for the *specific* task that needs to be performed within the larger task sequence implied by the work routine. Whether or not an individual habitually selects the system for *other* tasks is not of immediate relevance to this context, although it may have implications for how general IS habits develop over time. A more in-depth discussion of the relationship between general and specific IS habits appears in Appendix C.

IS Habit as Representing Habitual IS Choice

Incumbent system habits are most likely to cause problems when there is more than one system available for completing particular tasks, and there are compelling reasons as to why the organization wants individuals to choose a different system than the incumbent one to carry out those tasks. Thus, it is important to note that in the present study, IS habit refers only to the habitual choice of a particular IS to perform specific tasks, and in fact most prior IS habit studies have interpreted IS habit in this way without explicitly saying so. We do not address habitual ways of *using* that system (e.g., precise keystroke sequences followed) in the process of actually *carrying out* those tasks with a particular IS. However, as Murray and Haubl (2007, p. 78) describe, these habitual ways of using a system can in turn "create switching costs that *lead* to habitual choice."

Some may consider it odd to discuss habitual choice of an IS, given the term choice usually implies a conscious act (see Ortiz de Guinea and Markus 2009). However, the psychology literature commonly refers to choices as scripted behaviors that over time can become automatized and performed outside of consciousness, if performed frequently enough in a stable context (see Aarts and Dijksterhuis 2000a, 2000b; Verplanken and Orbell 2003; Wood et al. 2005). Further, the consumer behavior literature has used the term habitual choice as "a descriptive label for consumers' consistent, repeated purchase of the same brand over time" in a study of website usage behaviors (Murray and Haubl 2007, p. 78). It may help to view habitual IS choice as being nothing more than the behavioral act of clicking on an icon or link to open a particular application on one's computer, tablet, or smart phone screen. Thus, no conscious act is implied.

The selection of a specific IS to perform a task is often only one step in a much larger automatized task sequence. Extant habit research has looked at this isolated choice activity in the context of travel mode choice (e.g., Aarts and Dijksterhuis 2000a, 2000b; Aarts et al. 1997; Bamberg et al. 2003; Klockner and Matthies 2004; Møller 2003; Verplanken et al. 1997; Verplanken et al. 1994), eating and drinking habits (e.g., Burg et al. 2006; Honkanen et al. 2005; Saba and diNatale 1998, 1999; Saba et al. 1988; Saba et al. 2000; Sheeran et al. 2005; Towler and Shepherd 1991-1992; Verplanken and Faes 1999), and consumer purchasing patterns (e.g., Gefen 2003; Greenfield 2005; Ji Song and Wood 2007; Khalifa et al. 2002; Khalifa and Liu 2005; Verplanken et al. 2005; Verplanken and Wood 2006). However, research has not examined these habits of choice as they occur embedded within larger, instrumental, automatized task sequences. Understanding IS habits in this context is the focus of the sections that follow.

Studying Is Habits Embedded Within Work Routines

Scripts, Work Routines, and Habits

Figure 2 situates work-related habits (both IS and non-IS) within the larger concepts of scripts and organizational and individual level work routines. *Scripts* are a specific type of cognitive schema[5] known as *action schemas*. These represent standard event or behavior sequences that are generally frequently practiced, such as those that commonly take place in a work environment. Scripts not only help us to make sense of a frequently encountered business situation, but they also inform us of the appropriate behavior to practice in that situation (Gioia and Poole 1984; Schank and Abelson 1977). *Instrumental scripts* are a form of strong[6] script that represent a precise sequence of actions that must be followed to attain a specific goal.

Goal-oriented work routines have their origins in instrumental scripts and operate at the organizational, group, or individual level of analysis. While organizational routines are "multi-actor, interlocking, reciprocally-triggered sequences of actions" (Cohen and Bacdayan 1994, p. 554), individual routines are specific goal-oriented task sequences performed by a single employee and are often embedded within larger organizational (or group) level routines. Based on integrating the literature on organizational routines with the definitions of habit and instrumental scripts provided previously, it is clear that only *individual level* routines based on instrumental scripts have the potential to develop into habits (Becker 2005; Cohen and Bacdayan 1994; Gioia and Poole 1984; Verplanken and Aarts 1999). Put differently, individual level routines that are performed repeatedly in the same manner, with satisfactory experience, and in a stable context will, over time, have a tendency to become automatized and become a habit (i.e., initiated outside awareness, in a mentally efficient manner, and without conscious control).

[5]A *cognitive schema* is a knowledge structure that represents some specific, frequently encountered aspect of our world, and that serves "as a guide for the interpretation of information, actions, and expectations" (Gioia and Poole 1984, p. 450).

[6]Scripts may be either *weak* (specifying what will happen in a given situation, but not necessarily the exact order of occurrence) or *strong* (specifying both what will happen and in what sequence) (Gioia and Poole 1984).

Habits and Organizational Level Work Routines

As shown in Figure 2, organizational routines are often a composite of many individual level habituated task sequences where each habituated individual level routine represents a precise sequence of activities, one of which may include IS use. The triggers for these habituated task sequences are events that occur as the multi-actor script is being carried out. For example, Employee A in one department may complete a particular automatized sequence of tasks, after which she passes the work off to Employee B in another department, who then performs his own automatized sequence of tasks, etc., until the entire organizational routine has been completed. The point in time when the work gets passed from Employee A to Employee B is the trigger or cue for Employee B's habitual scripted behavior (Becker 2004). Thus, in some ways, organizational routines can be viewed as a combination of organizational structures and individual level habits that, "when triggered, lead to sequential behaviors" (Becker 2005, p. 818

Our theorizing on how incumbent system habits can be dis rupted (and the development of new system habits encouraged) focuses on organizational interventions that either interfere with, or promote, automatic script performance. Each of these intervention strategies draws on the embeddedness of IS habits within work routines and is, for the most part, highly dependent on manipulating or otherwise leveraging some aspect of the user's performance context. In the next section, we review the habit literature on context stability and describe how context stability should be interpreted when studying IS habits embedded within larger work routines.

Context Stability, Work Routines, and Habits

As already discussed, habits form when behaviors (including scripted task sequences and work routines) that are initially carried out consciously and intentionally are "overlearned" as a consequence of being repeated frequently over time in a *stable context* (Deci 1980) and with satisfactory experience (Limayem et al. 2007). Understanding how context stability supports work-related IS habits is important because the embeddedness of IS habits within organizational and individual level routines implies that a large part of this context stability is derived from the work routine itself. In addition, understanding how stability of the performance context influences IS habits is important in designing appropriate

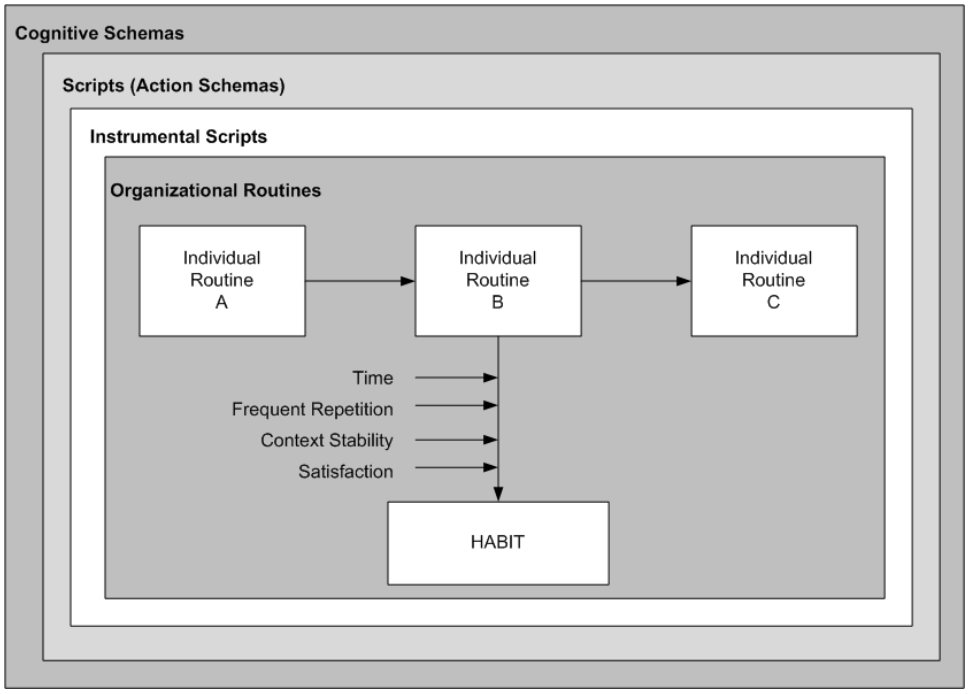

Figure 2. The Relationship Between Schemas, Scripts, Organizational and Individual Level Work Routines, and Habits[7]

interventions to manipulate or otherwise leverage this context to disrupt incumbent, and encourage new, IS habits.

Table 1 summarizes the contextual variables most commonly believed to exert an influence on individual behavior patterns. It is important to note that extant research on context stability and habit has focused on nonwork-related behaviors.[8] Therefore, we reinterpret each contextual variable in relation to the work routine context, and present implications of these interpretations for designing organizational interventions to encourage habit development and disruption. We also map these implications to the intervention propositions we present later in the paper. The following subsections expand on our conceptualization of the work routine context as presented in Table 1.

Temporal Context

Time is a common contextual cue for triggering IS habits, since many work-related tasks involving computer systems often have to be performed at specified times of the day or week. For example, many managers have reports that they generate and review each morning when they arrive at work, and employees may have to run through daily checklists, or submit various status reports at the end of each day, week, or month. And of course, one of the first tasks that many people do when arriving at work in the morning is to turn on their personal computer and check their email and voice mail.

While some tasks involving computer use must be performed at a very specific time of day, or performed repeatedly at spe-

[7]While for ease of exhibition this model depicts a linear view of how individual level work routines relate to each other, it is important to keep in mind that in reality there may exist multiple and nonlinear paths across these. We recognize that at a more granular level, each individual level work routine is composed of a sequence of activities, each of which can have interaction with activities across other individual level work routines. It is also important to note that we are focusing on the performative aspects of organizational routines—that is, how these routines are actually enacted and not how they are supposed to be enacted (ostensive aspects) (Feldman and Pentland 2003).

[8]Social psychology studies on the impact of context stability on habit performance have focused on such behaviors as watching news on TV, exercising, and purchasing fast food (Ji Song and Wood 2007; Wood et al. 2005). In the marketing literature, these same contextual variables have not been examined directly in terms of how they might explain habitual behaviors, but rather in terms of their impact on individuals' choice of beverages, meat products, snack products, fast foods, leisure activities, and motion pictures (Belk 1975).

Table 1. The Role of Work Routine Context in IS Habit Performance

Contextual Variable	Traditional View	Work Routine Context View	Implications for IS Habit Development	Implications for IS Habit Disruption
Temporal Context	Time of day, week, etc. when the individual normally performs the behavior in question (most common definition). However, the time that a behavior is performed may also be relative to other events that have taken, or will take, place (Belk 1975; Ji Song and Wood 2004; Wood and Quinn 2004; Wood et al. 2005).	IS habits are often event-driven, triggered by recurring business events or workflow-related triggers embedded within organizational and group level routines.	Standard operating procedures (SOPs) specifying the use of a particular IS in response to specific external business events will encourage the development of new system habits **(P10, P11)**.	Modification or elimination of external business event triggers will result in a weakening of incumbent system habits **(P2)**. Training in the context of multi-actor work routines will aid in the reprogramming of incumbent system habits triggered by external business events **(P7, P8).**
Physical Context	One's physical location when performing an action (most common definition), or the lighting, sounds, weather, and visual stimuli associated with the immediate environment (Belk 1975; Ji Song and Wood 2004; Wood and Quinn 2004; Wood et al. 2005).	The configuration of the user interface (e.g., appearance, layout, embedded links) can trigger habit performance.	A stable user interface configuration will encourage the development of new system habits **(P14)**. Replacing the access point for the incumbent system with an access point in the same location for the new system will encourage the development of new system habits **(P4)**.	Modifications to the manner in which users physically access the incumbent system will result in a weakening of incumbent system habits **(P3)**.
Social Context	One's social surroundings when performing an action. A particular behavior may tend to be practiced habitually when in the company of a particular set of other individuals (Belk 1975; Ji Song and Wood 2004; Wood et al. 2005).	The presence of significant referents† who may exert normative pressures can impact IS choice. IS habits may also be triggered when there is no actual physical presence of significant referents, but the user is aware of being electronically monitored.	Monitoring and feedback systems will serve as a proxy for significant referents, and thereby encourage the development of new system habits **(P6b)**.	Implementation of monitoring and feedback systems will result in a weakening of incumbent system habits **(P5, P6a)**.
Task Definition	One's intent or requirement to perform a particular activity, or their understanding of the task. Possibly analogous to the intentionality dimension proposed by proponents of the goal-directed automaticity view of habits (Belk 1975; Wood and Quinn 2004).	The specific sequence of steps that need to be performed to carry out a much larger individual level work task. These are often highly scripted and can occur in rapid succession.	SOPs specifying the use of a particular system at the same step in a scripted individual level task sequence will encourage the development of new system habits **(P12, P13)**.	Modification of a scripted individual level task sequence will result in a weakening of incumbent system habits **(P2)**. Training in the context of scripted individual level task sequences will aid in the reprogramming of incumbent system habits triggered by preceding steps in the task sequence itself **(P7, P8).**

†The term *referents* is used in Ajzen's (1991) work on the subjective norm construct, found in both the theory of reasoned action and the theory of planned behavior, to refer to individuals who exert normative pressures impacting one's behavior.

Table 1. The Role of Work Routine Context in IS Habit Performance (Continued)

Contextual Variable	Traditional View	Work Routine Context View	Implications for IS Habit Development	Implications for IS Habit Disruption
Mood	One's momentary mindset and internal state immediately prior to performing an action. Examples include acute anxiety, pleasantness, hostility, and excitation (Belk 1975; Ji Song and Wood 2004; Ortiz de Guinea and Markus 2009; Wood et al. 2005).	No unique interpretation and may be of less relevance for understanding IS habits in organizational settings.	No unique interpretation for IS habits in an organizational setting.	No unique interpretation for IS habits in an organizational setting.
Other Antecedent States	Goes beyond momentary moods to include momentary conditions such as "cash on hand, fatigue, and illness" that occur immediately antecedent to the performance of the behavior (Belk 1975, p. 159) (Belk 1975; Wood and Quinn 2004).	Being overwhelmed with work (including a need to multitask), being stressed, and facing time pressures can all impact whether or not one follows existing habituated routines, since habits require less mental capacity to perform.	Temporarily suspending or relaxing performance goals upon the introduction of a new IS will make a user less likely to slip back into habitual IS choices, and thereby indirectly support new habit development **(P9)**.	

cific times throughout the day (e.g., hourly quality control checks in a manufacturing plant), many of these "time of day" triggers for IS use are actually relative in nature. For example, an employee who arrives at work at 1:00 p.m. instead of 8:00 a.m., will most likely still begin the day by checking her e-mail. Thus, the temporal trigger to the IS use is *arriving at work*, regardless of the exact time that this takes place.

Temporal context may also be viewed as relative in that commonly performed work tasks are triggered by the activities of other individuals or by specific business events that occur regularly, yet not always at the exact same time each day. Many forms of interdepartmental workflow fit this description, including the tasks related to setting up accounts and processing paperwork for new employees, processing a loan application, or completing a trouble ticket. This implies that IS habits may be primarily *event-driven* (see Becker 2004, 2005), particularly when embedded within larger scripted group or organizational work routines.

Physical Context

Extant research has already discussed ways in which the physical environment, interpreted as one's actual physical surroundings, may trigger various types of habits, including those related to IS choice. For example, an individual may have developed the habit of only using a specific office or other portion of the workspace to perform certain tasks. The mere sight of (or entrance into) this physical space, particularly at a certain time of day, can trigger activities to be performed automatically (Limayem et al. 2007; see also Ortiz de Guinea and Markus 2009). Thus, one may potentially use a different IS to complete the same task depending on whether they are working in their office, in another location at work, at home, or traveling on business, and over time these different choices may become habituated based on built-in situational triggers. For example, an individual may use Microsoft Outlook or Thunderbird to check e-mail when at home or at work, but use a webmail program when traveling. In addition, individuals may perform different tasks altogether, as a consequence of the physical environment triggering a different set of work routines.

Since this approach to understanding the impact of physical context has already been tested in prior literature (e.g., Wood et al. 2002; Wood et al. 2005), we focus instead on other elements of physical context that may play an important role in determining which IS an individual uses, particularly when there is more than one option available for completing a given task. Belk (1975, p. 159) refers to these elements as the "visible configurations…surrounding the stimulus object." For example, the appearance and layout of the user interface, including the placement of objects and startup icons, as well as embedded links to other applications, may all encourage habitual choice of a particular system (Ortiz de Guinea and Markus 2009).

Social Context

While the temporal and physical contexts are generally considered to be the most important triggers of habitual behavior (see Wood and Quinn 2004; Wood et al. 2005), social context may also play a role in triggering the automatic choice of a given IS. This is particularly true when more than one system is available with which to perform a given task. For example, an employee may use the officially sanctioned workflow tracking system when in the presence of his superiors (knowing that to do otherwise might earn him a reprimand), but use other more informal methods (such as phone calls and e-mail) when alone and not being watched. This choice is based on recognizing that his superiors expect the sanctioned IS to be used for particular tasks to achieve predetermined organizational goals. Over time, an employee's decision to select either the officially sanctioned IS or an alternative system may be automatically triggered by who is present when the employee needs to perform a particular task.

Extant research (e.g., Wood et al. 2002; Wood et al. 2005) has already investigated the impact that the presence of other individuals may have on triggering habit performance. Thus, we focus instead on other elements of social context that are unique to understanding IS habits. Specifically, employees today do not need to be in the actual physical presence of superiors or other significant referents in order to feel pressure to use a particular IS. Rather, electronic monitoring systems may serve the same function. Further, monitoring systems have the advantage of always being present, even when one's coworkers or superiors are absent. Thus, IS habits may also be triggered by the knowledge that one's system use is being electronically monitored while they are at work.

Task Definition

Occasionally, two work tasks may superficially appear to be the same, and yet the individual selects a different IS for each. In such a case, understanding this habitual selection of one IS over another depends on a more precise definition of each task (e.g., the specific role the individual is fulfilling while performing the task, or the purpose or person for whom the task must be completed). Belk (1975) uses the example of a person shopping for a small appliance to buy as a wedding gift versus to buy for their own use. The difference in the situation leads to a different role being played, and therefore different steps being followed or different decisions being made, to fulfill the task. Similar situations may occur with IS use. For example, an academic researcher may use Google for general information searches on a research topic, an online library database such as Web of Science for electronic journal searches, and Google Scholar for quick keyword searches of research that has been done on a given topic. Over time, these varying search engine choices may become habituated based on the task at hand.[9]

Task definition can be viewed in other ways. For example, task definition can represent the specific sequence of steps that need to be performed to carry out a larger work task. Whereas event triggers are perhaps the most important contextual variable leading to habitual IS use within the context of a *multi-actor* routine, task definition is key to triggering habitual use for lengthy *single-actor* routines (where the "events" are actually antecedent steps in the individual task sequence).

Mood and Other Antecedent States

While IS researchers have recently begun to investigate the role that mood plays in IS acceptance and task performance (see Loiacono and Djamasbi 2010), we argue that momentary moods have little relevance for understanding IS habits embedded within work routines in an organizational setting. While an individual may well choose to use particular systems (such as video games or social networks) in their personal life when in a highly agitated or excited state, there is no direct parallel in a work environment, where systems are selected for their ability to help employees complete recurring work-related tasks. Other antecedent states, however, *may* impact IS choices in a work environment. In particular, when employees are tired, stressed, or under pressure to complete tasks under time constraints, they may fall back on using systems that require less mental effort, or systems with which they are already very familiar.

Now that we have an understanding of how contextual variables believed to trigger habit performance can be interpreted in the context of organizational and individual level work routines, we can formally propose how organizations might manipulate these contextual variables to disrupt incumbent system habits, and, afterward, stabilize them to support the development of new system habits. This is the focus of the remainder of our paper.

[9]See Lending and Straub (1997) for an example of how the choice of literature search techniques may become habituated over time based on characteristics of the situation.

Manipulating Work Routines to Disrupt Incumbent System Habits

One common response regarding how to break IS habits is to just turn the old system off and force people to use the new system. However, this is not always an option. In many organizations today, there are multiple tools that can be used to perform any given task, yet these tools do not all perform equally, nor are they equally sanctioned by the organization.

Take, for instance, the production of business intelligence (BI) reports. If a user has database access and is skilled at writing SQL code, he might be able to query the database directly for the needed information. Alternatively, if he is skilled in the use of Microsoft Access, he can link to an external "industrial grade" database from within Access and create his own queries and reports. Many users also pull data into Excel for manipulation, or use any number of off-the-shelf managed query tools or custom-built applications that the firm possesses. It is not likely that, in implementing a new BI tool, the company is going to revoke desktop access to either Excel or Access, or to all the other possible software tools available for creating a particular report. Thus in considering how an organization can change individual IS habits and encourage use of a new IS, another approach besides "pulling the plug" may be necessary.

We have already discussed our view of habits as individual level cognitive scripts that originate in pursuit of specific goals, and that, over time, come to be performed automatically in response to situational cues. To break a habit, we must therefore break the link between the goal and its associated behavior (Gollwitzer and Sheeran 2006; Sheeran et al. 2005; Verplanken 2005).[10] This can be accomplished in one of two ways: *interfering* with an individual's existing goals, or *distracting* the individual to pursue new goals (Schank and Abelson 1977). Such interventions work primarily by manipulating the various contextual variables presented in Table 1. In the absence of such interventions, action slips may occur, such that use of the incumbent system continues even after the individual has voiced intentions to switch to the new one.

In the remainder of this section, we integrate a number of different theory bases, including those dealing with attitude/intention models, action slips, context change, script disruption, self-efficacy, training, implementation intentions, and the dimensions of habit themselves, to analyze intervention strategies for breaking IS habits. Our theoretical development begins by examining the role of action slips in inhibiting new IS adoption and use. We then provide a detailed discussion of specific context-focused habit disruption strategies for preventing action slips from occurring. These strategies include script disruption techniques such as interference and distraction, reprogramming responses via training-in-context, and counteracting antecedent states via performance goal suspension. Where appropriate, we discuss how some of these strategies serve the dual role of disrupting incumbent system habits and strengthening new system habits. Since habit is a multidimensional construct, any intervention strategies that an organization undertakes should address one or more of the four habit dimensions. Thus, throughout our discussion, we argue for a multi-pronged approach to disrupting incumbent system habits (and encouraging new system habits) that individually addresses each of the four habit dimensions (intentionality, awareness, controllability, and mental efficiency).

The Role of Action Slips in Inhibiting New IS Adoption and Use

Viewing IS habits as being embedded within a larger task sequence aids in understanding one of the key ways in which habitual selection of an incumbent IS can inhibit use of a newly introduced one. In many cases, a user may be trained on how to use the new system, recognize its advantages, and even voice intentions to use it, yet "slip up" and continue using the incumbent system when an occasion arises to do so. Such behavior is referred to as an *action slip*, defined as "the performance of an action that was not what was intended" (Norman 1981, p. 1).

Several different categories of action slips have been identified (see Norman 1981), but only one, *faulty activation of schemas*, appears to be relevant to IS use in a work setting. In particular, a type of faulty activation known as a *capture slip* occurs "when a familiar habit substitutes itself for the intended action sequence…if the habit is strong enough, even partial matches from the situation are apt to activate the relevant parent schema, and once activated, it can get triggered" (Norman 1981, p. 8). An example of a capture slip (so named because the familiar action sequence "captures" control over one's behavior) is a bus driver who, while off duty and driving the family car, pulls over to the side of the road as if to pick up passengers (Bargh 1994).

Action slips can occur in an organizational setting as well. Consider the example of an employee who for several years has come in to work in the morning, logged onto her computer, and automatically opened Microsoft Outlook to check

[10] A detailed discussion of goal hierarchies, task hierarchies, and their relationship to IS habit disruption strategies can be found in Appendix B.

her e-mail before beginning the day's tasks. If the company introduced Lotus Notes but left Microsoft Outlook installed (at least temporarily) on everyone's machines, one can easily picture the employee coming in to work in the period of time immediately following implementation and, without thinking, automatically going through her normal "start of day" routine, including opening Microsoft Outlook.

While this example is relatively simple in nature, any time two different task sequences (such as those associated with use of an incumbent and new IS) are triggered by the same business event, there is potential for action slips to occur, leading to the wrong sequence of activities beginning and being carried to its conclusion. This is true even if the worker is aware of the new work routine and intends to follow it (including having voiced an intention to use the new system). An action slip is particularly likely to occur when the two task sequences begin in a similar fashion (in our example above, the only difference was choice of the system). When the triggering event occurs, the similarity in other contextual cues may lead the worker to begin the new sequence but then slip up, automatically reverting to doing things in the old way without even being aware (at least at that moment in time) of having done so.

Thus, habits in regard to an incumbent behavior can inhibit the performance of a new behavior, despite intentions otherwise, as a consequence of action slips (see further support in Betsch et al. 2004; Fishbein and Ajzen 1975; Heckhausen and Beckmann 1990; Møller 2003; Ouellette and Wood 1998; Verplanken and Faes 1999). Over time, if no organizational interventions are in place to cue employees to their behavioral slips and encourage change, they may continue automatically using the incumbent system to the point that "inaction inertia" (Tykocinski et al. 1995) sets in, and a voluntary switch to the new IS becomes less and less likely. Therefore we propose:

Proposition 1: Incumbent system habit will moderate the relationship between new system usage intention and actual new system usage, such that the relationship is weaker in the presence of strong incumbent system habits due to action slips.

The moderating relationship in Proposition 1 and visualized in Figure 1 appears on the surface to be identical to that which has already been hypothesized and tested in Limayem et al. (2007). However, it is not. The Limayem et al. study focused on the role of habit toward a system in moderating the continuance intention–continuance usage relationship for the *same* system. Habit is proposed as a negative moderator of this relationship based on intentions becoming less important in predicting behavior once usage has habituated. Our study looks at *incumbent* system habit as a negative moderator of the intention–usage relationship for a *different* system, and is based on action slips leading the relationship to be weaker in the presence of a strong habit.

Context-Focused Habit Disruption Strategies

We propose several categories of context-focused habit disruption strategies for breaking, or otherwise discouraging the continued performance of, incumbent system habits. First, script disruption techniques (i.e., interference and distraction) manipulate important aspects of the work routine context in which habitual incumbent system choices occur, thereby reducing action slips. Second, training-in-context increases awareness of the situational triggers leading to incumbent system habits, and reprograms responses to these triggers toward use of the new system. Finally, performance goal suspension counteracts antecedent states by reducing stress and fatigue, thereby reducing the likelihood that the worker will revert back to habitual patterns of IS use. Each of these strategies is discussed in detail next.

It is worth noting that some of these strategies (e.g., training-in-context) serve the dual purpose of disrupting incumbent system habits and strengthening new system habits. We provide a discussion of these dual effects where applicable and develop the associated propositions. Propositions associated *only* with encouraging the development of new system habits are discussed in a later section of the paper. Figure 3 provides a high level mapping of all the habit disruption and habit development interventions proposed in our study to the system (incumbent or new) that they impact. Table 2 provides a further mapping to the organizational actors involved in each intervention, and the specific habit dimensions that each intervention impacts.

Script Disruption Techniques

The script literature suggests several ways in which habituated work routines might be disrupted. The first method is through the use of *interference*, which is defined as "states or actions which prevent the normal continuation of a script" (Schank and Abelson 1977, p. 52). Interference may involve *obstacles* ("where some enabling condition for an impending action is missing") or *errors* ("where an action is completed with an unexpected and inappropriate result") (Schank and Abelson 1977, p. 52). The second method of disrupting habituated routines is through the use of *distractions*, which are defined as "unexpected states or actions which initiate

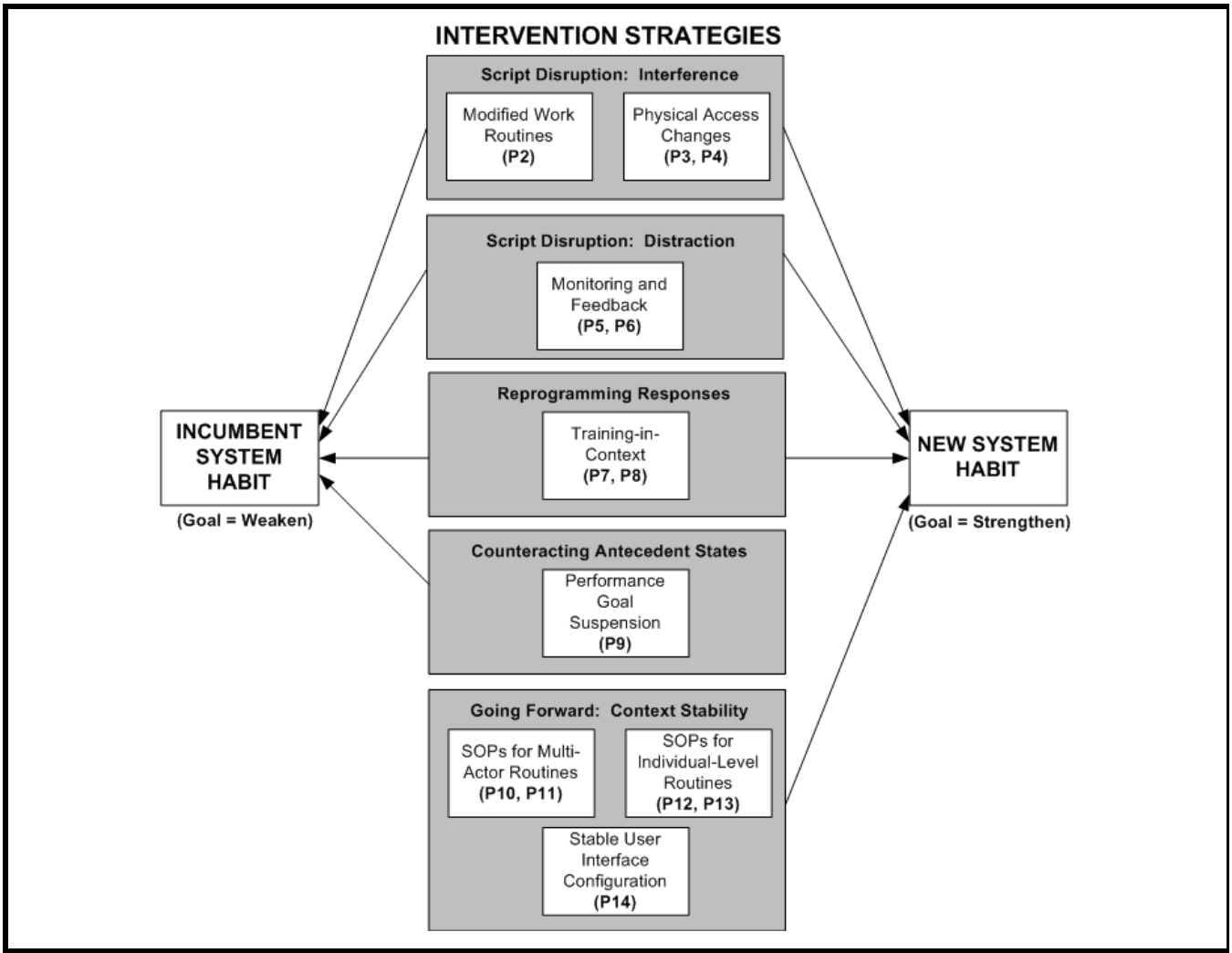

Figure 3. IS Habit Intervention Strategies

new goals for the actor, carrying him temporarily out of the script" (Schank and Abelson 1977, p. 53; see also Wood and Quinn 2004). The key difference between interference and distraction techniques is that interference prevents the individual from successfully pursuing their goal, whereas distraction leads the individual to pursue a different goal altogether (Figure 4).

Both interference and distraction techniques work by manipulating aspects of the context (Table 1) in which habitual IS choices occur, such that action slips are reduced or prevented altogether. Context changes succeed by forcing the individual to exit from their behavioral script, become more aware of their actions, and thereby exert more conscious control over their behavior (Wood et al. 2005). Interventions to change the behavioral context can also increase the user's awareness of the contextual triggers *themselves*, again enabling more conscious control over behavior. We now turn to a more detailed discussion of the use of interference and distraction techniques to disrupt IS habits.

Interference

The most obvious example of an interference technique is the case where a user's access to a particular system is eliminated altogether. However, less drastic approaches exist. Interference in situations where both the incumbent and new system coexist can be accomplished in one of two ways. The first involves substantially modifying work routines to eliminate built-in contextual triggers to habitual IS choice. The second involves modifying elements of context within existing (unchanged) work routines.

Table 2. IS Habit Intervention Strategies: Actors and Dimensions Impacted

Intervention Category	Intervention (Proposition #)	Actors Involved	Habit Dimensions Impacted (I = Incumbent, N = New)
Script Disruption - Interference	Modified Work Routines **(P2)**	Any number of different organizational change agents	Awareness (I) Controllability (I)
	Physical Access Changes **(P3, P4)**	System designers	P3: Awareness (I) Controllability (I) Mental Efficiency (I) P4: Awareness (N) Controllability (N) Mental Efficiency (N)
Script Disruption - Distraction	Monitoring and Feedback **(P5, P6)**	System designers	Intentionality (I, N) Awareness (I) Mental Efficiency (I)
Reprogramming Responses	Training-in-Context **(P7, P8)**	Any number of different organizational change agents (trainers, managers, coworkers) in conjunction with the user him/herself	Intentionality (I, N) Awareness (I) Controllability (I)
Counteracting Antecedent States	Performance Goal Suspension **(P9)**	Managers	Awareness (I) Controllability (I)
Going Forward: Context Stability	SOPs for Multi-Actor Routines **(P10, P11)**	Managers	Intentionality (N) Awareness (N) Controllability (N) Mental Efficiency (N)
	SOPs for Individual-Level Routines **(P12, P13)**	Managers	Intentionality (N) Awareness (N) Controllability (N) Mental Efficiency (N)
	Stable User Interface Configuration **(P14)**	System designers	Mental efficiency (N)

Eliminating Triggers by Modifying Work Routines. Many times the introduction of a new IS, such as an enterprise resource planning (ERP) system, does in fact bring with it major changes to work routines. However, even when it does not, it may still be possible to intentionally modify work routines in such a way that it becomes more difficult, if not impossible, to use the incumbent system to complete a given task sequence. Such an intervention strategy might involve the manipulation of several different contextual variables (Table 1), bringing about substantial enough changes to work routines that existing contextual triggers built into timeworn routines will never have the chance to be activated.

For example, business process improvement efforts often result in changes to the sequencing and timing of subtasks within a larger routine, such that tasks are performed by different people or departments, at different times, or no longer performed at all. Event triggers may be changed by either setting up automatic alerting systems, or automating certain tasks altogether. The physical context of a task sequence can be modified by embedding the interface for performing those tasks within a larger, integrated system, such as a portal or other web interface. Setting up dashboard reports that "push" information to the end user further eliminates the need to use the incumbent IS to "pull" data for commonly used reports. All of these work routine changes either eliminate or modify antecedents to a given action (IS use), thereby disrupting the automatic cues to behavior in such a way that the user has to stop and think about what to do next, rather than simply operating on "autopilot" (in other words, increasing their levels of *awareness* of, and thereby their ability to *control*, their behavior). Therefore we posit:

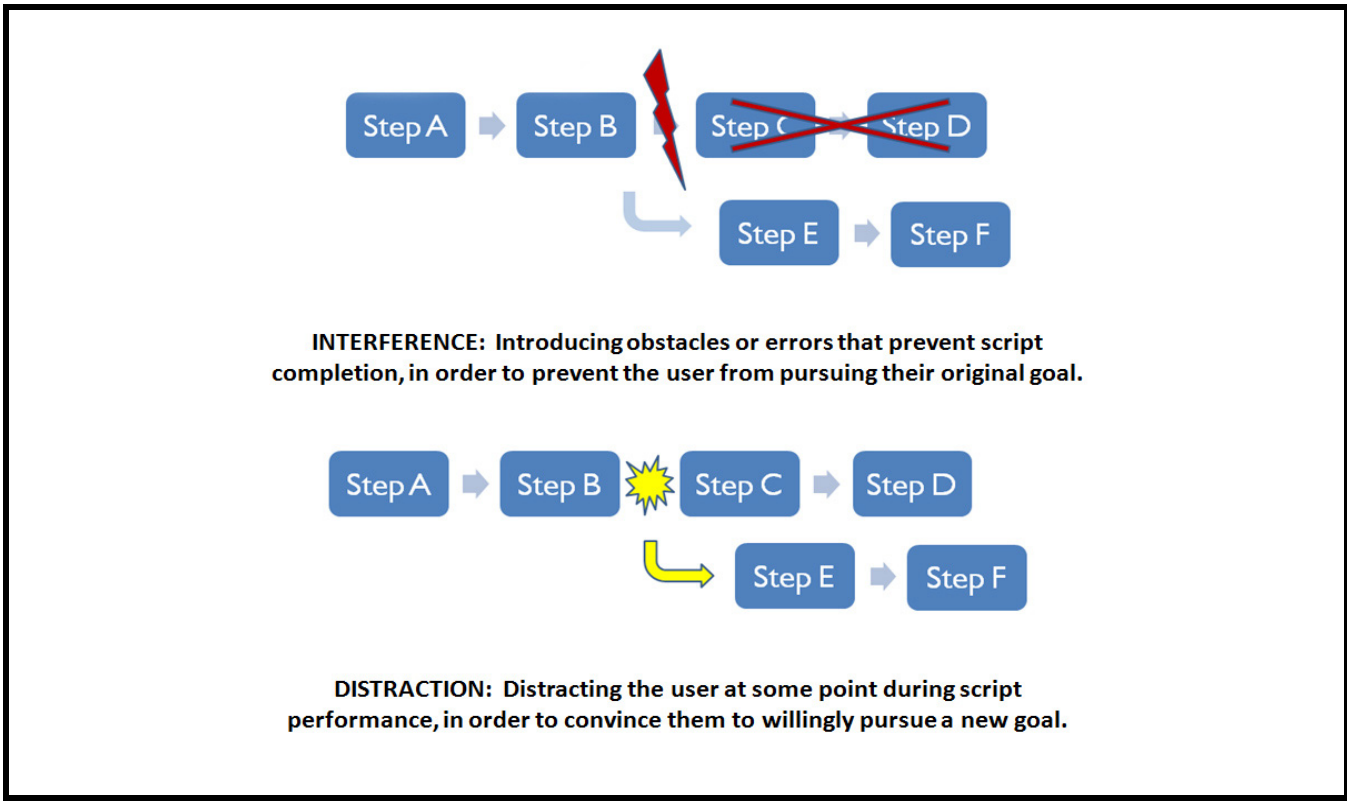

Figure 4. Script Disruption Techniques

Proposition 2: When change agents modify one or more aspects (e.g., task definition, task sequence, timing, event trigger, physical context) of incumbent work routines upon the introduction of a new IS, the result will be fewer action slips by users, due to these changes providing maximally dissimilar triggers to activation of new IS behaviors.

Proposition 2a: When change agents modify one or more aspects (e.g., task definition, task sequence, timing, event trigger, physical context) of incumbent work routines upon the introduction of a new IS, users will make fewer action slips, because they will have greater ***awareness*** *of their behavioral choices.*

Proposition 2b: When change agents modify one or more aspects (e.g., task definition, task sequence, timing, event trigger, physical context) of incumbent work routines upon the introduction of a new IS, users will make fewer action slips, because they are forced to exercise conscious control over their behavior, thus increasing the ***controllability*** *of incumbent system habits.*

It is critical that the modified work routines achieve a certain threshold of differentiation from the way that they have been performed in the past in order to eliminate action slips. This is because action sequences tend to be complex, with many component schemas, and they also tend to take considerable time to complete. Thus multiple intentions and schemas may be active at any given time. According to Norman (1981),

> the determination of the appropriate triggering conditions for a given schema then becomes a critical factor in the correct performance of an act.…The model provides each schema with a set of specific conditions that are required for it to be triggered. An activated schema can be triggered by current processing activity whenever the situation matches its conditions sufficiently well. Exact match is not required (p. 4).

Norman provides an example of driving home from work, but needing to stop at a fish store:

> Because the fish store route is almost identical to the route required to go home, it is specified as a devia-

> tion from the better-learned, more frequently used home route schema. For this purpose I must set up a new schema, one that is to be triggered at a critical location along the usual path. If the relevant schema for the deviation is not in a sufficiently active state at the critical time for its triggering, it is apt to be missed, and as a result, the more common home route followed: I find myself home, fishless (p. 5).

This example implies that implementing only minor changes to existing work routines may not have the desired effect in relation to increasing user awareness and conscious control over actions, and therefore may not result in the desired elimination of incumbent system habits.

Interfering with the Performance of Scripts for Existing Work Routines. It is not always possible to drastically modify work routines when implementing a new IS. However, it *is* possible to manipulate other contextual variables associated with an existing work routine to encourage behavioral change. One way of interfering with an automated script when work routines cannot be changed is to manipulate the physical context variable, by making physical access changes (modifying how users access the incumbent system). Broadly defined, physical context includes such visual cues to action as the content and configuration of the user interface (Kim et al. 2005; Ortiz de Guinea and Markus 2009). Thus it should be possible to trigger conscious thought, and therefore consciously performed behaviors, by modifying the user interface, if not to eliminate links to the incumbent IS altogether, then at least to make it more difficult for the user to locate and click on them. Leaving programs installed, but removing them from the desktop, Windows Start menu, or portal interface (if one exists) can all accomplish this purpose. Such changes act to disrupt the mental efficiency with which the user can carry out his task, causing him to have to stop and think about how to proceed rather than operating on automatic pilot. Thus we posit:

Proposition 3: When system designers make physical access changes (modifying how users access the incumbent system), users will make fewer action slips, since these changes provide maximally dissimilar triggers to activation of new IS behaviors.

*Proposition 3a: When system designers make physical access changes (modifying how users access the incumbent system), users will make fewer action slips, because they will have greater **awareness** of their behavioral choices.*

*Proposition 3b: When system designers make physical access changes (modifying how users access the incumbent system), users will make fewer action slips, because they are forced to exercise conscious control over their behavior, thus increasing the **controllability** of incumbent system habits.*

*Proposition 3c: When system designers make physical access changes (modifying how users access the incumbent system), users will make fewer action slips, because the **mental efficiency** with which they can access the incumbent system will be decreased.*

While this interference strategy is primarily directed at disrupting incumbent system habits in order to prevent action slips, it can also be used in a slightly different way to facilitate the development of *new* system habits. Specifically, one can manipulate the physical context variable to take advantage of the fact that habitual users will tend to automatically navigate to the same location in the user interface where they had formerly started up the incumbent application, even after the introduction of a new one. Thus a simple act of replacement, such as placing the icon or link for the new system in exactly the same location where the icon or link for the incumbent system used to be, can turn potential action slips into opportunities to habituate use of the new system. Selecting the new system will be just as mentally efficient as selecting the incumbent one used to be. Further, since selection of the new system will occur (at least initially) outside of awareness, it will be more difficult for the individual to control. Thus we posit:

Proposition 4: When system designers minimize physical access changes by simply replacing the incumbent system access point with an access point for the new system, users will be more likely to develop new system habits, since action slips will result in performance of the new behavior.

*Proposition 4a: When system designers minimize physical access changes by simply replacing the incumbent system access point with an access point for the new system, users will be more likely to develop new system habits, due to decreasing **awareness** of selecting the new IS.*

*Proposition 4b: When system designers minimize physical access changes by simply replacing the incumbent system access point with an access point for the new system, users will be more likely to develop new system habits, due to decreasing the **controllability** of selecting the new IS.*

Proposition 4c: When system designers minimize physical access changes by simply replacing the incum-

bent system access point with an access point for the new system, users will be more likely to develop new system habits, due to the increased ***mental efficiency*** *of selecting the new IS.*

Distraction

Distraction techniques for disrupting habitual scripts focus on introducing unexpected states that lead the user to exit the script by pursuing new goals (Schank and Abelson 1977). Distraction can also be accomplished through context manipulation. For example, people who know that they are being watched while they work (social context) tend to become much more aware of what they are doing (Wood et al. 2002). This in turn may make them more likely to pursue a course of action (such as using a new IS) that they know is preferred by the organization and individuals within it whose opinions hold sway for them. Thus one potential distractionary approach to modifying IS habits (i.e., an approach aimed at initiating new usage goals) is to implement some form of *monitoring function*, combined with a *feedback mechanism*, to make users more aware of their behavior (Norman 1981, p. 11). Such monitoring and feedback mechanisms serve to alter the social context variable.

A common yet simple example of changing the social context to disrupt a script and encourage new IS usage goals is implementation of a pop-up message that prompts the user when they habitually click to open the incumbent system. The message might prompt the user as to whether they really want to use the incumbent system or not, suggest or remind them to use the new system instead, or even ask them if they would like to make the new system their default choice going forward. The message could also inform the user of how many times they have ignored the prompt to use the new system in the past, or have a delay/countdown that requires the user to wait before the incumbent system starts up. Such messages force the user to both think about what they are doing and actively respond to the message. If the time delay that is introduced is relatively substantial, or if organizational tracking of user behavior is incorporated into the monitoring/feedback mechanism (with the user aware that their choices are being tracked and presumably viewing noncompliance in a negative fashion), we might also expect them to come to view the incumbent behavior as a less desirable means of achieving work goals. This will impact the intentionality of incumbent system use (negatively) and new system use (positively).[11] We further expect monitoring and feedback to impact incumbent system habits by decreasing the mental efficiency with which a user can complete tasks, and increasing their awareness of their behavior. However, monitoring and feedback in and of itself will not change the fact that the incumbent behavior is difficult to control. We do *not* expect monitoring and feedback to have an immediate impact on decreasing the employee's awareness of their choice of the *new* IS, ability to control that choice, or mental efficiency of that choice. Only satisfactory repetition of that choice over time will bring these things to pass. Thus we posit:

Proposition 5: When system designers implement monitoring and feedback systems in conjunction with the introduction of a new IS, the result will be fewer action slips by users.

Proposition 5a: When system designers implement monitoring and feedback systems in conjunction with the introduction of a new IS, users will make fewer action slips, because they will have greater ***awareness*** *of their behavioral choices.*

Proposition 5b: When system designers implement monitoring and feedback systems in conjunction with the introduction of a new IS, users will make fewer action slips, because the ***mental efficiency*** *with which they can perform incumbent system habits will be decreased.*

Proposition 6: When system designers implement monitoring and feedback systems in conjunction with the introduction of a new IS, this will change the user's association of the incumbent IS versus the new IS for achieving work-related goals.

Proposition 6a: When system designers implement monitoring and feedback systems in conjunction with the introduction of a new IS, users will make fewer action slips, because they will become less likely to associate the incumbent IS with achieving specific work-related goals, thereby weakening ***intentionality*** *in regard to the incumbent IS.*

Proposition 6b: When system designers implement monitoring and feedback systems in conjunction

[11] A more specific, real world example of an organization that has attempted to disrupt undesirable habitual behaviors related to IS use (although not specifically targeting habitual use of a particular *system*) is a private university in the United States that has implemented a monitoring and feedback mechanism to discourage individuals from automatically printing documents when using campus computers. A pop-up window informs each user of how many pages they have already printed from campus computers during the current academic session, and reminds them of their informal (i.e., not currently enforced) quota of 500 pages. This intervention seeks to modify habitual IS user behaviors in accordance with the university's campus wide "greening" initiatives.

with the introduction of a new IS, users will be more likely to develop new system habits, because they will become more likely to associate the new IS with achieving specific work-related goals, thereby strengthening ***intentionality*** *in regard to the new IS.*

Reprogramming Responses: Training-in-Context

User training is viewed as an important organizational intervention for increasing user acceptance and implementation success. Training provides hands-on experience that can change users' attitudes, beliefs, and perceptions of usefulness and ease of use (Agarwal and Prasad 1999), increase their feelings of self-efficacy (Compeau and Higgins 1995; Compeau et al. 1999; Gist et al. 1989), and overcome knowledge barriers, such as a lack of sufficient knowledge of the software application, or of how to use it to perform key business tasks (Olfman et al. 2006; Sharma and Yetton 2007).

However, while providing training for the purpose of increasing self-efficacy and eliminating knowledge barriers is important, engrained IS habits require that we go beyond simply increasing *knowledge* of how to perform a given task or series of tasks, to increasing awareness of all the various *situational triggers* associated with use of the incumbent (and new) system for that task, and reprogramming the *response* to those triggers. The fact that identical (or even sufficiently similar) triggers associated with task sequences can lead to action slips implies that experience obtained during formal training with a new IS should be practiced within the context of an entire task sequence, or at minimum with its associated antecedent trigger. Training an individual to use the new system in a situation where actual situational triggers are in operation may not prevent action slips altogether, but might make them less likely to occur.

One method of accomplishing this (particularly when the situational triggers arise from the actions of other individuals) is through group training, taking into account entire sequences of tasks as work is passed from one individual or group to another (see Figure 2). In fact, recent research on training methods for new systems that are business process oriented in nature (such as collaborative, workflow, and ERP systems) has highlighted the importance of taking task interdependencies with other users into account when training individuals on how to use the system (Olfman et al. 2006).

When new system training is designed around *existing* work routines (i.e., in cases where use of the new IS is embedded within larger, otherwise unchanged, task sequences), it becomes possible to "recondition" the user's response to situational triggers such that they will be more likely to use the new system. This reconditioning takes place in two ways, the first of which focuses on disrupting dimensions of the habit construct in regard to use of the *incumbent* system, and the second of which focuses on strengthening the dimensions of the habit construct in regard to use of the *new* system.

By training users in the context of real task sequences (whether individual or multi-actor in nature), users will develop a greater awareness of situational triggers. This increased awareness will in turn give them the ability to exercise more conscious control over their choice of which IS to use to complete a given task, therefore leading to fewer action slips. Such "training-in-context" is an extension of the concept of training on collaborative task knowledge and goes beyond the goals of increasing self-efficacy and overcoming knowledge barriers, to include disruption of engrained IS habits. Thus we propose:

Proposition 7: When change agents provide users with training-in-context (i.e., training within the context of actual work routines and situational triggers), users will make fewer action slips as compared to receiving self-efficacy and knowledge-based training outside the context of these routines, because training-in-context will sensitize users to the situational triggers to IS use.

Proposition 7a: When change agents provide users with training-in-context (i.e., training within the context of actual work routines and situational triggers), users will make fewer action slips as compared to receiving self-efficacy and knowledge-based training outside the context of these routines, because training-in-context will increase their ***awareness*** *of habitual selection of the incumbent IS when completing work tasks.*

Proposition 7b: When change agents provide users with training-in-context (i.e., training within the context of actual work routines and situational triggers), users will make fewer action slips as compared to receiving self-efficacy and knowledge-based training outside the context of these routines, because training-in-context will increase their ability to ***control*** *habitual selection of the incumbent IS when completing work tasks.*

While the focus of this training strategy is primarily on eliminating action slips by making users more cognizant of situational triggers leading to incumbent system use, it can also reprogram the situation–goal–behavior link. Specifically, training within the context of existing work routines helps the user to associate the new system with specific work-related

goals/tasks and subgoals/subtasks.[12] This will impact the intentionality of incumbent system use (negatively) and new system use (positively), facilitating the replacement of incumbent system habits with new system habits. Furthermore, training within real-world work situations gives the user practice at using the new system that, if repeated frequently enough in the training environment, will make using the new system for specific tasks more natural and "behaviorally efficient."[13] This "behavioral efficiency" could eventually lead to mental efficiency as well. However, in most training environments, we would not expect enough repetition to occur for the habit dimension of mental efficiency to become truly developed at that time, making the link between contextual training and mental efficiency indirect at best. Thus we expect training-in-context to have a direct positive impact on the development of *new* habits primarily through goal associations, leading us to posit the following:

Proposition 8: When change agents provide users with training-in-context (i.e., training within the context of actual work routines and situational triggers), users will make fewer action slips as compared to receiving self-efficacy and knowledge-based training outside the context of these routines, because this will change the user's association of the incumbent IS versus the new IS for achieving work-related goals.

*Proposition 8a: When change agents provide users with training-in-context (i.e., training within the context of actual work routines and situational triggers), users will make fewer action slips as compared to receiving self-efficacy and knowledge-based training outside the context of these routines, because training-in-context will make them less likely to associate the incumbent IS with achieving specific work-related goals, thereby weakening **intentionality** in regard to the incumbent IS.*

*Proposition 8b: When change agents provide users with training-in-context (i.e., training within the context of actual work routines and situational triggers), users will make fewer action slips as compared to receiving self-efficacy and knowledge-based training outside the context of these routines, because training-in-context will make them more likely to associate the new IS with achieving specific work-related goals, thereby strengthening **intentionality** in regard to the new IS.*

Counteracting Antecedent States: Performance Goal Suspension

Antecedent states such as anxiety, stress, fatigue, and a need for speed of execution in performing tasks may all trigger the automatic use of incumbent systems (Belk 1975; Wood and Quinn 2004). Consciously directed behaviors have been shown to be associated with higher levels of stress than habitual behaviors, and fatigue may inhibit one's ability to override incumbent system habits and consciously choose a new system to perform a task over the existing system (see Wood et al. 2002). Thus if an employee is feeling overwhelmed, stressed, or under time pressure to complete a given task, he or she may automatically revert back to using a system that lowers stress or promises faster task completion (i.e., revert back to the incumbent system). This would be the case in resource constrained environments where employees are already spread very thin. In addition, work-related stress is particularly likely to occur shortly after the introduction of a new system, when the system may still be unfamiliar, and completion of even simple tasks may take longer. Modified work routines associated with the new system may also lead to stress.

The change management literature suggests that employee stress can be reduced through managerial strategies that provide the employee with empathy, support, and slack resources. Incremental change is also less likely to be traumatic to the employee (Armenakis and Bedeian 1999; Kettinger and Grover 1995), implying that timing the switch to the new system is important (both in avoiding multiple changes occurring at once, and in taking enough time to roll out big systems) (Kemppainen 2004). Flexible milestones are generally preferred during the implementation phase as well (Stoddard and Jarvenpaa 1995). All of this implies that reasonable and attainable performance goals should be set while end users get used to the changes brought on by the new system. This will reduce employee stress, thereby setting the stage for them to be more aware of contextual triggers to habitual incumbent system use, so that they can better control these habits. Thus we posit:

Proposition 9: When managers temporarily suspend or relax performance goals after the introduction of a new IS, users will make fewer action slips, because the reduction

[12]See Appendix B for a detailed discussion of goal and task hierarchies. This association can also be encouraged through the provision of training designed to impart what Olfman et al. (2006) refer to as "tool conceptual" and "motivational" knowledge; however, a discussion of such training techniques is beyond the scope of our current study.

[13]See Gupta and Bostrom 2006 for a more detailed discussion of behavioral efficiency from the perspective of enactive learning.

in stress and fatigue will make users less likely to slip back into old behavioral patterns.

Proposition 9a: When managers temporarily suspend or relax performance goals after the introduction of a new IS, users will make fewer action slips, because the reduction in stress and fatigue will cause their ***awareness*** *of triggers for habitual IS choices to increase.*

Proposition 9b: When managers temporarily suspend or relax performance goals after the introduction of a new IS, users will make fewer action slips, because the reduction in stress and fatigue will increase ***controllability*** *in regard to habitual IS choices.*

Stabilizing Work Routines to Encourage New Habit Development

In the previous section, we discussed how modifying contextual variables associated with incumbent work routines can reduce action slips, and thereby disrupt incumbent system habits. In this section, we elaborate on how stabilizing contextual variables associated with the newly modified work routines can facilitate the development of new system habits. We begin by discussing how the temporal context of new work routines can be stabilized through the implementation of SOPs for *multi-actor* routines. Next, we discuss how the task definition of new work routines can be stabilized through the implementation of SOPs for *individual* level routines. Then, we discuss how the physical context of new work routines can be stabilized by maintaining stability of the user interface configuration. We close this section by discussing the importance of combining intervention strategies to successfully disrupt incumbent system habits and encourage development of new system habits.

Stabilizing Temporal Context: SOPs for Multi-Actor Routines

One way that organizations can encourage the development of desired IS habits is by implementing SOPs for multi-actor work routines that specify the use of a particular IS in response to certain external (to the individual's work routine) business events. This will lead employees to associate the use of that IS with achieving specific work-related goals whenever the external event is encountered, thereby impacting the intentionality dimension of habit. With satisfactory repetition of the same IS choice over time in response to the temporal trigger (representing satisfactory fulfillment of the work goal associated with that trigger), the act of choosing the IS will gradually become more mentally efficient, and eventually occur outside the user's awareness (or at minimum, the users will no longer be aware of their interpretation of the temporal trigger for that choice). As a consequence, the automatic choice of that IS will also become more difficult to control. Thus we posit that the implementation of SOPs for multi-actor work routines will strengthen the intentionality dimension of new system habits, whereas the user's repeated execution, over time, of the steps spelled out in the SOPs will lead to decreased awareness, decreased controllability, and increased mental efficiency.

Proposition 10: When managers implement an SOP for a multi-actor work routine that specifies the use of a particular IS in response to a specific external event (temporal IS trigger), users will develop a habit of selecting that IS in response to the event, because its use is associated with achieving specific work-related goals, thus strengthening ***intentionality****.*

Proposition 11: When users repeatedly follow an SOP that specifies selection of a particular IS in response to a specific external business event, they will develop a habit of selecting that IS in response to that event.

Proposition 11a: When users repeatedly follow an SOP that specifies selection of a particular IS in response to a specific external business event, they will develop a habit of selecting that IS in response to that event, because their ***awareness*** *of individual choices made in carrying out the SOP will be decreased.*

Proposition 11b: When users repeatedly follow an SOP that specifies selection of a particular IS in response to a specific external business event, they will develop a habit of selecting that IS in response to that event, because the performance of the SOP will hinder ***controllability*** *of individual choices made in carrying it out.*

Proposition 11c: When users repeatedly follow an SOP that specifies selection of a particular IS in response to a specific external business event, they will develop a habit of selecting that IS in response to that event, because they are able to complete the entire task sequence associated with the SOP with ***mental efficiency****.*

Stabilizing Task Definition: SOPs for Individual Level Routines

We have previously discussed how the events triggering IS habits in an individual level work routine are the antecedent steps in the individual level task sequence. These steps are often completed in rapid succession, and users may or may not be consciously aware of every action they are taking, or every keystroke that they are entering, while performing the overall task. However, once a given sequence of steps is committed to memory and performed on an ongoing basis, the individual steps embedded in that larger sequence will be carried out efficiently and without conscious thought, and will be difficult to control. Therefore, organizations can encourage the development of IS habits by implementing SOPs that specify the exact sequence of steps to follow in completing individual level work routines. This would include specifying the use of a particular IS to complete certain steps in the task sequence. As employees learn the precise set of steps to follow, they will eventually complete the entire task sequence by habit. Thus we posit that the implementation of SOPs for individual level work routines will strengthen the intentionality dimension of new system habits, whereas the user's repeated execution, over time, of the steps spelled out in the SOPs will lead to decreased awareness, decreased controllability, and increased mental efficiency.

Proposition 12: When managers implement an SOP for an individual level task sequence that includes use of a specific IS as part of the sequence, users will develop a habit of selecting that IS at the same point in the task sequence, because the task definition will lead the user to associate the use of the IS with achieving specific work-related goals, thus strengthening intentionality.

Proposition 13: When users repeatedly follow an SOP to execute an individual level task sequence that includes use of a specific IS as part of the sequence, they will develop a habit of selecting that IS at the same point in the task sequence, because the task sequence creates a stable performance environment with the preceding step in the sequence serving as a trigger to habit performance.

*Proposition 13a: When users repeatedly follow an SOP to execute an individual level task sequence that includes use of a specific IS as part of the sequence, they will develop a habit of selecting that IS at the same point in the task sequence, because the performance of the task sequence will decrease their **awareness** of individual choices made in carrying it out.*

*Proposition 13b: When users repeatedly follow an SOP to execute an individual level task sequence that includes use of a specific IS as part of the sequence, they will develop a habit of selecting that IS at the same point in the task sequence, because the performance of the task sequence will hinder **controllability** of individual choices made in carrying it out.*

*Proposition 13c: When users repeatedly follow an SOP to execute an individual level task sequence that includes use of a specific IS as part of the sequence, they will develop a habit of selecting that IS at the same point in the task sequence, because it enables them to complete the entire task sequence with **mental efficiency**.*

Stabilizing Physical Context: Maintaining Stability of the User Interface Configuration

An individual does not need to consciously think about the location of the web browser icon on their desktop, of a particular application in the Windows Programs list, or of the weather section on a news web site. Rather, over time, they simply click on the icon, browse to the application name in the Programs list, or scroll down the web page to the weather report, without ever needing to think about it.[14] Such behaviors will likely continue habitually until the "launch point" for the application is relocated, removed, or modified in some other way (see Kim et al. 2005; Ortiz de Guinea and Markus 2009). Thus, when organizations want to encourage habitual choice of a particular IS, it is very important that the physical user interface configuration remains as consistent as possible over time. We expect stability of the user interface configuration to directly impact the mental efficiency dimension of habit, since the user will not have to devote any thought to the act of selecting the IS. We do not expect stability of the user interface configuration to directly impact the habit dimensions of awareness or controllability. Only satisfactory repetition of the behavioral choice over time will reduce one's awareness of and ability to control IS selection. Thus we posit:

*Proposition 14: When system designers embed use of a particular IS within a stable (unchanging) user interface configuration, users will develop a habit of selecting that IS when presented with that same interface in the future, because it enables them to perform tasks with **mental efficiency**.*

[14]This represents mental efficiency and not lack of awareness, since the habit dimension of awareness relates to whether the individual is aware of the actual trigger to perform a habit or, alternatively, is aware of the interpretation or impact of that trigger.

The Importance of Combining Intervention Strategies

Any given method of encouraging behavioral change, when used as the *sole* method of promoting such change, tends to possess weaknesses. This is in part because, as we have demonstrated through our various propositions, each contextual variable and organizational intervention strategy only directly addresses particular incumbent or new system habit dimensions. Further, according to Wood and Quinn (2004, p. 46), some habits are "likely tied to specific aspects of context," whereas others are "likely tied to configurations of cues and thus depend on combinations of locations, times, interaction partners, and moods." When a relevant feature of the context is changed, people may ask themselves, "How can I still meet my goal given the new context?" Thus, while changing the situational cues may help in disrupting habits, if enough similarity remains, the behavior in question may continue to be practiced. It is possible that naturally occurring shifts in context may operate much differently than strategic decisions to make contextual changes that will impact behavioral cues.

For these reasons, habit researchers today have suggested that interventions to encourage behavioral change should occur at multiple levels within the organization as well as at different stages of the implementation process, and should target both habits themselves and individuals' conscious attitudes and beliefs related to these habits. At the macro level of analysis, organizational structure and norm-based interventions[15] seek to both discourage incumbent habit performance and create an environment conducive to the formation of new habits. Such interventions (which may include formal policies and incentive programs) target social norms and structural support for the desired behavior, making it easier for employees to use the new system, and leading to changes in attitudes which will help to encourage and cement their intentions to make a change (Verplanken and Wood 2006).

At the individual level of analysis, *pre-trigger performance context interventions*[16] include both *naturally occurring* context changes (such as those resulting from new work routines accompanying the introduction of a new IS) and context changes that are *intentionally planned* for the purpose of disrupting individual habit performance. As we have discussed previously, such interventions aim to eliminate or alter situational triggers, or exploit natural context changes, such that incumbent habits are never cued to begin with (Wood and Neal 2007). *Post-trigger interventions*, on the other hand, seek to inhibit or suppress habitual responses to situational triggers (Wood and Neal 2007). Interventions discussed in this paper that fall in this category include monitoring and feedback as well as interventions designed to reduce the stress and fatigue that make habit performance more likely.

Finally, individual level interventions categorized as *downstream* in Verplanken and Wood (2006) provide education and information to individual users, and are aimed at increasing self-efficacy, changing attitudes and intentions, and motivating self-control. In the IS domain, such interventions would focus on providing information and training in order to impact the user's decision making process concerning the new technology. As we have discussed, such training should ideally take place within the context of actual work routines in order to encourage reprogramming of behavior in the real world. However, since strongly engrained habits are activated automatically outside awareness, curtail information search, and tend to persist without a noticeable change in context, these types of interventions alone are not enough to disrupt IS habits, and should be combined with either naturally occurring or planned context changes to "provide informational input at points when [everyday] habits are vulnerable to change" (Verplanken and Wood 2006, p. 1).

Conclusions and Implications for IS Research

Many IS usage behaviors performed in a work environment are performed in a habitual fashion, meaning that they are performed automatically, outside awareness, and occasionally not subject to conscious control. As we show in our synthesis of prior IS literature on habit and technology acceptance, habit plays both a positive and negative role in IS use. While habit facilitates the practice of routine behaviors (and thus increases the user's behavioral and mental efficiency when performing work tasks), it also serves to inhibit innovative usage behaviors. Habit may prevent users from adopting and using new information systems, or it may prevent them from exploring unused system features that might provide individual or organizational benefits such as increased productivity.

In order to properly understand IS habits and how they can be changed, we must study them within the context of the larger task sequences in which they are embedded. Often entire sequences of activities making up common work routines are practiced habitually. Thus it is important to implement inter-

[15]Verplanken and Wood (2006) refer to these as "upstream" interventions.

[16]We use the terms *pre-trigger* and *post-trigger* here in place of Wood and Neal's (2007) terminology of *upstream* and *downstream* to represent the same concepts (regarding *when* the intervention occurs in relation to the situational cues of habitual behavior), to avoid confusion with the upstream (organizational level) and downstream (individual level) interventions discussed in Verplanken and Wood (2006).

ventions that not only look at the immediate behavior in question, but that change the various work routines, contextual variables, and other immediate antecedents that are triggering the undesired behavior. Various ways of disrupting habits have been suggested in the psychology, marketing, and organizational literature. We have argued that these interventions need to take place at multiple stages in the process of implementing a new IS. These include changing user attitudes toward the new IS, reprogramming their subconscious behavioral processes through appropriate training methods which take into account the embeddedness of IS use within larger task sequences, setting up barriers to make it more difficult to continue practicing undesirable usage behaviors, and, finally, providing users with monitoring and feedback that will encourage their continued conscious performance of tasks involving IS use, until they reach a place where the desired IS behavior has itself become habituated.

To date, studies on IS habit have focused on relatively simple behaviors that take place outside of an organizational environment, and that are studied over a relatively short period of time. We encourage testing of the propositions presented here in an organizational environment, focusing on IS habits that are embedded within simple to complex work routines and task sequences. We further argue for the importance of examining IS habits, and the various intervention strategies suggested for modifying them, via longitudinal studies, where the development of work-related IS habits and the success of organizational efforts to disrupt incumbent habits can be properly examined.

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THEORY AND REVIEW

THE EMBEDDEDNESS OF INFORMATION SYSTEMS HABITS IN ORGANIZATIONAL AND INDIVIDUAL LEVEL ROUTINES: DEVELOPMENT AND DISRUPTION

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Appendix A

Representative Habit Definitions from Prior Research

Table A1. Representative Habit Definitions Used in Research from Other Disciplines

Theoretical Definition	Example Studies	Behavioral Context
GOAL-DIRECTED AUTOMATIC BEHAVIOR: "learned sequences of acts that have become automatic responses to situations, and are functional in obtaining certain goals or desired effects" (Verplanken and Aarts 1999, p. 104) "habits are represented as links between a goal and actions that are instrumental in attaining this goal" (Aarts and Dijksterhuis 2000a, p. 54); "these associations are shaped by frequent performance of actions and require the activation of the goal to become manifest" (Aarts and Dijksterhuis 2000a, p. 60)	Aarts and Dijksterhuis (2000a, 2000b) Aarts et al. (1997a) Aarts et al. (1998) Verplanken and Aarts (1999) Verplanken et al. (1997) Verplanken et al. (1998)	Travel mode choice
	Aarts et al. (1997a)	Physical exercise
	van Empelen and Kok (2006)	Condom use
	Honkanen et al. (2005)	Eating seafood
	Orbell et al. (2001)	Ecstasy use
	Sheeran et al. (2005)	Social drinking
	Verplanken and Orbell (2003)	Four studies covering a wide range of behaviors representing both daily and weekly habits
	Verplanken (2006), study 2	Negative thinking about oneself
	Verplanken (2006) study 3	Underlining words in a novel

Table A1. Representative Habit Definitions Used in Research from Other Disciplines (Continued)

Theoretical Definition	Example Studies	Behavioral Context
BEHAVIOR THAT IS REPEATED IN A STABLE CONTEXT (*importance of goal-directedness is discounted*): "tendencies to repeat responses given a stable supporting context" (Ouellette and Wood 1998, p. 55) "behavioral dispositions to repeat well-practiced actions given recurring circumstances" (Wood et al. 2005, p. 918)	Ouellette and Wood (1998)	Meta-analysis of prior
	Wood et al. (2005)	Exercising, newspaper reading, and TV watching by students
	Wood et al. (2002)	Student participants kept a diary of all behaviors performed in their daily lives
	Thøgersen (2006)	Travel mode choice
QUICK, ACCURATE, AND EFFORTLESS BEHAVIOR: "practice automatizes voluntary acts so that they come to be performed quickly, easily, and with minimal focal attention" (Kimble and Perlmuter 1970, in Wood and Quinn 2004, p. 6) "A habit is a behavior that can be performed quickly, accurately, and effortlessly" (Carvajal 2002, p. 10)	Kimble and Perlmuter (1970)	Conditioning simple responses (finger press, eye blink) to a light or tone
	Carvajal (2002)	Sorting documents with key words into separate piles
FREQUENTLY PRACTICED BEHAVIOR THAT IS AUTOMATICALLY TRIGGERED BY STIMULUS CUES (*no explicit mention of goal-directedness or context stability*): "situation-behaviour sequences that are or have become automatic, so that they occur without self-instruction" (Triandis 1980, p. 204) Habit is "automatically activated by environmental cues without deliberate reflection" (Bamberg 2006, p. 823) "behaviour comes under the control of stimulus cues and is performed automatically with little effort or conscious awareness….Habits are performed frequently, but they are also performed automatically, efficiently, and with little effort or conscious awareness" (Norman and Conner 2006, pp. 58, 66)	Bamberg (2006)	Travel mode choice
	Norman and Conner (2006)	Binge drinking
	Ronis et al. (1989)	Health-related behaviors
	Saba and diNatale (1998, 1999) Saba et al. (1988) Saba et al. (2000)	Consumption of 9 types of fat-containing food products
	Towler and Shepherd (1991-1992)	Eating chips
	Triandis (1980)	
	Verplanken (2004)	Nurses chatting at work
ROUTINIZED BEHAVIOR: Focus of the study was on task routinization, which was defined as automaticity in behavior	Ohly et al. (2006)	Employees at a high-tech firm provided lists of their frequently performed tasks (e.g., developing software, dealing with documentation, handling emails, interacting with subordinates, attending meetings, dealing with customers)

Table A1. Representative Habit Definitions Used in Research from Other Disciplines (Continued)

Theoretical Definition	Example Studies	Behavioral Context
WELL-LEARNED BEHAVIOR / MENTAL STATE: Habit implies behavior that is learned well from repeated past performances: "habit is a mental state that is conceptually distinct from previous behavior. A person could perform a behavior many times and yet not think of herself as being in the habit, or she may perform a behavior only a few times and nevertheless consider the behavior to be habitual" (Triandis 1980, p. 386)	Trafimow (2000)	Condom use

Table A2. Representative Habit Definitions Used in Recent IS Research

Theoretical Definition	Example Studies	Behavioral Context
AUTOMATIC BEHAVIORAL TENDENCIES THAT RESULT FROM LEARNING: "the extent to which people tend to perform behaviors (use IS) automatically because of learning" (Limayem et al. 2007, p. 705) "the automatic behavior tendencies developed during the past history of the individual such that a particular situation/stimuli will elicit the behavior even when the individual does not instruct him or herself to perform the act" (Limayem et al. 2001, p. 277)	Limayem et al. (2007)	World Wide Web
	Limayem and Hirt (2003), Limayem et al. (2001)	Student use of WebBoard
	Khalifa et al. (2002)	Online grocery shopping
GOAL-DIRECTED AUTOMATIC BEHAVIOR: "the extent to which using a particular IS has become automatic in response to particular situations" (Limayem et al. 2003b, p. 2) "goal-directed automatic responses to system use when encountering the same situation" (Wu and Kuo 2008, p. 52)	Kim et al. (2005)	Website
	Limayem et al. (2003b)	World Wide Web (WWW)
	Cheung and Limayem (2005a, 2005b) Limayem et al. (2003a)	Student use of Blackboard
	Wu and Kuo (2008)	Google searches
BEHAVIORAL PREFERENCES: "previous usage preference of an IT" (Gefen 2003, p. 2)	Gefen (2003)	Online CD / book vendors
BEHAVIOR THAT OCCURS OUTSIDE CONSCIOUS AWARENESS: "a repeated behavioral pattern that automatically occurs outside conscious awareness"; "habit is made possible by a cognitive representation that links a situational cue and an action" (Kim and Malhotra 2005, p. 746)	Kim and Malhotra (2005)	Websites
	Kim and Malhotra (2005)	Web based information system

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Appendix B

Goal Hierarchies, Task Hierarchies, and IS Habit Disruption Strategies

We subscribe to the view of habits as a form of goal-directed automaticity that can be triggered by various features of one's performance context. Thus, some specific examples of the relationship between situational features, goal hierarchies, task hierarchies, and habits may be helpful for understanding how work-related IS habits operate in an organizational context, and how they can be disrupted.

In a study of consumer goal setting and goal striving, Bagozzi and Dholakia (1999) proposed a hierarchy of goals using the example of weight loss. While an individual's focal goal (*what* they want) is to lose weight, superordinate goals (*why* they want it, e.g., to live longer or to look and feel good) as well as subordinate goals (*how* they will achieve it, e.g., through exercise and dieting) are also present. While any of the goals in the goal hierarchy may be activated by a situational feature (e.g., viewing oneself in the mirror, walking past the refrigerator or exercise bike), it is the behavior associated with the *subordinate* goal (which originated from action planning) that actually has the potential to habituate over time.

We draw from Bagozzi and Dholakia's work to provide two examples that relate situational features and goal hierarchies to IS habits within organizations (Table B1). Notice that in both examples, the individual is aware of the situational feature or stimulus, but they are not necessarily aware of activation of all the various goals in the hierarchy or their choice of the action response. This is particularly true if either scenario has occurred frequently enough in the past for the response to become habituated.

Table B1. Situational Features and Goal Hierarchies			
Situational Feature	**Focal Goal ("*What* do you want?")**	**Superordinate Goal ("*Why* do you want to achieve the focal goal?")**	**Subordinate Goal ("*How* is the focal goal achieved?")**
System not working	Get it fixed	Be able to get work done	Call, email, or log problem in a tracking system
Business event occurs (e.g., a drop in sales of a certain product)	Determine the reason and get it corrected	Improve the company's bottom line or competitive position	Use a particular IS to drill into data, use a particular communication tool to contact and discuss the problem with others

It is important to determine the goal of a particular instance of IS use in order to break the link between the goal and the IS behavior, because goals are very closely associated with the contextual variable of task definition (Table 1). Since habitual work routines can be viewed as script or task hierarchies, a lengthy or complex work routine will generally have a single overarching business goal that it seeks to accomplish. However, smaller goals may also be associated with individual steps in the task sequence (Schank and Abelson 1977). These subtasks and subgoals are in turn associated with the business events and task definitions that make up the behavioral context. It is likely that these smaller subgoals actually direct much habitual IS behavior, and as such may be activated either consciously or subconsciously. By correctly identifying the goal or subgoal associated with a particular instance of habitual IS use, appropriate intervention strategies can be devised that break the goal–behavior link at the corresponding location in the task hierarchy.

Referring to the script disruption techniques shown in Figure 4 may be helpful here. If the organization is replacing an entire task sequence with a markedly different, tightly coupled, new one, the relevant goal most likely resides at the top level of the hierarchy, and one should simply need to break the link at the top level, such that the old sequence never has an opportunity to begin. Given the drastic difference between the old and new sequences, all triggers further down the hierarchy will be automatically bypassed. On the other hand, if the old and new task sequences are similar or share steps, or if the organizational routine is loosely coupled, one must pay much more attention to the exact point where the individual's IS use is triggered and seek to break that link. This is particularly true if the habitual use occurs at one of the work handoff points in a multi-actor organizational routine. Here, the top-level goal remains unchanged, and the subgoals become relevant. The task sequence has a much greater potential of being carried through to completion uninterrupted, unless action is taken to break the link at the subgoal/subtask level. Thus the objective of the intervention is to prevent this from happening.

Determining the exact goal that directs habit performance is made more complicated by the fact that pursued goals are often subconscious in nature, meaning that a person may not be able to articulate clearly her actual goal for performing a habitual behavior (see Cohen and Bacdayan 1994). In fact, she may never have even thought about it, but rather simply learned how to follow the standard operating procedure for a particular task. While all scripts are theorized to have their basis in goal attainment, over time (and through constant repetition) they begin to require less and less of the individual's attention to the point that the person may no longer even be aware of beginning the behavior. Thus, habitual IS use may continue even when the associated goal is no longer present (Wood and Quinn 2004). For example, a person may generate a particular report every day which no longer has any legitimate business purpose, simply because they always have. Thus we recognize that there are times where the exact goal cannot be elucidated; in such cases, interventions must focus on other contextual variables, including visibly observable business events that are subconsciously triggering the behavior.

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Appendix C

General Versus Specific IS Habits

Even though a given system may offer different features, habits initially develop in relation to choosing that system (or particular features of that system) for a given task, and not necessarily for all features and all tasks. However, while individual habits are task-specific, Limayem et al.'s (2007) introduction of the IS habit antecedent of "comprehensiveness of use" indicates that it is possible that the wider the range of tasks a particular system supports and the more habituated choice of that system has become for each individual task, the stronger the habit toward choosing the system *overall*, across *all* tasks.

This is similar to the way in which computer self-efficacy has been conceptualized at both the general and task-specific levels (see Marakas et al. 1998). Task-specific computer self-efficacy exists when an individual feels capable of performing a specific task using a computer, and is further associated with a specific computing environment and type of application (e.g., word processor, spreadsheet, database). General computer self-efficacy, on the other hand, exists when that individual feels capable of using a computer across a number of different application domains (Marakas et al. 1998). We draw from Marakas et al.'s conceptualization of the multiple levels of self-efficacy to demonstrate the relationship between task-specific and general IS habits and IS usage in Figure C1.

We can see from the left-hand side of this figure that many different tasks can be performed using a particular IS. Over time, the choice of that IS to perform some or all of these tasks may become habituated. If the set of tasks for which the system is habitually selected is large enough (in relation to all possible tasks that can be performed with that system), then a general system habit may develop. Just as each task-specific habit will predict future use of the system for that task, so too will a general system habit predict general (overall) use of that system in the future.

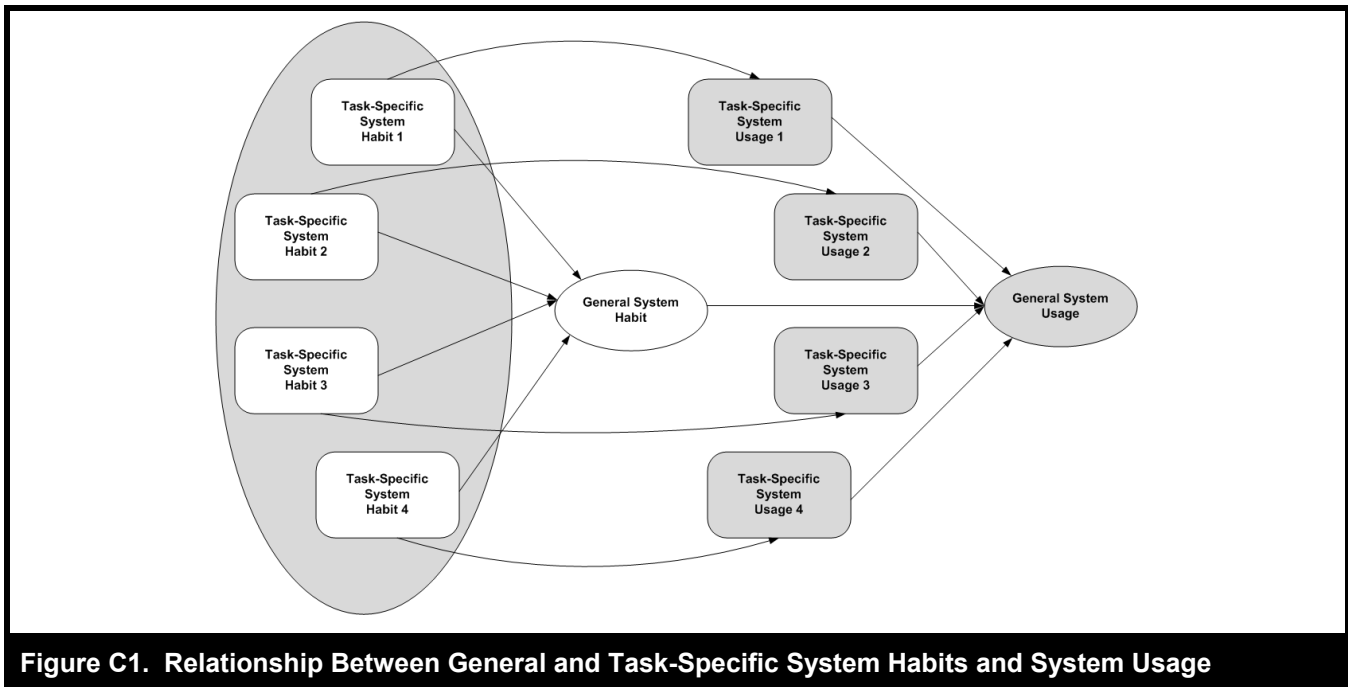

Figure C1. Relationship Between General and Task-Specific System Habits and System Usage

References

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