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ABSTRACT

This paper proposes a process model for habit formation in IS post-adoption. On the basis of extant literature (in IS and other fields), we provide insights into five important constructs that play a role in the formation of IS-use habits: satisfaction, reinforcement, frequency, extent of use, and stability in context. Our proposed model is dynamic in nature and highlights the relative roles of habit and intention as antecedents of IS post-adoption use. The proposed model was developed in three phases. Phase I explains the initial interaction of users with the system, which may pave the way to habit formation. Phase II sheds light on the actual development of habits and highlights the balance between habits and intention as antecedents of IS use. Phase III provides insights on how a habit can crystallize. The paper closes with a discussion of implications for researchers and practitioners.

Keywords

Habit formation, IS post-adoption, IS continuance use, intention, habit.

INTRODUCTION

Compared to the numerous information systems (IS) adoption models proposed in the literature (Davis, 1989; Venkatesh and Davis, 2000; Venkatesh, Davis and Morris, 2007), post-adoption phenomena have received less attention. Still, for an IS implementation to be considered "successful," it is important that users continue to use the system beyond initial adoption (Cheung and Limayem, 2005; Limayem, Hirt and Cheung, 2007). It has been argued that models of IS use such as TAM (Davis, 1989) cannot explain continuance of use or the lack thereof (Bhattacherjee, 2001). Recently there has been growing interest in information technology (IT) post-adoption behaviors (Hong, Thong and Tam, 2006; Jasperson, Carter and Zmud, 2005; Ortiz de Guinea and Markus, 2009; Limayem and Cheung, 2008).

Past research has generally found different set of factors influencing IS post-adoption. While some authors have kept "intention" as the sole predictor of IS post-adoption behaviors (Bhattacherjee, 2001; Saga and Zmud, 1993), others have introduced "habit" as an antecedent of IT post-adoption usage (Limayem et al. 2007; Ortiz de Guinea and Markus, 2009). Even though the role of habits in IS post-adoption has recently received some attention, the exact nature of the process by which habits are formed has remained unexplored, and the relationships between habit, intention and IS use are poorly understood. Understanding this process is crucial as it will provide a roadmap on how to promote and foster new and more useful habits.

The objective of this paper is first to introduce the key factors that play a role in the IS habit formation process. Second, it will develop a model that explains the process by which an IS habit emerges, takes shape, and then crystallizes. To do so, we review IS and non-IS literature to identify the actual nature of habit and we propose a three-stage process model to show how IS usage habits develop.

This study makes several contributions. First, it identifies constructs that play a role in IS habit formation, using literature from IS and other disciplines. Second, it departs from extant literature, which has taken a variance-based approach to post-adoptive behaviors (Limayem et al. 2007; Jasperson et al., 2005; Bhattacherjee and Premkumar, 2004), by presenting a process model of IS habit formation. Finally, by answering the question of how habits are formed, our model contributes to an understanding of how users respond to IS implementation, and may contribute to the successful implementation of IS.

LITERATURE REVIEW

IS Post-Adoption

IS post- adoptive use has gained significant attention in the past decade. Most researchers have argued that it is not simply a recurrence of initial use (Limayem et al. 2007). Bhattacherjee (2001) theorized IS continuance by showing how satisfaction with past IS use influences continued IS use, and demonstrated that there is a substantial difference between initial and continued IS use. With time, IT use can intensify, diminish, become routinized or be prevented due to changes in contextual factors. This idea has been used to explain how user's attitudes may alter or remain unchanged with time, which in turn can change or reinforce subsequent IT-usage behavior. For example, Bhattacherjee and Premkumar (2004) showed how the role of beliefs and attitudes as key drivers of IT usage transforms over time, and explained the transition from initial intention to use to a continuance intention. Ortiz de Guinea and Markus (2009) proposed three key pillars for continued IT use. First, such use is driven by conscious intentions resulting from a logical decision-making process that embeds belief, expectation, reflection on past experience, etc. Second, emotion, beyond cognition, is an important factor in the continued use intention. Third, in stable contexts, continued IT use becomes habitual over time, which means that well-learned actions may be activated by contextual factors, and may recur without attentive intention (Ortiz de Guinea and Markus 2009).

Some researchers have focused on this notion of "habit," challenging the role of intention as a major predictor of behavior when users engage in routinized work (Limayem et al. 2007; Jasperson et al. 2005). Limayem, Hirt, and Chin (2001) suggested the equally important role of habits in explaining usage, and proposed a model that showed the effect of both intention and habit on IS behavior; they even argued that in some situations intention will have no impact. In the same vein, Jasperson et al. (2005) emphasized that along with any repetitive behavior, cognitive processing disappears over time and results in a routinized behavior. Substantial empirical evidence supports a direct relationship between past behavior and intentions regarding future behavior (Limayem and Hirt, 2003; Limayem and Cheung 2008; Limayem et al. 2007). Initially, users are actively involved in cognitive processing and decision making. Repetition of such behavior creates a mental pattern that helps users act with less cognition. This is why Limayem et al. (2007) proposed habit as a moderating variable on the relationship between intentions and IS continuance behavior; Ortiz de Guinea and Markus (2009) even described habit as a direct driver of continued IS use.

Habit Conceptualization

Habits have been studied from two different perspectives. In some studies, habit is defined along with behaviorist approaches, typically providing a "mechanistic" view of behavioral responses (Aarts and Dijksterhuis, 2000). This means that a habit mainly operates without intervention of mental processes; it just emerges based on the frequency of a behavior. As the same action repeats frequently, it becomes habitual and does not require triggers such as reasoning or cognitive thinking (El-Khatib and Barki, 2009). In this view, habit is linked to "automaticity." Such studies (mostly in psychology, e.g. Bagozzi and Warshaw (1990)) are based on measures of self-reported frequency of past behavior (Ouellette and Wood, 1998). In IS, some studies have taken this narrow view of habit and measured habits only by frequency (Bergeron, Raymond and Rivard, (1995)).

The second perspective comes from studies that examined habits from a "humanistic" view, defining habit as a conscious-related activity. Here, habit is recognized as a mindset that triggers repetitive activity. This is different from a repeated behavior. Indeed, in theses cases, habit develops through continuous activation and recurrence toward a defined task (Bargh and Gollwitzer, 1994). Bargh (1994) classified automatic responses into preconscious activities (requiring only notification of the presence of triggers), post-conscious activities (requiring recent conscious processing) and goal-dependent activities (only occurring with the person's consent and intent). IS-usage habits belong to the last category; while the task has a goal, the process is still less guided by conscious attitudes and intentions.

In this study, we adopt Limayem et al.'s definition of IS-use habits as "the extent to which people tend to perform behaviors (use IS) automatically because of learning" (2007:705). Table 1 provides a few examples of different habit conceptualizations according to the mechanistic and humanistic views.

	In Psychology	In IS	Definition
Mechanistic view	(Ajzen, 1991), (Bagozzi and Warshaw, 1990)	(Bergeron et al. 1995), (Gefen, 2003)	Habit is conceptualized as past behavior and measured in terms of frequency of behavior.
Humanistic view	(Verplanken, Aarts, and Van Knippenberg, 1997), (Bargh, 2002)	(Limayem et al, 2007), (Kim and Malhotra 2005)	Habits comprise a goal-directed type of automaticity, which may be consciously instigated because of learning or a cognitive representation that links a situational cue and an action.

Table 1: Concept-centric Definitions of Habit

Habit Formation

Although extant IS research has shed light on the construct of habit and its characteristics, the process of habit formation has received little theoretical or empirical attention. In other disciplines, congruent with a mechanistic view, the habit formation process is framed by the repetition of a past behavior. For instance, Hull (1943) found that as the number of repeated pairings between a situation (e.g., travel location) and a response (e.g., travel mode) increases, so does the strength of that association, which he called habit.

In contrast and taking a more humanistic view, other studies identified a more complex habit formation process. Wood, Quinn and Kashy (2002) proposed that habits develop by satisfactorily repeating behavior in stable contexts. Danner, Aarts, and deVries (2007) illustrated habits as being guided by mental representations of goal–means associations in a multiple-means context. Thus habit formation would occur when the same means are repeatedly and consistently called for to attain the same goal, because it fosters an automatic search in memory. Once a habit is formed, the result could be immediate retrieval and selection of the associated habitual means. Aarts, Paulussen, and Dijksterhuis (1997) proposed a model that focused on the formation of physical exercise habits. In this context, habit development is the outcome of automated cognitive processes, making physical exercise habits capable of being automatically activated by the situational features that normally precede these behaviors. In this model, evaluation and satisfaction lead to users' feeling that they need to repeat the practice (behavior) again and again until the habit of physical practice is completely formed.

TOWARD A PROCESS MODEL OF IS HABIT FORMATION

In order to understand how a habit forms in the context of IS use, it is important to understand what factors play a role in the habit formation process. Based on a thorough review of extant literature, we found five important constructs (see Table 2) playing such a role:

Satisfaction: Based on expectation-confirmation theory (Bhattacherjee, 2001), satisfaction predominantly determines the willingness to continue using a system. While satisfied users will form an IS-use habit, dissatisfied users terminate usage. A similar argument can be made in the context of IS post-adoption use, where satisfaction with an IS tends to reinforce a user's intention to continue using the system and dissatisfaction inhibits further use (Cheung and Limayem, 2005). Generally speaking, if users have a successful experience with a system, their continued interaction is highly probable (Limayem et al. 2007). In the IS literature, user satisfaction is typically viewed as an attitude toward an information system. Following Wixom and Todd (2005), we will focus on two constructs: system quality and information quality. Satisfaction with information produced by the system will affect user's perceptions of usefulness. Likewise, satisfaction with the system represents the user's degree of congeniality with the system or their feeling of ease while interacting with it. As people are more pleased with the system, they find it easier to use. We argue that these two perceptions provide a base for further system usage, which fosters the formation of a habit.

Reinforcement: It has been argued that habits are guided by well-practiced stimulus–response combinations reinforced by positive rewards (Danner et al. 2007). It means that reinforcement is essential to encourage repetition (Verplanken and Wood, 2006). Adopting and repeating a new action depends largely on the judgment that the resulting outcome is more desirable than those offered by alternative actions. The more desirable the outcome, the stronger the reinforcement, and the stronger the association between the goal and the action.

In general, there are two types of reinforcement: external and internal. External reinforcement embeds social aspect or behavior: users quickly become accustomed to attitudes that are recognized by others as "approved behavior." In contrast, internal reinforcement relates to personal standards and codes that individuals develop in an environment over long periods of time. This self-approval helps users control the direction of their behavior (Marshall and Mchardy, 1999). For a habit to be developed, a good combination of both types of reinforcement is required. Prior studies emphasized the role of positive reinforcement as a way to create stronger habits (Aarts et al. 1998). Reinforcement by peers and superiors is done by showing significant desire to perform or not perform a behavior. According to Taylor and Todd (1995), such reinforcement can change user's subjective norms. Based on this, we theorize that reinforcement directly influences subjective norms, which include individual and peer approval.

Frequency: In the extant literature, frequency is often portrayed as key factor in the understanding of the habit formation process. In studies that used a mechanistic approach, habit has often been equated with behavioral frequency (Verplanken, 2006), i.e. the number of times a behavior is repeated. Danner et al. (2007) found that frequency has a positive influence on the formation of a habit. Jager (2003) stated that the more recurrent a behavior is, the more automatic the process. In the context of IS use, Limayem et al. (2007) found that an increase in the recurrence of a behavior leads to a stronger association between the habit and the use behavior. Consequently, we assert that more repetitions of a behavior result in practice and familiarity and help form a strong habit.

Extent of use: Through direct experience with an IS and constant learning, individuals attain the ability to use a system to its full potential. Saga and Zmud (1994) defined extensive use as to how users apply more of the technology's features in order to accommodate a more comprehensive set of work tasks. Similarly, Schwarz (2003) proposed the term "deep usage" to indicate the extent of use of different IT features. Limayem et al. (2007) introduced comprehensiveness of usage, which refers to the extent to which an individual makes use of the various applications offered under the umbrella of a single IS system. Extent of use leads to more interaction with the IS and strengthens the habit development process. We argue that extent of use reflects intensity of use during the habit formation process.

Stability in context: Habit formation is not only the repetition of a behavior, but consistency as the behavior is performed in a given context (Danner et al. 2008). Ouellette and Wood (1998) stressed the importance of context in habit creation, and found that context stability helps explain the role of habit in the prediction of future behavior. A stable context is characterized by the existence of similar situational cues and goals across frequently occurring situations (Limayem et al. 2007). When a behavior recurs in the same setting, the context becomes strongly and exclusively linked to the mental representation of the behavior. Hence context is capable of eliciting the execution of the behavior with no conscious intention (Danner et al. 2008). We therefore believe that a stable context plays a role in IS habit formation.

Construct	Support in Non-IS Literature	IS Definition	Support in IS Literature
Satisfaction	(Verplanken 2006), (Jager, 2003), (Aarts et al. 1998), (Aarts et al. 1997), (Verplanken et al. 1997),	Attitude toward an information system regarding information and system quality	(Limayem, Hirt, and Cheung 2003), (Bhattacherjee and Premkumar 2004), (Hong et al. 2006), (Limayem et al. 2007), (Parthasarathy and Bhattacherjee 1998), (Goodhue, 1995), (Wixom and Todd, 2005), (Cheung and Limayem, 2005)
Reinforcement	(Danner et al. 2007), (Jager, 2003), (Aarts et al. 1998), (Ouellette and Wood, 1998), (Aarts et al. 1997), (Verplanken and Wood, 2006)	Active strengthening of IS use that is followed by positive internal and external returns	(Limayem and Hirt, 2003) , (El Khatib and Barki, 2009)
Stability in context	(Verplanken, 2006), (Danner et al. 2008), (Verplanken and Melkevik, 2008), (Ouellette and Wood, 1998),	Presence of similar conditional cues and goals across similar repetitive situations	(Limayem, Hirt, and Chin 2001), (Limayem et al. 2007)
Frequency	(Verplanken, 2006), (Verplanken et al. 1997), (Trafimow, 2000), (Danner et al. 2008), (Jager, 2003), (Aarts, Verplanken, and Knippenberg 1998), (Verplanken and Melkevik 2008), (Aarts and Dijksterhuis, 2000), (Bamberg, Ajzen, and Schmidt 2003), (Danner et al. 2007), (Ouellette and Wood 1998),	The number of times a certain IS use has recurred	(Limayem and Hirt, 2003), (Gefen, 2003)
Extent of use		The extent to which individuals make use of diverse applications provided by IT	(Hsieh and Zmud, 2006) (Limayem et al. 2007)

Table 2: Habit Constructs and Definitions

A DYNAMIC PROCESS MODEL OF HABIT FORMATION

We propose a process model that explains how habits are formed and how they influence an IS-use behavior in post-adoption. In this model, the role of habit changes over time. In addition to explaining habit formation, our model clarifies the relationships between intention, habit and usage. This model explains rather than predicts the IS-use behavior. Before introducing our model, two important issues must be addressed: the balanced interaction between intention and habit and the dynamic nature of habit formation.

The Balanced Interaction between Intention and Habit

The relationship between habit and intention in the explanation of use is complex. As a behavior becomes more recurrent, the related cognitive thinking behind it disappears, leading to a routinized behavior (Jasperson et al., 2005). In other words, performing a behavior becomes less influenced by intention. Triandis (1980) used both habit and intention to predict behavior. He argued that when a behavior is new to user, it is determined by intention. As the behavior recurs and becomes habitual, the weight of intention decreases. Habits become automatic to the extent that the behavior is no longer guided by intentions (Danner et al. 2008).

In contrast, Ouellette and Wood (1998) argued that frequent behaviors in stable contexts persist because their initiating process becomes automatic. However, when behaviors not well-practiced or the context is unstable, conscious decision making is necessary to initiate and perform the behavior. This implies that when behavior is rather new, intention is key to explaining the behavior, and as the behavior becomes automatic, the role of intention disappears in favor of habit. Similarly, in a study of travel bookings, Aarts et al. (1997) showed that the cognitive decision-making process underlying goal-directed behavior ceases to exist when habits grow stronger. Based on this evidence, we believe that there is a balance between habit and intention: when one goes up, the other goes down.

The Dynamic Nature of Habit Formation

Time plays an important role in the process of habit formation. Limayem et al. (2007) proposed that IS behaviors become habitual and automatic actions *over time*. The effect of time can be understood by focusing on how changing the relationship between habit and intention explains a behavior. As we discussed above, when habit becomes stronger, the information processing required for decision-making in IS use declines significantly (Aartes et al., 1997). Thus, by constantly using an IS, an individual becomes more influenced by habit and less by conscious planning or intention (Cheung and Limayem 2005).

Considering the effect of time in this process, we divide our model into three distinct phases: t_{n-1}, t_n, and t_{n+1} , where t_{n-1} represents the time shortly after user's initial interaction with the system, t_n represents the time when habit formation occurs, and t_{n+1} is when the habit is totally formed. Note that t_0 (initial use as explained by TAM and other models) is outside the boundaries of our model, such that our model does not try to explain the user's very first interaction with a system. While such timelines have been used in previous IS studies to show the recurrence of a process (e.g. Limayem et al., 2003), our study pursued a different approach by defining distinct and specific habit formation functions in each period.

Phase I (t_{n-1}): Paving the Way to Habits

Commencing after a few interactions with the system, Phase I is when the user forms an impression of a system. Here, usefulness and ease of use still have considerable effect on attitude. In this phase, intention is the most important factor affecting behavior. This phase paves the way for habit development through repetition of a behavior via reinforcement (defined by Taylor and Todd (1995) as subjective norms). Positive reinforcement will seed habit and provide a base for its emergence. In contrast, negative reinforcement weakens a behavior and eliminates the likelihood of repetition of the same behavior.

Based on Aarts et al. 1997, the development of routinized actions mainly occurs when the same behavior is repeatedly followed by satisfactory outcomes. Users constantly evaluate their experience with the system, modifying their beliefs and attitudes in response. Each time a user interacts with the system, they evaluate the quality of outcome and compare it with desired expectations. If the outcome is consistent with the expectation, the user has a feeling of satisfaction, which promotes future usage. In our model, satisfaction is linked to information quality and system quality (Wixom and Todd (2005)), which represent object-based attitudes that serve as external variables shaping behavioral beliefs. Satisfaction with the information influences beliefs about actual usefulness. System satisfaction represents the degree of favorableness toward to the system and the mechanics of the interaction. This argument supports traditional views of the habit formation process, which state that satisfactory experiments increase the tendency to repeat the same action because the behavior becomes more strongly associated with the goal one initially wishes to attain (Aarts et al. 1997). Figure 1 presents our model of habit formation in Phase I.
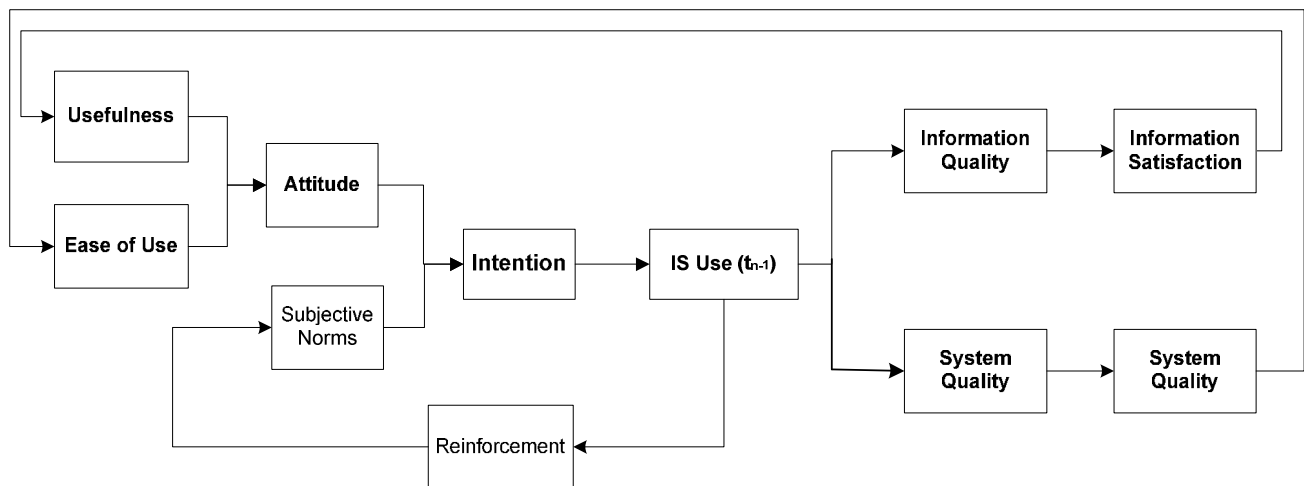

Figure 1: Phase I - Paving the Way to Habits[1]

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[1] We have emphasized on the importance of the constructs in each phase by showing them in bold.

Phase II (t_n): Creating Habit

The second phase is when habitual behavior actually forms. After users become familiar with a system, habits begin to emerge. The focus here is on the interaction between habit and intention. At the beginning of this phase, intention weighs more heavily than habit in explaining behavior. Frequent reiteration of this cycle creates automaticity, which provides a foundation on which habits can form. As stated above, changes in the relationship between habit and intention are balanced. As habits develop, intentions become less important.
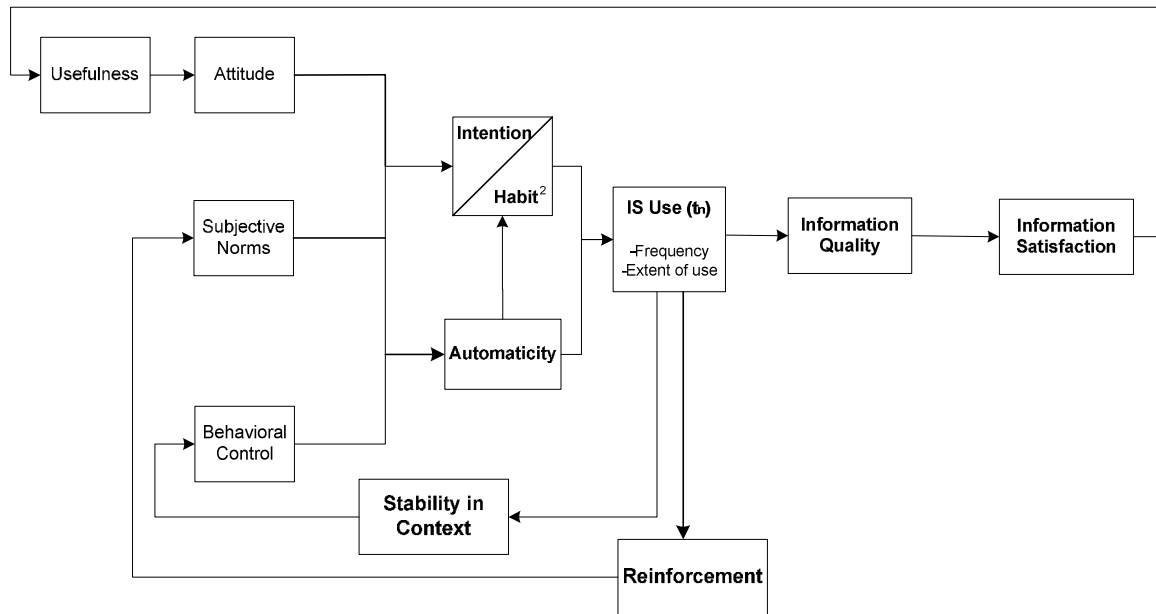

Figure 2: Phase 2 - Creating Habit

For habits to form, a recurring situation is needed to stimulate further use. Danner et al. (2007) argue that beyond frequency, there is a need for consistency in performance of the behavior. A stable context improves the user's control over the behavior and facilitates further recurrence. In addition, evaluations of system quality fade away, such that ease of use no longer affects attitudes. However, the information provided by the system still influences beliefs about system usefulness. Finally, reinforcement strengthens the role of subjective norms in the process. After numerous repetitions of this cycle, habits are created, automaticity becomes increasingly important and the role of intention diminishes, as illustrated in Figure 2.

Phase 3 (t_{n+1}): Reinforcing Habit

In the final phase, habits have already formed. This is when full automaticity of the behavior occurs and IT becomes embedded into the organization's work system. Minimal cognitive effort is required for action and intention no longer plays a role, as habit assumes the main role in explaining behavior. This is consistent with prior empirical studies (Warshaw, 1990) that demonstrated that at some point, intention no longer influences behavior and habit becomes the main driver.

Settled habits will endure for long periods of time if the conditions remain unchanged. These conditions are stable context, reinforcement by internal and external sources, and satisfaction. Users with strongly-established habits develop expectations for certain environmental and behavioral events (Verplanken and Wood, 2006), and they expect prior experiences to repeat. Thus they do not easily notice minor changes in the environment. Also, they usually do not seek new information about behavior alternatives, and when they do, their search is biased toward finding similar information and providing support for current habits. Information satisfaction therefore strengthens established habits. But, as the features of the system do not often change during time, system quality will no longer be evaluated by habitual users of the system, and will be considered as a stable context. Overall, in this phase, the evaluation process does not occur as often as before, although it still has an

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[2] There is a balance between habit and intention: when one goes up, the other goes down.

imperative function. Figure 3 presents the last phase of the habit formation process, in which habit becomes the sole antecedent of the behavior.
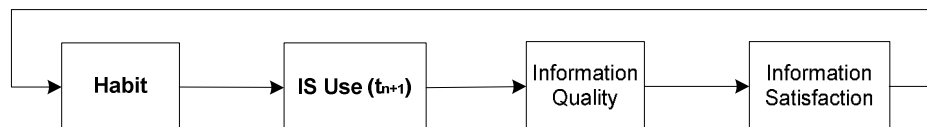

Figure 3: Phase 3 – Reinforcing Habit

DISCUSSION AND CONCLUSION

This study proposes a three-phase process model of habit formation. To develop our model, we conducted a literature review to identify the constructs that play a role in this process, their role and the nature of their relationships. Our model explains how, over a long period of time, habits emerge, take shape and, finally, crystallize.

We must acknowledge that this paper has some limitations. Most importantly, and despite the fact that it is based on sound theoretical foundations, our proposed model is purely conceptual. To better understand the dynamic nature of the habit formation process and interactions between the constructs we have identified, it will be important to use empirical data, such as in a qualitative longitudinal study.

Despite its limitations, our research framework has made several contributions to theory and practice. To our knowledge, there is only a handful of studies that have investigated habits in IS use. Most of these studies simply added the habit construct to classic variance models of IS use to investigate the relationship between habit and intention with regards to use. Our study has identified constructs that play an important role in the development of IS-use habits and has shed light on the process by which habits form along three chronologically-ordered phases of IS use. For practitioners, our study identifies many factors involved in the formation of IS habits. Context stability can foster the user's perception of control, which indirectly impacts behavior. In addition, internal and external reinforcement can modify the user's subjective norms and, eventually, affect behavior. This suggests that the decision to continue a behavior can be encouraged if these conditions are perceived by users. Managers should realize that in order to capitalize on positive working habits (e.g. frequent IS use), they need to provide these conditions in the work environments. Developing positive routines will enhance the perceptual readiness for habit-related cues, and impedes other, inefficient and negative types of action (Limayem et al., 2007).

Future research should aim at validating and refining this model. Other research avenues could include studying the issue of habit disruption to show how managers can intervene to terminate undesirable behaviors, for example by changing the settings or providing negative reinforcement.

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