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What is This?
The Roles of Habit, Self-Efficacy, and Satisfaction in Driving Continued Use of Self-Service Technologies: A Longitudinal Study

Cheng Wang¹, Jennifer Harris², and Paul Patterson²

Abstract
Recent years have witnessed increased use of self-service technologies (SSTs) across the services sector, which has dramatically changed the nature of the service delivery process. Although an abundance of research has investigated how customers evaluate a new SST and what drives the initial adoption, little is known about how customers interact with, and adapt to, an SST after their first experience. Thus, this study focuses on the dynamic and complex process through which customers move from initial adoption to continued use, after repeated interactions with an SST. A three-wave longitudinal study examines how habit, self-efficacy, and satisfaction affect SST usage over time in a retailing context. The results indicate that as learning occurs and experience accumulates, customers’ continued use of an SST is initially largely rational driven (self-efficacy), then largely emotional driven (satisfaction), and, finally, habitual (habit). Over time, habit completely mediates the impact of intentions on future usage. The article concludes with a discussion of the managerial implications and directions for further research.

Keywords
self-service technology, self-efficacy, habit, longitudinal study

The past decade has witnessed an infusion of technology which has dramatically changed the nature of service industries and, in particular, the service delivery process (Bitner, Brown, and Meuter 2000). One example is the introduction of self-service technologies (SSTs)—that is, technological interfaces “that enable customers to produce a service independent of direct service employee involvement” (Meuter et al. 2000, p. 50). Today, traditional “high-touch and low-tech” interpersonal service encounters, such as airline check-in, hotel booking, and retail banking, are being gradually supplemented, or even replaced, by a range of “high-tech and low-touch” SST interfaces. With its proliferation in the services sector, SST has received considerable scholarly attention in recent years (see Table 1 for a review of major empirical SST studies). Previous research has found that customers’ initial adoption is primarily driven by two categories of antecedents—namely, SST characteristic and individual difference variables—with the former having greater explanatory power than the latter (e.g., Dabholkar 1996; Meuter et al. 2005). More specifically, customers are more likely to adopt an SST if they perceive the technology as useful, easy to use, enjoyable, not risky, and controllable (e.g., Dabholkar and Bagozzi 2002; Walker et al. 2002). In terms of individual differences in SST adoption, it has been found that compared with nonadopters, adopters are generally younger, predominately male, better educated and paid, less anxious, embrace new technology more readily, and have less need for personal contact (e.g., Meuter et al. 2003; Nilsson 2007).

Although previous research has significantly enhanced our understanding of the drivers of the initial SST adoption, little is known about what happens next. According to Rogers’s (2003) innovation diffusion theory, there are six stages in the adoption process: awareness, investigation, evaluation, trial, repeated use, and commitment. It is apparent that most prior SST research has focused on the evaluation and/or trial stage. Therefore, a critical question is: What drives continued use of SSTs over time? Research on repeat behavior indicates that factors other than SST characteristics and individual differences may play a role in driving continued use. For example, loyalty studies have consistently shown the effect of satisfaction on repeat purchase (Oliver 2010; Szymanski and Henard 2001). Information systems (IS) literature has found the importance of self-efficacy in the usage of information technology (e.g., Hsu, Ghiu, and Ju 2004). Moreover, habit research suggests that in predicting repeat behavior, intentions alone are not sufficient because the behavior may simply become a force of
### Table 1. A Chronological Review of Major Empirical SST Studies.

<table>
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<tr>
<th>Study</th>
<th>Technology</th>
<th>Methodology</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dabholkar (1996)</td>
<td>Restaurant touch screen ordering</td>
<td>Cross-sectional</td>
<td>The cognitive model is better than the affective model. Ease of use, enjoyment, control, attitude, and need for interaction are important determinants</td>
</tr>
<tr>
<td>Meuter et al. (2000)</td>
<td>Various</td>
<td>Critical incident technique</td>
<td>There are three categories of satisfying SST incidents and four categories of dissatisfying SST incidents</td>
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<td>Selnes and Hansen (2001)</td>
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<td>Dabholkar and Bagozzi (2002)</td>
<td>Restaurant touch screen ordering</td>
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<td>Ease of use, performance, and fun impact on attitude, which then impacts on intention. Consumer traits and situational factors moderate these relationships</td>
</tr>
<tr>
<td>Lee and Allaway (2002)</td>
<td>Online shopping</td>
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<td>More perceived control leads to lower perceived risk, higher perceived value, and higher adoption intention</td>
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<td>General, not specific</td>
<td>Cross-sectional</td>
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</tr>
<tr>
<td>Curran, Meuter, and Surpremant (2003)</td>
<td>ATM Internet banking ATM Internet banking</td>
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<td>Meuter et al. (2003)</td>
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<td>Technology anxiety is a better predictor of SST use than demographics (age, gender, education)</td>
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<td>Curran and Meuter (2005)</td>
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<td>Meuter et al. (2005)</td>
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</tr>
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<td>Lin and Hsieh (2006)</td>
<td>Various</td>
<td>Cross-sectional</td>
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<td>Cross-sectional</td>
<td>SST adoption intention is determined by capacity, risk, relative advantage, and need for interaction</td>
</tr>
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<td>Online financial services</td>
<td>Cross-sectional</td>
<td>Cost, time, control, age, and gender are key determinants of SST preference</td>
</tr>
<tr>
<td>Lin, Shih, and Sher (2007)</td>
<td>Online stock trading</td>
<td>Cross-sectional</td>
<td>SST intention is determined by usefulness and ease of use, which are then influenced by technology readiness</td>
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<td>Nilsson (2007)</td>
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<td>Weieters et al. (2007)</td>
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<td>Johnson, Bardhi, and Dunn (2008)</td>
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<td>The effects of technology paradoxes on customer satisfaction are mediated by consumer performance ambiguity and consumer trust in technology</td>
</tr>
<tr>
<td>Reinders, Dabholkar, and Frambach (2008)</td>
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<td>Cross-sectional</td>
<td>Forced use leads to negative attitudes toward using the SST and toward the service provider, and it indirectly leads to adverse effects on behavioural intentions</td>
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<tr>
<td>Zhao, Mattila, and Tao (2008)</td>
<td>Library self-checkout</td>
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<td>Robertson and Shaw (2009)</td>
<td>Various</td>
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<td>Consumers’ likelihood of voice is influenced by ease of voice, SST powerlessness, and need to vent</td>
</tr>
<tr>
<td>van Beuningen et al. (2009)</td>
<td>Online stock investment scale</td>
<td>Cross-sectional</td>
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</tr>
<tr>
<td>Lin and Hsieh (2011)</td>
<td>General, not specific kiosks Online catering booking</td>
<td>Cross-sectional</td>
<td>Development and validation of SST service quality scale</td>
</tr>
<tr>
<td>Mattila, Cho, and Ro (2011)</td>
<td>Various</td>
<td>Cross-sectional</td>
<td>Compensation is more effective in restoring justice with traditional failures than with SST failures. Human touch seems more effective than online recovery</td>
</tr>
</tbody>
</table>

(continued)
habit rather than intentional (e.g., Limayem and Hirt 2003; Ouellette and Wood 1998). Therefore, to better understand what drives continued SST use, previous adoption models are not appropriate or adequate, so there is a need to develop a more relevant conceptual framework.

Thus, a research opportunity is to examine how customers interact with SSTs after their initial adoption and how this dynamic process results in their continued nonuse. This research attempts to shed light on this gap by developing and empirically testing a model that captures the drivers of continued SST use from a dynamic perspective. Because our focus is on repeat behavior, we draw on habit research in social psychology literature and include habit as a direct driver of continued SST use, in addition to intention. Habit represents an automatic, unconscious, driver, whereas intention represents a deliberate, conscious one. We also include satisfaction and self-efficacy as affective and cognitive determinants, respectively, of behavioral intention and habit. Satisfaction is not relevant in the initial SST adoption stage because customers have little experience, but as repeat purchase studies show, it can be an important factor impacting continued use as customers' experience with an SST accumulates. We also draw on social cognitive theory (Bandura 1997, 2001) and include self-efficacy as an important antecedent because SST is an information technology-related service, and the use of technology is often influenced by self-confidence (e.g., van Beuningen et al. 2009; Zhao, Mattila, and Tao 2008).

From a static perspective, our model shows that habit and intentions mediate the impact of satisfaction and self-efficacy on continued use (see Figure 1). From a dynamic perspective, however, although we expect the general nature of the relationship between the variables to remain constant, we hypothesize that the relative impact of the four predictor variables will vary over time. Through a three-wave longitudinal testing of the model in a retailing context, we find that as learning occurs and experience accumulates, customers' decisions to continue using an SST are initially rational (self-efficacy), then largely emotion driven (satisfaction), and, finally, habitual (habit).

The contributions of this study are threefold. First, we shift the focus from the initial adoption to continued use of an SST, as scholars in the services domain have suggested (e.g., Curran and Meuter 2005; Meuter et al. 2005). Our model focuses explicitly on continued SST use and differs from previous models by incorporating self-efficacy, satisfaction, and habit. Second, our three-wave longitudinal design enables the examination of changing effects of satisfaction and self-efficacy on habit, intention, and, ultimately, continued SST use over time. Third, in response to calls for future SST research to go beyond emphasizing attitude and behavioral intentions and focus on actual behavior (Meuter et al. 2005), we include actual continued use as the outcome variable. Doing so ensures that our model is more robust in explaining real-life behavior. In the following sections, we draw on related literature streams to develop our conceptual model and a series of hypotheses. This is followed by a description of the methodology and a presentation of the results. Finally, we discuss the managerial implications and provide limitations and future research directions.

**Conceptual Development**

Figure 1 depicts our conceptual model; the factors in the shaded area highlight our focus, and we empirically test them in this research. The point of departure in developing the model is the view of continued SST use as a type of repeat behavior. We then draw on habit research in the social psychology literature to identify the determinants of repeat behavior in an SST usage context. We also review the customer satisfaction literature and social cognitive theory to establish the relevance of satisfaction and self-efficacy as affective and cognitive factors, respectively, in explaining repeat behavior (in an SST context). The model is based on the premises that (1) repeat behavior is driven by habit as well as behavioral intention, (2) satisfaction and self-efficacy influence repeat behavior through behavioral intention and habit, and (3) the relationships change (strengthen or weaken) over time (indicated by the bold lines in Figure 1).

**Determinants of Continued SST Use**

Rooted in the theory of reasoned action (e.g., Ajzen and Fishbein 1980; Fishbein and Ajzen 1975), the behavioral intention–actual behavior relationship has been well established and widely used to explain a range of human behavior. However, recent research on human automaticity has found that a great amount of human functioning is rooted in
Figure 1. Conceptual model: The drivers of continued SST use over time.
nonconscious processes that do not require conscious control (Bargh and Ferguson 2000). According to this research stream, when studying human behavior, consideration of nonconscious as well as conscious processes should be the norm rather than the exception. Nevertheless, in consumer behavior, despite the growing evidence that social judgments and behaviors actually occur without conscious awareness, the field is still dominated by purely cognitive approaches in which decisions and actions are deliberate. This approach is evident in some of the widely adopted models, including the theory of reasoned action, theory of planned behavior, and technology acceptance model, in which behavioral intention is the only key determinant of action. This has prompted Bargh (2002, p. 280) to suggest that the next wave of consumer research should center on “the assessment of how much of a role nonconscious influences play in real life in decisions and behavior.”

To account for the nonconscious influences in behavior, social psychology literature has focused on habit as another direct determinant of behavior in addition to behavioral intention. Habit is a learned sequence of actions that become automatic responses to specific situations that function in attaining certain goals or end states (Triandis 1977, 1980; Verplanken, Aarts, and Van Knippenberg 1997). It is a form of goal-directed automatic behavioral tendency. In contrast with behavioral intention, or the deliberate, conscious influences of behavior, habit captures automatic, nonconscious influences. Prior research indicates that habit is a potent predictor of actual behavior (e.g., Ouellette and Wood 1998) and that it predicts well-learned behavior better than intention (e.g., Landis, Triandis, and Adamopoulos 1978).

The relevance and importance of habit in explaining repeat behavior is highlighted in Triandis’s (1977; 1980) model, which is expressed as:

$$\Pr = (w_1 H + w_2 I) F,$$

where the probability of an act ($\Pr$) is a weighted function of habit ($H$) and intention ($I$) multiplied by facilitating conditions ($F$; e.g., a person’s ability to perform the act). Moreover, Triandis (1977, p. 205) further considers the changing influence of habit and intention over time, suggesting that “when a behavior is new, untried, and unlearned, the behavior–intention component will be solely responsible for the behavior, while, when the behavior is old, well learned, or over learned and has occurred many times before in the organism’s life span, it is very likely to be under control of the habit component.” That is, as experience accumulates and learning occurs from repetition, the performance of the behavior is largely a matter of habit rather than the result of intentional reasoning.

With this theoretical background, we argue that in explaining customers’ continued use of an SST (a type of repeat behavior), their intentions alone are not sufficient because after repeated interactions, the usage is likely to become a force of habit that does not require intentional thinking. Thus over time, habit should play a major role in driving continued use. Moreover, in line with Triandis (1977, 1980), we hypothesize that as customers gradually pass from the initial adoption (new, untried, and unlearned behavior) to the continued use of an SST (repeated and well-learned behavior), the impact of behavioral intention will weaken, and the impact of habit will strengthen. Thus:

Hypothesis 1a: Behavioral intention has a positive impact on continued use at $T_2$ and $T_3$.

Hypothesis 1b: The impact of behavioral intention on continued use weakens over time as customers’ experience with an SST accumulates.

Hypothesis 2a: Habit has a positive impact on continued use at $T_2$ and $T_3$.

Hypothesis 2b: The impact of habit on continued use strengthens over time as customers’ experience with an SST accumulates.

Although we model intention and habit as distinct drivers of continued SST use, we also hypothesize a positive path from intention to habit. This is because behavioral intentions increase the likelihood of actual behavior (Ajzen and Fishbein 1980; Fishbein and Ajzen 1975), and the frequency of past behavior is a necessary condition for habit formation (e.g., Limayem, Hirt, and Cheung 2007; Verplanken 2006). That is, if customers are willing to use an SST, they are more likely to actually use it, and the more frequently they use it, the more likely the use will become habitual. Thus:

Hypothesis 3: Behavioral intention has a positive impact on habit at $T_1$ and $T_2$.

The Role of SST Satisfaction

Customer satisfaction has been a central issue in marketing for decades and has been extensively studied (see Oliver 1997; Szymaniski and Henard 2001 for a review). While some scholars view satisfaction as a cognitive function of a comparison between expectations and performance, most view it an overall affect elicited during the acquisition and consumption of a product/service. This conceptualization is consistent with Oliver’s (1992, p. 242) proposal that “satisfaction and dissatisfaction reflect the general affective tone” and is also in line with Giese and Cote’s (2000) work, which limits satisfaction to an affective response. Recently, Oliver’s (2010, p. 8) extensive treatise on the topic makes it clear that customer satisfaction is an affect: “Satisfaction is the consumer’s fulfillment response. It is a judgment . . . providing a pleasurable level of consumption-related fulfillment.” Thus, we take the view that satisfaction is more of an affective factor. However, this does not preclude the importance of cognitions in determining satisfaction; cognitions are bases for the formation of satisfaction (i.e., when comparing attribute performance with expectations), but they are not satisfaction per se.

Considerable prior research indicates that satisfaction is a primary driver of repurchase intention (e.g., Seiders et al.
Satisfaction has a positive impact on habit. In addition, a customer’s decision to continue using an SST is similar to his or her product repurchase decision in that “both decisions (1) follow an initial (acceptance or purchase) decision, (2) are affected by the initial use (of IS or product), and (3) can potentially lead to ex post reversal of the initial decision” (Bhattacherjee 2001, p. 355). Furthermore, the IS literature has found a positive impact of satisfaction on customers’ intentions to use technologies again (e.g., Eriksson and Nilsson 2007; Hsu, Ghiu, and Ju 2004). Therefore, it stands to reason that in an SST context, satisfaction will positively affect behavioral intentions. Thus:

**Hypothesis 4a:** Satisfaction has a positive impact on behavioral intention at $T_1$ and $T_2$.

Moreover, prior research has shown that customer satisfaction is not static in nature and should be viewed from a dynamic perspective (Homburg, Koschaté, and Hoyer 2006). This is especially true in SST adoption because it is a dynamic, continuous process and satisfaction feelings may change after repeated use. Thus, it is critical to consider the potential changing effect of satisfaction. Satisfaction is typically modeled on the disconfirmation-of-expectations paradigm (Oliver 2010). As service researchers note, expectations are dynamic and shift over time (Wood and Moreau 2006). Furthermore, for inexperienced users of complex, innovative services (e.g., professional services, SSTs), expectations are unstable and vague, and thus satisfaction feelings are similarly flexible (e.g., Patterson 2000). Therefore, in the context of SST adoption, customers can experience strong emotions (e.g., delight, disappointment) after the initial trial because they may have been surprised by the difficulty or ease of their first usage experience (Wood and Moreau 2006). However, one initial extreme satisfaction feeling will not necessarily lead to continued use or nonuse in the future, because at this stage the technology is new to customers and their expectations are vague from limited experience. In these circumstances, satisfaction feelings are often unstable and held with less certainty and hence are not an ideal predictor of future intentions (Homburg, Koschaté, and Hoyer 2006). Over time, as experience accumulates, we predict that customers’ expectations will be formed more accurately and be more stable, and accordingly their satisfaction feelings will be formed with more certainty, which leads satisfaction to be a more powerful predictor of behavioral intentions. Thus:

**Hypothesis 4b:** The impact of satisfaction on behavioral intention strengthens over time as customers’ experience with an SST accumulates.

Past satisfactory experiences are also a key condition for habit development because they increase people’s tendency to repeat the same course of action again. Thorngate (1976, p. 32) depicts the relationship between satisfaction and habit as follows: “If a response generated in an interaction is judged to be satisfactory, it will tend to be reproduced under subsequent, equivalent circumstances from habit rather than thought.” Empirical evidence for the impact of satisfaction on habit appears in some habit studies (e.g., Limayem, Hirt, and Cheung 2007). In an SST context, we expect that if customers are satisfied with an SST, they are more likely to use it repeatedly in the future, which (frequency of behavior) is necessary for developing a usage habit. In contrast, dissatisfied customers may discontinue using an SST and return to the traditional personal service or reduce the frequency of use if no alternative is available. Consequently, a habit of using the SST is unlikely to develop. Thus:

**Hypothesis 5a:** Satisfaction has a positive impact on habit at $T_1$ and $T_2$.

From a dynamic perspective, and in line with Hypothesis 4b, we also propose that as customers gain experience with an SST over time, satisfaction will exert a stronger influence on habit formation. This is because, on one hand, the initial emotions elicited during use of an SST are often unstable because of vague expectations, which leads to a weak and vulnerable impact of satisfaction on habit. The impact gets stronger as customers gain more experience and form satisfaction feelings with more certainty. On the other hand, as satisfaction becomes more effective in eliciting future usage, this repeat customer–SST interaction accelerates the formation of habit. Thus:

**Hypothesis 5b:** The impact of satisfaction on habit strengthens over time as customers’ experience with an SST accumulates.

**The Role of SST Self-Efficacy**

Studies in social psychology suggest that behavioral intentions are not determined solely by emotional drivers (e.g., satisfaction) but also by cognitive drivers (Ajzen 1991; Bandura 1986). In particular, social cognition theory holds that self-efficacy beliefs are a key cognitive determinant of human behavior. Self-efficacy is “beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments” (Bandura 1997, p. 3). In addition, Bandura (1997, p. 43) states, “Can is a judgment of capability; will is a statement of intention. Perceived self-efficacy is a major determinant of intention, but the two constructs are conceptually and empirically separable.” The positive effect of self-efficacy on behavioral intentions is based on the notion that people are more likely to engage in tasks they think they can accomplish and avoid those they cannot.

In an SST context, customers become coproducers of the service, and their beliefs in their capabilities to produce a satisfying outcome should have a positive influence on their willingness to continue using an SST. In addition, using a new SST may require new skills and some level of confidence (e.g., Limayem, Hirt, and Cheung 2007); thus, self-efficacy seems particularly relevant in these circumstances. Hence, we hypothesize that self-efficacy, as a cognitive determinant, affects a customer’s intention to continue using an SST.
Research on technology adoption indicates that people’s efficacy beliefs about their capability of using technology significantly influence their subsequent decision to adopt or reject a technology (e.g., computers, software). Specifically, customers are more willing to try a new technology if they believe that they can use it properly and achieve desired outcomes (e.g., Compeau and Higgins 1995; Hill, Smith, and Mann 1987). Following this line of thinking, we propose the following:

**Hypothesis 6a:** Self-efficacy has a positive impact on behavioral intention at \( T_1 \) and \( T_2 \).

Moreover, because self-efficacy changes as learning occurs and experience accumulates, it is important to examine its changing effect as customers move from the initial trial to the continued use of an SST. During the early stage of adoption, customers need to develop new skill sets to become coproducers of the service. As novice users, they are likely to experience difficulties and service failures that, in turn, result in low or negative confidence, which may dampen future use. In contrast, high levels of confidence can stimulate the trial of a new SST and convert novice customers into regular users (e.g., Meuter et al. 2005; van Beuningen et al. 2009). After repeated interactions, we expect that customers experience less anxiety and their confidence level increases accordingly. Therefore, the role of self-efficacy will stabilize or diminish and intention will be largely determined by users’ appreciation of the SST’s benefits (i.e., satisfaction). Thus:

**Hypothesis 6b:** The impact of self-efficacy on behavioral intention weakens over time as customers’ experience with an SST accumulates.

In addition to driving behavioral intention, we predict that self-efficacy beliefs will be positively associated with habit formation. By definition, habit is an automatic behavioral tendency (Verplanken, Aarts, and Van Knippenberg 1997). The more confidence a person has in performing a task, the more likely he or she will perform the task without major cognitive effort. Although prior habit research has typically focused on the roles of past behavior and satisfaction in habit development (Limayem, Hirt, and Cheung 2007; Verplanken 2006), we argue that in the adoption of technological innovations such as SSTs, self-efficacy plays a key role in driving habit because it captures the technology component that may facilitate (e.g., technology anxiety) or inhibit (e.g., technology readiness) habit development. Thus:

**Hypothesis 7a:** Self-efficacy has a positive impact on habit at \( T_1 \) and \( T_2 \).

In line with Hypothesis 6b, we also expect that the impact of self-efficacy on habit will diminish over time. As discussed previously, customers’ self-efficacy beliefs are particularly salient in the initial stage of SST adoption when they experiment with the technology and build confidence. As they become accustomed to an SST, their confidence level stabilizes, making self-efficacy no longer an active or relevant contributor to habit development. Thus:

**Hypothesis 7b:** The impact of self-efficacy on habit weakens over time as customers’ experience with an SST accumulates.

**Methodology**

**Research Setting**

Supermarket self-checkout kiosks served as the SST context for this investigation. This setting is ideal because such SSTs are new in Australia, providing an opportunity to approach a sufficient number of new users and track their experience from initial trial to continued use. Moreover, supermarket shopping is a relatively high-frequency household activity, and thus use of the self-checkout SST is likely to become a frequent, regular task for customers. Such factors facilitate empirical testing for the habitualization of SST behavior. The self-checkout technology was introduced in supermarkets as an alternative to traditional checkout counters, with customers having the option of choosing either. This is important because testing the model would be meaningless if customers had no choice of service delivery options.

**Research Design**

We used a three-wave panel survey to examine the dynamic changes in the strength of the relationships between variables over time. Seven stores in an eastern Australian city that had recently been equipped with the self-checkout helped recruit the panel. Customers were approached after checking out through the self-checkout SST and were asked if they would take part in the study. Those who agreed were screened for eligibility. Eligible respondents were those who shopped regularly in the store and were still in the early stage of using the self-checkout SST. To avoid the situation that a customer might have used the SST in other stores, we required that respondents should not have used it more than five times previously. Immediately after the screening, respondents were asked to complete a questionnaire \((T_1)\) in which all the variables in the model were measured except for continued use. On completion, respondents were asked to leave their preferred contact information for the remaining two waves (mail, e-mail, or telephone). Six weeks later, the same respondents were contacted \((T_2)\) to measure all the variables, including continued use between \(T_1\) and \(T_2\). Six weeks after that, each respondent was again contacted \((T_3)\) and asked to provide information about continued use between \(T_2\) and \(T_3\) only. Control variables (customer demographics and psychographics) were captured at \(T_1\). We selected 6 weeks for the time interval between waves of surveys because it was long enough for customers to use the SST at least several more times before the next contact yet short enough for a longitudinal study and hence manageable in terms of time and cost. As with all panel studies, respondent attrition could not be avoided. To help reduce the attrition rate,
Measurement

We measured satisfaction with a 3-item, 7-point scale adapted from Spreng, MacKenzie, and Olshavsky (1996), anchored by dissatisfied/satisfied, unhappy/happy, and terrible/delighted. This scale has been successfully used in prior technology studies (e.g., Bhattacherjee 2001), and therefore it is considered relevant to the SST context. We measured self-efficacy with a single-item, semantic-differential scale based on guidelines from Bandura (1997) and adapted from Dabholkar and Bagozzi (2002). Respondents indicated their confidence in successfully using the self-checkout SST, followed by a 7-point scale anchored by not at all confident and totally confident. The theoretical argument in favor of a single-item measure comes from Rossiter’s (2002) C-OAR-SE framework, which suggests that for many constructs consisting of a concrete singular object and a concrete attribute, single-item measures should be used (e.g., Bergkvist and Rossiter 2007). We measured behavioral intention with a single-item, 7-point Likert-type scale, which asked respondents the extent to which they agreed or disagreed with the statement “Next time I shop at this store, I will use the self-checkout SST no matter what” (1 = strongly disagree, 7 = strongly agree). This is in line with the operationalization of the construct in many widely used theories. We measured habit with a 3-item, 7-point, Likert-type scale originally developed by Limayem and Hirt (2003) and refined by Limayem, Hirt, and Cheung (2007). Respondents indicated the extent to which they agreed or disagreed with the statements “Using the self-checkout SST is part of my shopping routine at this store”; “When checking out at this store, the self-checkout SST is an obvious choice for me”; and “Using self-checkout SSTs has become automatic/natural to me.” We used this scale for its relevance (IS usage context), parsimony (3 items), and recency (year 2007). To obtain continued SST use, we asked the respondents to report the percentage of time they used the self-checkout SST during the past 6 weeks when shopping at the store. Note that this was a self-reported measure and we used it as an estimation/approximation of the actual continued SST use. For a more robust test of our hypotheses, demographic and psychographic variables served as the control variables.

Sample Description

In total, 268 eligible respondents were obtained at $T_1$, 210 from the store panel and 58 from the online panel. After $T_1$, 126 respondents dropped out, resulting in 142 panel members at $T_2$ (106 in the store panel and 36 in the online panel). The attrition rate was 49.5% and 37.9% for the store panel and the online panel, respectively. This was slightly better than the average attrition in a longitudinal study, which is approximately 50% (Sudman and Wansink 2002; Taris 2000). At the end of $T_3$, 85 respondents from the store panel and 30 from the online panel remained, resulting in a final sample size of 115.

According to a series of independent-samples $t$-tests, there was no significant difference ($p > .05$) between the store panel and the online panel in terms of the means of the key constructs and the control variables in the model. Factor analysis of multi-item constructs showed that all the factor loadings were highly consistent, indicating measurement invariance across the two panels; this allowed for the pooling of data from the panels. Another series of independent-samples $t$-tests checked for nonresponse bias among the three groups of respondents (those who dropped out after $T_1$, those who dropped out after $T_2$, and those who did not drop out). The results indicated no significant difference ($p > .05$) in terms of their demographics and SST attitudes and behaviors. Thus, dropping out was considered random and not systematic, and nonresponse bias was not considered an issue.

The final sample covered a wide range of age groups. Female respondents accounted for 72.2% of the sample. More than half the respondents held a university degree or higher. Although the data did not strictly follow a normal distribution ($p < .05$ in normality tests), they were marginally normally distributed because most variables had a skewness of less than 0.75 and a kurtosis of less than 1.5. Thus, measurement validation and hypotheses testing were based on the final 115 respondents across the three waves. Although the sample size was not ideal or preferred in structural equation modeling (SEM), it was adequate because (1) our model is relatively simple, with just six constructs; (2) our data are marginally normally distributed (judged from skewness and kurtosis); and (3) missing data were limited as a result of the data collection procedure (immediate check of completed questionnaires before giving incentives, compulsory answer to all questions in the online survey; Hair et al. 2006).

Results

Measurement Validation

Because we measured only two of the six key constructs (i.e., satisfaction and habit) with a multi-item scale, we estimated an overall measurement model with satisfaction and habit items to assess construct validity. The same measurement model was estimated at $T_1$ and $T_2$. Table 2 shows the results of the confirmatory factor analysis.

Overall, the $T_1$ measurement model fit the data well, with CMIN/df less than 2 (1.183); $p$ value greater than .05 (.305);
Hypotheses Testing

Table 2. Summary of CFA Results.

<table>
<thead>
<tr>
<th></th>
<th>$T_1$ Measurement Model</th>
<th>$T_2$ Measurement Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall model fit</td>
<td>CMIN/df</td>
<td>1.183</td>
</tr>
<tr>
<td></td>
<td>$p$ value</td>
<td>0.305</td>
</tr>
<tr>
<td></td>
<td>CFI</td>
<td>0.986</td>
</tr>
<tr>
<td></td>
<td>RMSEA</td>
<td>0.040</td>
</tr>
<tr>
<td></td>
<td>SRMR</td>
<td>0.030</td>
</tr>
<tr>
<td></td>
<td>GFI</td>
<td>0.965</td>
</tr>
<tr>
<td></td>
<td>AGFI</td>
<td>0.909</td>
</tr>
<tr>
<td>Factor loadings</td>
<td>SAT</td>
<td>HAB</td>
</tr>
<tr>
<td>SAT1</td>
<td>0.957</td>
<td>0.987</td>
</tr>
<tr>
<td>SAT2</td>
<td>0.992</td>
<td>0.988</td>
</tr>
<tr>
<td>SAT3</td>
<td>0.941</td>
<td>0.905</td>
</tr>
<tr>
<td>HAB1</td>
<td></td>
<td>0.950</td>
</tr>
<tr>
<td>HAB2</td>
<td></td>
<td>0.954</td>
</tr>
<tr>
<td>HAB3</td>
<td></td>
<td>0.930</td>
</tr>
<tr>
<td>Construct statistics</td>
<td>AVE</td>
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</tr>
<tr>
<td>CR</td>
<td>0.975</td>
<td>0.961</td>
</tr>
<tr>
<td>Correlation</td>
<td>0.748</td>
<td></td>
</tr>
</tbody>
</table>

Note. AGFI = adjusted goodness-of-fit index; AVE = average variance extracted; CFI = comparative fit index; CR = composite reliability; GFI = goodness-of-fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

The vast majority of PLS results mirrored the SEM results, appropriate to verify parameter comparisons because parameters can be estimated independent of sample size in PLS. The vast majority of PLS results mirrored the SEM results, thus providing confidence in the results despite a modest sample size.

Hypothesis 1a suggests a positive impact of intention on continued use. We find partial support for this hypothesis; the positive impact was significant in the first model ($\beta = .245$) but nonsignificant in the second model ($\beta = .098$). This change in the path coefficient was consistent with Hypothesis 1b, which proposes that the impact of intention on continued use weakens over time ($p < .1$). Therefore, Hypothesis 1b was fully supported. Hypothesis 2a posits a positive impact of habit on continued use. This was confirmed; the path coefficient was significant and positive in both models ($\beta = 0.769$ and 0.597, respectively). However, contrary to Hypothesis 2b, the positive effect of habit on continued use weakened over time ($p < .05$). Thus, Hypothesis 2b was rejected. Hypothesis 3 posits a positive effect of intention on habit; this was partially supported, but with mixed results. While the path coefficient was positive...
in both models ($\beta = 0.178$ and 0.254, respectively), it was only significant in the second model. Together, the results for Hypotheses 1 and 3 indicate that habit mediates the impact of intentions on habit over time.

Regarding the role of satisfaction, Hypothesis 4a posits a positive impact of satisfaction on intention. This was fully supported; the path coefficient from satisfaction to intention was significant and positive in both models ($\beta = 0.385$ and 0.575, respectively). The results also support Hypothesis 4b, showing a significantly stronger impact of satisfaction on intention over time ($p < .05$). Hypothesis 5a posits that satisfaction has a positive influence on habit. This was supported; the path coefficient was significant and positive in both models ($\beta = 0.351$ and 0.570, respectively). Hypothesis 5b was also supported; a $\chi^2$ difference test showed a significant increase in the path coefficient between satisfaction and habit ($p < .05$).

Hypothesis 6a posits that self-efficacy has a positive influence on intention. The path coefficient from self-efficacy to intention was significant and positive in both models ($\beta = 0.487$ and 0.306); thus, Hypothesis 6a was fully supported. Hypothesis 6b was also supported; the positive influence of self-efficacy on intention significantly weakened over time ($p < .05$). Hypothesis 7a proposes that self-efficacy has a positive impact on habit. This was fully supported; the path coefficient from self-efficacy to habit was significant and positive at both periods ($\beta = 0.357$ and 0.182, respectively). Finally, Hypothesis 7b was supported; the impact of self-efficacy on habit weakened over time ($p < .1$). Figure 3 provides a summary of the hypothesis testing.

**Discussion**

Previous research has argued that though the initial adoption is an important first step in implementing successful SSTs, the long-term viability of an SST and its eventual success depend on its continued use rather than first-time use (e.g., Bhattacharjee 2001; Eriksson and Nilsson 2007). Surprisingly, despite the call for moving SST research forward by focusing on continued use (e.g., Curran and Meuter 2005; Meuter et al. 2005), prior to this study, little, if any, effort has been made to fill this literature gap.

The primary purpose of this study then was to understand the drivers of continued SST use from a dynamic, longitudinal perspective. We proposed that continued SST use is driven by both customers’ intention and habit, which in turn are driven by satisfaction and self-efficacy. Overall, we found that as experience accumulates and learning occurs, customers’ decisions to continue using an SST are initially rational driven (self-efficacy), then largely emotional driven (satisfaction), and, finally, habitual (habit).

Our findings show that customers’ intentions directly influence their initial use of an SST. Over time, however, the impact weakens to the extent that it only influences future behavior indirectly via habit. That is, habit fully mediates the impact of intentions on behavior. Hence, although intentions may drive initial adoption behavior, they are inadequate in explaining repeat behavior, such as continued SST use. Conversely, habit has a direct impact on behavior over time, and its impact is consistently stronger than intentions. Thus, habit seems to be a better predictor than intentions. However, although this finding holds in this study’s context (i.e., use of a supermarket self-checkout SST—a frequent, regular task), it may not hold in other SST settings in which the frequency of use is low, such as online flight check-in. In such a case, habit is difficult to form because of limited repetition, and intentional reasoning may still be needed each time customers decide to use the SST.

Contrary to our hypothesis, the effect of habit weakens slightly over time. This is likely due to the strong effect of habit.

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**Figure 2.** Full structural model in SEM. SAT = satisfaction, EFF = self-efficacy, INT = behavioral intention, HAB = habit, USE = continued use, NHI = need for human interaction.
However, we did not expect this because respondents did not have a chance to form a habit after just several SST trials. One explanation could be that respondents in our sample had experience with other SSTs or technology in general, and this product norm experience contributed to the formation of the habit of using the focal SST.

For the roles of satisfaction and self-efficacy, we found that self-efficacy has a strong impact initially, but over time, satisfaction plays a more influential role in driving intentions and habit. This means that in the early stage of SST adoption, customers’ confidence in using an SST is critical in determining whether they will use it again. Furthermore, for use of an SST to become automatic and habitual, customers need to be able to use it without difficulty and deliberate thinking, which requires a high level of self-confidence. As customers accrue experience with the SST, self-confidence is no longer a major issue because users begin appreciating the advantages and benefits of using it. At this point, satisfaction becomes the driving force through habit and intention.

Managerial Implications

Our research findings provide several implications for service organizations offering an SST service option. First, managers should understand that producing both confidence and a satisfying service experience clearly affects customers’ willingness to use the SST again. Our results suggest that a dissatisfactory experience, combined with a lack of confidence in using the technology, is sufficient for customers to avoid the hassle and use the service from a frontline service employee. Therefore, managers should try to increase perceived skills and abilities, thus enhancing customer confidence. For example, some retail banks use “greeters” in branches to assist customers in migrating to in-branch banking technologies. This not only helps customers overcome any technology anxiety but also builds confidence in their ability to use the SST again. Another example is that some airlines have an assistant around to help with the check-in through the self-check-in kiosks at the airport. When customers believe that SST encounters are easy and convenient, they feel empowered and thus are more likely to opt for it again. Furthermore, providing clear instructions or built-in simulations can be effective in enhancing confidence levels in Internet-based- or kiosk-based SST contexts (e.g., a step-by-step demonstration of online banking). For more complicated SSTs such as tax return online, a comprehensive online tutorial or training is needed to equip users with necessary skills and abilities.

Second, in order to keep customers using an SST regularly, managers should undertake various measures to facilitate habit development. When a habit of use is formed, it is often difficult to suppress (e.g., Aarts and Dijksterhuis 2000). At the same time, a habit of not using is also difficult to break. Our results suggest that self-efficacy has a stronger impact on habit.
initially, and satisfaction plays a more influential role over time. Thus, managers should pay special attention to “ease of use” when designing and implementing an SST. This can be done through sufficient and appropriate pretesting among target customers. If customers find the SST easy to use, their self-confidence will increase, in turn facilitating the development of habitual behavior. Over time, as customers overcome the initial technology anxiety, managers can then focus on communicating the benefits of using the SST (e.g., control, time saving, fun to use) to them. At this stage, satisfaction is the main contributor to the formation of a habit of SST use. Finally, managers could force the use of an SST by offering only the SST service or a price differential between the SST and non-SST service options. Forcing the use of the SST is likely to lead to habit formation. However, this measure should be taken with caution because research has shown that forcing customers to use SSTs may have negative consequences such as negative attitudes toward using the SST as well as toward the service provider (e.g., Reinders, Dabholkar, and Frambach 2008).

Limitations and Future Research Directions
One limitation of this study is its small sample size. This is partially due to the panel study, in which attrition could not be avoided. Another reason might be the strict screening criteria for panel recruitment. Eligible respondents needed to have shopped regularly at a store and to have just begun using the self-checkout kiosk. However, our strict selection of respondents increases the validity of our findings. Further research could test our model with a larger sample in a different SST context (e.g., Internet-based or telephone-based SSTs) and/or in a different country, to determine whether the results are generalizable across different types of SSTs and/or different cultures.

Second, our results uncovered changing effects of satisfaction and self-efficacy and the importance of habit. However, it can be argued that a three-wave, 12-week longitudinal study may not be long enough to fully capture the changing pattern or the habit formation process. Previous research suggests that the effect of satisfaction on innovation adoption may follow a reversed U shape (Wood and Moreau 2006), and our study only captures the first half. Thus, further research could conduct a longitudinal study over a longer period to capture a more complete picture of customers’ post-adoption experience.

Finally, although our model shows that habit and behavioral intentions mediate the influence of satisfaction and self-efficacy on continued SST usage, other SST characteristics (e.g., ease of use, usefulness) may be relevant. For example, as Figure 1 depicts, we consider these factors initial antecedents influencing continued SST use indirectly through satisfaction and self-efficacy. However, our purpose was to test a parsimonious model of continued use, and therefore we did not add third-order effect variables in this study. Although prior research has examined some of the links between SST characteristics and satisfaction and self-efficacy (e.g., Limayem, Hirt, and Cheung 2007; Zhao, Mattila, and Tao 2008), further research could take a dynamic perspective and investigate how the impact of various SST characteristics may strengthen or weaken over time. Doing so would provide additional insight into effective SST management.

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Notes
1. In this study, a single sample provided data at different periods. This contrasts with the typical case in SEM when two or more independent samples provide data during the same period. Therefore, multigroup analysis is not appropriate for the $\chi^2$ difference test, and we use an alternative analysis procedure to test pairs of corresponding paths in the $T_1$–$T_2$ and $T_2$–$T_3$ models. First, we select a path in the $T_2$–$T_3$ model to be tested (e.g., satisfaction → habit) and fix its coefficient to the unstandardized value of the corresponding path in the $T_1$–$T_2$ model. Second, we reestimate the $T_2$–$T_3$ model and obtain a $\chi^2$ statistic. Finally, we compare the $\chi^2$ statistics from the
initial $T_2-T_3$ model and the reestimated $T_2-T_3$ model. The difference between the two is itself a $\chi^2$ statistic with one degree of freedom, which we check for significance. A significant value means that the path coefficient in the $T_2-T_3$ model is different from the corresponding path in the $T_1-T_3$ model.

2. We acknowledge Dr. Liem Ngo’s assistance in running PLS analysis when we revised the manuscript. Details of the PLS analysis can be supplied upon request.

References


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