J. of the Acad. Mark. Sci.
DOI 10.1007/s11747-007-0019-3

ORIGINAL EMPIRICAL RESEARCH

Self-service technology effectiveness: the role of design features and individual traits

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Received: 13 November 2006 / Accepted: 15 February 2007

Abstract Self-service technologies (SSTs), such as in-store kiosks, are increasingly prevalent and becoming a critical component of marketing. Researchers and practitioners alike have recognized the need to understand the effectiveness of these computer-based innovations for self-services—in particular, how to strengthen customers' perceived control over and evaluations of SSTs. Drawing on the resource-matching theory and the technology-based services and self-services literature, the authors hypothesize the interactive effects of two SST design features—namely, comparative information and interactivity—on customers' perceived control and interface evaluations. The authors then propose that the interaction pattern is further moderated by two individual traits: prior experience and technology readiness. The hypotheses are tested in two separate computer-based experiments with representative samples of the general U.S. population in a shopping environment. The findings support the hypotheses, enhancing knowledge in this emerging domain and providing important implications for managers and researchers.

Keywords Self-service technology effectiveness · Comparative information · Interactivity · Experience · Technology readiness · Resource-matching theory

Advances in information technology are fundamentally changing the marketing of goods and services (Vargo and Lusch 2004). One noticeable trend is the increasing use of self-service technologies (SSTs) by businesses. According to Meuter et al. (2000, p. 50), SSTs are "technological interfaces that enable customers to produce a service independent of direct service employee involvement." The services that SSTs provide are surprisingly varied, including monetary transactions (e.g., retail purchases), self-help (e.g., distance learning), and customer services (e.g., hotel checkout). Companies are drawn to SSTs by their promise of greater cost efficiencies, enhanced service quality, and attraction of new customers over in-person services (Parasuraman and Grewal 2000).

In their seminal conceptualization of SSTs, Alba et al. (1997) suggested that design features, such as interactive information searching and enhanced choice comparisons, are of considerable value to customers in computer-mediated shopping environments. More particularly, when these features of SSTs work well, customers believe that they have greater control over the service process and outcomes (which Bateson [1985b] termed "perceived control") and thus form favorable evaluations of the technologies and the services themselves (Hoffman and Novak 1996). Given these benefits, practitioners and researchers have attempted to understand how features of

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SSTs can be better designed to improve effectiveness from the perspective of customers. Although prior studies of SSTs and e-services have provided some evidence of the positive impact of individual design features (e.g., Coyle and Thorson 2001), little is known about the combined effects of multiple SST design features.

In our study, we address this knowledge gap by providing new insights into what may lead to greater SST effectiveness. More specifically, we examine two questions in our study. First, how do multiple SST design features, or what we term a "combined-feature design," influence perceived control and interface evaluation? The features we examine are *interactivity* (i.e., the degree to which users can modify the form or content of the mediated environment in real time; Steuer 1992) and *comparative information* (i.e., the amount of factual and evaluative information provided about competitive product offerings; Alba et al. 1997). Importantly, prior studies have suggested that the characteristics of customers also influence SST effectiveness (Langeard et al. 1981). Some users are more adept at exploring SSTs to obtain desired services, while others interact with innovations only reluctantly or with limited ability. Therefore, we examine the roles of two differentiating traits among users in SST effectiveness: prior experience with similar technologies, which helps a person become familiar with technology interfaces (Alba and Hutchinson 1987), and technology readiness (TR), or one's general propensity to embrace new technology (Parasuraman 2000). Thus, our second question is what role such individual traits have in determining perceived control and interface evaluation?

As we elaborate in the subsequent literature review, we draw on resource-matching theory, technology-based services, and self-services concepts to predict and explain the roles of design and user trait variables in SST effectiveness. On the basis of the theory and concepts, we posit that SST design features, such as comparative information and interactivity, represent the cognitive resources required in SST tasks. Individually, they enhance effectiveness; however, when the features are combined, they put an excessive burden on the user's cognitive processing and thus result in diminished control and evaluation (i.e., lower effectiveness). Furthermore, individual traits, such as prior experience and TR, moderate the effect of feature designs on SST effectiveness by representing resource availability, or customers' level of elaboration in the service tasks.

We answer the research questions through two experiments of live computer-mediated self-service encounters using representative samples of the general U.S. population. In Experiment 1, we test the individual and combined effects of interactivity and comparative information on SST effectiveness; in Experiment 2, we test the moderating effects of prior experience and TR.

Theoretical background

Resource-matching theory

Resource-matching theory describes the conditions under which cognitive tasks can best be achieved (Anand and Sternthal 1990; Petty et al. 1983). According to this theory, consumers have finite cognitive resources to process information and carry out information-related tasks. The more mental elaboration demanded in the tasks, the more cognitive resources are required. Importantly, the outcomes are optimized when the cognitive resources consumers make available equal or are "matched" by those required by the activities. When resources either exceed or fall below what is required, effectiveness of these activities is impaired. It has been well documented that the vividness of a stimulus message affects the favorableness of judgments. For example, a color, an image, or music can be used to induce elaboration so that resource availability approximates the resource requirement (e.g., Meyers-Levy and Peracchio 1995). Related research further suggests that people employ two kinds of evaluation strategies for information processing. Some customers are highly involved in handling a task; they engage in systematic or piecemeal processing strategies. Others invest less effort in information processing and make judgments based on peripheral cues, whether categorical knowledge, signs of quality, or ease of the processing task itself (e.g., Sujan 1985). The resource-matching theory has been well applied in advertising, branding, and other consumer research.

How can resource-matching theory guide SST studies? The theory suggests that the effectiveness of SST features depends on the match between cognitive resources available to customers and resources demanded by the features. Thus, SST design features that place much heavier or lighter cognitive loads on users than they are willing to carry will be less effective than features that do not. Notably, the theory also posits that individual traits or characteristics may influence a customer's involvement in and cognitive elaboration of information tasks (Peracchio and Meyers-Levy 1997). As a result, both the design of the SST interface (which affects the level of cognitive demand) and the traits of the customers (which modify the supply) are likely to determine effectiveness. Thus, a contribution of this study is the application of this well-regarded theory to understanding SST effectiveness. Nonetheless, it should be noted that we are not directly testing the resource-matching theory, but rather incorporating it into the study's conceptual foundation. Prior SST investigations have used other conceptualizations, including the technology-acceptance model and the theory of reasoned action (e.g., Dabholkar and Bagozzi 2002). Resource-matching theory offers a new perspective that emphasizes the cognitive dynamic that occurs during human-to-machine interactions; thus, we selected it as a logical and parsimonious concept for our study.

Technology-based services and self-services concepts

Perceived control The technology-based services and self-services literature points to perceived control as a key aspect of SST effectiveness. The term “perceived control” describes a subjective assessment of control over a task in an environment. In an SST setting, it refers to a customer’s sense of mastery over the processes and outcomes of the service interface (Langeard et al. 1981). It is also a situation-particular psychological outcome that is often influenced by environmental conditions and consumer traits, such as self-efficacy in handling a specific technology (e.g., Mittal et al. 2002). Services researchers were among the first in the marketing discipline to recognize the potency and relevance of perceived control. As they sought to distinguish between higher- and lower-quality services and their interactions, perceived control surfaced as a salient explanation. For example, Hui and Bateson (1991) argued that perceived control is the key to unlocking consumers’ emotional and behavioral responses to service encounters. They empirically determined that greater perceived control is associated with greater client satisfaction, deeper customer loyalty, and elevated service quality. Subsequently, researchers studying SSTs maintained that perceived control is a critical element in customer appraisals, driving intentions and use of the technologies (Zeithaml et al. 2002).

In considering cognitive resource principles, we theorize that perceived control evolves with cognitive and decisional efforts in a task; it is enhanced by the perceived opportunity to modify the nature of a stimulus interface, to obtain and appraise information, and to make choice decisions (Averill 1973). Because either navigating the interactive feature or comparing service choices involves mental effort, customers gain a sense of control and give favorable judgments of the stimulus (or SST) when they have sufficient resources to engage in these activities. Thus, we argue that the resource-matching theory provides conceptual support for explaining customers’ perceived control in SSTs. Such an explanation has been conjectured but not tested in the services literature (Bateson 1985b).

Interface evaluation The technology-based services and self-services literature suggests that interface evaluation is another core dimension of SST effectiveness. Interface evaluation refers to the judgments or attitudes formed about an SST on the basis of experience with that technology. Bateson (1985a) maintained that satisfaction with service technologies, along with perceived control, is an important customer outcome. Prior research has shown that customer satisfaction, which is often reflected in evaluations of a technology’s features (e.g., information provision, ease of use), determines use and adoption of an e-service. For example, Dabholkar and Bagozzi (2002) found that customers’ attitudes toward SSTs determine their intention to use them. Interestingly, business practices such as the J.D. Power Award adopt similar criteria for evaluating Web-based services. In studies of services beyond SSTs, we observe that satisfaction with services and delivery vehicles are commonly used and accepted as important gauges of effectiveness from the customer’s perspective (e.g., Vargo and Lusch 2004). Consequently, we include interface evaluation as a critical and logical indicator of SST effectiveness.

Effects of interface design features

The technology-based services literature indicates that interface design matters greatly to customers, affecting their perceptions of technologies and service encounters (e.g., Zeithaml et al. 2002). In our study, we focus on two design elements of the SST interface—namely, comparative information and interactivity—on which there has been limited systematic research in relation to effectiveness. Through SSTs, a firm can provide comparative information on its own offerings, those of rivals, or both (Lynch and Ariely 2000). Alternatively, a firm can provide interactivity in SST interfaces, a design feature that reacts to users’ requests, permits them to control information flow, and facilitates speedy and reciprocal communications (Ariely 2000). In our study, an interface that provides either comparative information or interactivity is considered a single-feature condition, whereas one that provides both features is termed a combined-feature condition.

Effects of single-feature design

Comparative information Previous research has identified information and choice as two of the most prominent antecedents of perceived control. Internalizing comparative information invites a series of cognitive actions, from reading about and differentiating among the items to linking and eliminating pieces of information (Bettman et al. 1990). Because these actions activate the idle cognitive resources available to customers, they may enhance customers’ sense of control and technology evaluations. Alba et al. (1997) suggested that informed choices in home-shopping interfaces lead to a higher degree of confidence in purchasing decisions and exert a positive impact on customers’ attitudes toward the shopping experience. In SST settings, choice comparisons assist in reducing the information asymmetry between customers and the service provider. As such, comparative information engages customers more in the decision-making process and produces a greater sense of self-determination about the services.

Interactivity Prior studies have suggested that the interactivity feature provides a stronger sense of control by presenting information in hierarchical layers and connected formats. Information given in this manner aids users in forming preferences and developing contingent strategies while browsing (Hoffman and Novak 1996). Because it is difficult for marketers to predict exactly which information each individual customer may need, interactive designs also allow users to select their own priorities and strategies of information processing. Another benefit of interactivity is stimulating excitement and flow in task processing, which results in positive subjective experiences (Novak et al. 2000). For example, the design of the Lands' End virtual dressing model engages customers cognitively and sometimes even physically when they select, rotate, and preview clothes tailored to their needs.

Following the logic of cognitive resources, we expect that a single-feature design in an SST interface, either comparative information or interactivity, vivifies customers' cognitive capacity and thereby elevates perceived control and interface evaluation.

Effects of combined-feature design

How does a combined-feature design influence the effectiveness of SSTs? One prediction might be that the impact of comparative information and interactivity features is simply additive, cumulatively accruing customer benefits or increasing SST effectiveness. However, the resource-matching theory and cognitive-resource principles suggest the opposite. Because customers have finite cognitive resources, they are subject to resource shortages when the resources demanded by SST features surpass those that they have available (e.g., Anand and Sternthal 1990). In electronic-shopping environments, the demand for customers' cognitive search abilities—that is, the cost of making sense of information sources and then sorting the information—increases exponentially as the number of stores and products grows. If customers are also stretched to master new technical features, their cognitive resources can fall considerably short of what is needed.

In support of this argument, prior consumer research has shown that multiple tasks can increase cognitive load and thus impede task effectiveness. For example, in a maze-learning study, Richardson et al. (1981) found that participants who were required to define their pattern of maze learning and to play the game performed worse than those who only played the game; apparently, handling two challenging tasks concurrently exceeded available cognitive resources and diminished performance. Along the same lines, customers perform two tasks in an SST process: (1) they cognitively comprehend the content and consequences of service choices, such as the terms and charges of a service delivery, and (2) they behaviorally manage the sequence of message navigation and configure the service procedure to achieve their desired outcomes. Because both tasks require intensive information processing, excessive cognitive demands can lead to a resource deficiency and a subsequent decline in the SST's effectiveness (Ariely 2000). Therefore, we predict that when customers are faced with a combined-feature design, they will experience diminished perceptions of control and give lower evaluations of the SST interface than when they encounter a single-feature design.

Hypothesis 1 A single-feature design (whether interactivity or comparative information alone) has a higher positive effect on perceived control than a combined-feature design.

Hypothesis 2 A single-feature design (whether interactivity or comparative information alone) has a higher positive effect on interface evaluation than a combined-feature design.

Experiment 1

Materials and methods

We designed Experiment 1 to examine the effects of comparative information and interactivity on the effectiveness of SSTs. Using a computer-based experiment, we tested the hypotheses by simulating the self-service process that occurs with the use of airport car-rental kiosks. This method allowed participants to respond to and evaluate the SST on the basis of their actual interaction with the technology rather than to a hypothetical service scenario, though the latter method has been commonly used. Interacting directly with the technology medium (rather than imagining the interaction) enabled participants to form a sense of control (or not) over the environment and to assess the technology fully.

We selected the car-rental kiosk setting because renting a car is a common experience and car-rental companies are increasingly offering a technology interface to complete rental transactions. The setting is also a typical example of transaction-type interfaces, according to Meuter et al.'s (2000) categorization of SSTs. To ensure the realism of the SST interface, we examined the form and content of the comparative information, interactive features, and service processes of 15 commercial Web sites (e.g., http://www.Hertz.com, http://www.Budget.com, http://www.Enterprise.com) and then selected those that were appropriate to incorporate into the simulation. To create the interface, we employed the programming language MacroMedia Director 8. Finally, we used a hypothetical brand name to control for participants' familiarity with the service supplier and to eliminate the possibility of brand bias.

Stimuli

We conducted an experiment with four scenarios with a 2 (presence versus absence of comparative information) × 2 (interactive versus static interface) design. We provide examples of the comparative information and interactivity features in Panel A of the Appendix.

On the basis of the literature on information search in computer-mediated environments (Alba et al. 1997) and e-service quality (Zeithaml et al. 2002), we composed two features for an interface that provided comparative information. First, participants observed the availability of alternative rental agencies at the beginning of the rental process. Second, the interface compared detailed information about car models and price ranges for rentals. To facilitate customers' comparisons of price and vehicle models, the rental rates for the various car models available from the car-rental firm appeared next to the rates from the rival firms. This information was not available in the interface without comparative information.

Consistent with previous studies on interface interactivity (Hoffman and Novak 1996; Steuer 1992), we built three navigational features into the interactive interface. First, a real-time reaction with no response delay characterized the interactive interface; a three-second response delay to any click on the screen occurred in the static interface. Second, the responsiveness of the interface was manipulated by instantaneously changing images on the screen according to the position of the mouse in the interactive interface. For example, maps of car-rental outlets automatically popped up when customers pointed their mouse at the vehicle pickup locations, and vehicle images appeared on the screen when customers pointed to the model list. These features were not available in the static interface. Third, we created user control features by adding hyperlinks and "back" buttons in the content pages to facilitate browsing in the interactive interface. In addition, information about car models was sorted hierarchically, so that participants could select and withdraw information about only the vehicle categories in which they were interested. This setting was absent in the static interface.

Participants

Participants of the study were 141 consumers recruited from four shopping malls in four states (California, Texas, New York, and Illinois) whose demographic profiles reflected that of the U.S. population. Because prior studies have found that demographics can influence SST adoption (e.g., Meuter et al. 2005), we established sample quotas for age, gender, education, ethnicity, and household income based on the U.S. census data.[1] Such quotas enabled us to control for the impact of demographic features and to enhance the generalizability of our research findings.

Task and procedure

Customers in the selected shopping centers were approached randomly and screened for qualification by trained interviewers. Qualified participants were led to a separate area equipped with computer facilities and assigned randomly to one of four technology interfaces. Next, they were asked to use an airport car-rental kiosk to rent a car for a 3-day round trip. We collected measures of participants' perceived control and interface evaluation through a computer interface at the end of the transaction. To verify the effectiveness of the manipulation, participants also completed a paper-and-pencil questionnaire after the SST experience. Each participant took approximately 10 min to complete the study. Finally, participants were thanked, debriefed about the research, and given a $5 gift.

Manipulation checks

We ran a full analysis of variance (ANOVA) model to verify the effectiveness of the comparative information and interactivity manipulations. We used the mean of two items ("I found alternative service suppliers through this technology" and "I had full information about choices" with a scale anchored by 1 = *strongly disagree* and 7 = *strongly agree*) to check the manipulation of comparative information (r=0.56). For interactivity (Cronbach's α=0.90), we used seven items ("little waiting time," "loaded quickly," "stay in each step at my own pace," "focus on the content I had interest in," "browse pages back and forth easily," "responded correspondingly to the request I entered," and "offered information related to the message I entered earlier") that also had a scale anchored by 1 (*strongly disagree*) and 7 (*strongly agree*).

[1] Of the participants, 50% were between 18 and 34 years of age, and 50% were between 35 and 50 years of age. Female participants accounted for 50% of the sample. Approximately 25% of the participants had grade school or lower education; 50% finished high school, technical school, or vocational school; and 25% had a college or higher degree. Of the participants, 60% were Caucasian, 20% were African American, 10% were Asian, and 10% were Hispanic. In addition, 25% reported an annual household income of less than $25,000, 50% reported between $25,000 and $79,000, and 25% reported more than $79,000.

Participants perceived significant differences in availability of comparative information between the two manipulations (M_{present}=5.16, M_{absent}=4.28; $F(1, 137)=10.89$, $p<0.01$). Participants in the interactive and static conditions also differed significantly in their perceptions of interactivity ($M_{\text{interactive}}$=5.52, M_{static}=4.98; $F(1, 137)=5.75$, $p<0.05$). None of the other effects were significant.

Effects on perceived control and interface evaluation

We adopted three scales from previous studies (Hui and Bateson 1991; Mehrabian and Russell 1974) to measure perceived control. Respondents indicated whether they agreed that "while working with the service technology, I felt in control/dominant/decisive" (1 = *strongly disagree*, and 7 = *strongly agree*). The three items indicated high reliability (Cronbach's α=0.92) and were averaged as a measure of perceived control. To assess interface evaluation, instead of using general measures such as *like/dislike* or *good/bad*, we followed Petty and Cacioppo's (1996) suggestion to use more "issue-relevant" measures. In line with the e-service quality literature (Zeithaml et al. 2002) and commonly used business standards for interface evaluations, such as J.D. Power's criteria for online investment firms, we asked respondents to specify how much they agreed that the SST had been "resourceful, flexible, and satisfactory" (1 = *strongly disagree*, and 7 = *strongly agree*) (Cronbach's α=0.92).

To confirm the validity of the measures, we conducted a confirmatory factor analysis comprising measures of comparative information, interactivity, perceived control, and interface evaluation. The overall model fit was satisfactory ($\chi^2_{(79)} = 129.54$, $p<0.05$: Root Mean Square Error of Approximation [RMSEA]=0.06; Standardized Root Mean Square Residual [SRMR]=0.05; Goodness-of-Fit Index [GFI]=0.90; and Confirmatory Fit Index [CFI]=0.97), and each measure loaded significantly on the expected construct. A discriminant validity test indicated that perceived control and interface evaluation were two distinct constructs $\left(\Delta\chi^2_{(1)} = 33.57, p < .01\right)$.

We next tested the hypotheses by conducting two full ANOVAs, with interactivity and comparative information as the independent variables, the five demographic features (age, gender, ethnicity, education, and income) as covariates, and perceived control and interface evaluation as the dependent measures. The ANOVA revealed significant interactions between comparative information and interactivity on perceived control ($F(1, 132)=6.00$, $p<0.02$, $\eta=0.20$) and on interface evaluation ($F(1, 132)=5.09$, $p<0.03$, $\eta=0.19$). In addition, the main effects of comparative information were significant for perceived control (M_{present}=5.41, M_{absent}=5.02; $F(1, 132)=4.40$, $p<0.05$, $\eta=0.17$) and interface evaluation (M_{present}=5.59, M_{absent}=5.12; $F(1, 132)=5.73$, $p<0.05$, $\eta=0.21$). However, the main effects of interactivity were not significant for the dependent variables (for perceived control: $F(1, 132)=1.43$, $p>0.05$, $\eta=0.09$; for interface evaluation: $F(1, 132)=0.46$, $p>0.05$, $\eta=0.06$).

Hypotheses 1 and 2 predicted that a single-feature design would lead to greater perceived control and higher interface evaluation than a combined-feature design. Indeed, we found that the interactivity-feature-only and comparative-feature-only conditions led to significantly greater customer perceived control (5.58 vs. 5.04, $F(1, 132)=3.93$, $p<0.05$) and marginally higher interface evaluations (5.68 vs. 5.31, $F(1, 132)=2.26$, $p=0.07$) over the combined-feature design.[2] Therefore, Hypothesis 1 and Hypothesis 2 were supported.

Of the covariates, participants with more education perceived greater control and gave higher interface evaluations than did those with less education ($F(1, 132)=6.16$, $p<0.05$; $F(1, 132)=4.85$, $p<0.05$, respectively). Ethnicity also had significant associations with perceived control ($F(1, 132)=3.32$, $p<0.05$) and interface evaluation ($F(1, 132)=4.79$, $p<0.01$); that is, African Americans gave the highest interface evaluations (M=5.74), and Asian Americans gave the lowest (M=4.24). Other demographic features did not have any significant associations with the dependent measures. None of the additional tests of interactions between the covariates and the interface features on the dependent variables were significant (all ps>0.05).

In summary, Experiment 1 revealed that customers experience a greater sense of control and render higher interface evaluations when equipped with a single SST feature design, one that is ample but does not surpass their processing abilities. Inserting a second feature, though technically feasible, may exceed a cognitive tipping point and cause customers to believe that they have diminished control over the SST, resulting in a less satisfying experience.

Effects of individual traits

In Experiment 2, we examine the impact of individual differences on SST effectiveness. Resource-matching theory points to significant differences in the information-processing strategies of people with lower versus higher cognitive

[2] As an additional analysis, we examined the condition in which neither interactivity nor comparative information was provided, which we termed the "null condition." Resource-matching theory would suggest that the null condition would result in an overabundance of cognitive resources because there is very little to engage users. This state should increase tedium and lower SST effectiveness. Consistent with the theory, the null condition resulted in significantly lower perceived control over the single-feature conditions (5.58 vs. 4.75, $F(1, 132)=5.06$, $p<0.05$).

involvement (Petty et al. 1983). For example, Peracchio and Meyers-Levy (1997) demonstrated that less motivated people apply few resources to process an advertisement, relying heavily on simplifying heuristics or their internal knowledge of the subject. In contrast, more motivated people apply greater cognitive resources and use that abundance to elaborate on complex advertisements. In either case, only when the resources required for the task are commensurate with those provided by the individual can the effectiveness of the stimulation be maximized.

The consequences of processing strategy are likely to alter drastically under different SST design conditions. An SST design with a proper level of stimulation (e.g., a single-feature design) will benefit involved and motivated people, who assign sizable cognitive resources to their interactions with technologies and render judgments based on the substantial content provided. However, even highly involved and motivated people can be overextended. In a condition that requires extremely high resources (e.g., the combined-feature condition), the tension between the demanded and the available resources may be acutely intensified for these consumers. When using SSTs, these consumers are apt to follow a resource-consuming strategy and thus experience difficulties in processing all information systematically. This situation then undermines their cognitive performance and evaluations of the SSTs.

In contrast, less involved and motivated people allot a smaller portion of their cognitive resources to information-related tasks. They process information unsystematically and spottily to reduce their exposure to stressful cognitive challenges (Petty et al. 1983). Although these consumers have made fewer resources available, their strategy of selective processing demands fewer; this resource mismatch may cause less favorable psychological outcomes. When using SSTs, these consumers may apply simple heuristics associated with superficial cues, such as focusing on the graphics of a Web interface or the number of choices provided (but they may not attend to the content of those choices). Paradoxically, this peripheral route protects them from experiencing a cognitive deficit in a demanding setting. As a result, these users may believe that they have a greater sense of control over and give more favorable evaluations to a combined-feature design than a single-feature design.

In this experiment, we examine two individual traits that represent varying levels of cognitive involvement and motivation: prior experience with an SST and similar technologies and the general propensity to accept technologies, or TR. Traits such as inertia, novelty seeking, and need for cognition have been recently investigated (Dabholkar and Bagozzi 2002; Meuter et al. 2005), but prior experience and TR, which are intrinsically tied to a customer's motivation to use SSTs, have not been empirically examined. In this experiment, we classify active participants as those who are novice SST users or high in TR and inactive participants as those who are experienced SST users or low in TR.

Prior experience

Following Alba and Hutchinson's (1987) concept of familiarity, we define prior experience as the number of occasions a customer has used a similar technology interface to fulfill service needs. Studies in consumer experience reveal that cognitive activation decreases markedly as a function of familiarity with a given simulation situation (Bargh 2002). Experienced customers rely mainly on their internal knowledge and ignore outside messages (Alba and Hutchinson 1987). Sujan (1985) determined that experts use more general categorical knowledge in evaluating cameras, whereas novices use more piecemeal or attribute-specific evaluations. We expect that because perceived control increases when users can better predict the consequences of their choices and events (Averill 1973), experienced users may fail to appreciate the meaningful new information provided by an SST feature, such as comparative information or interactivity. Conversely, according to Dabholkar (1996), unfamiliarity with an SST encourages novices to examine the attributes. Because novices cannot rely on previously acquired heuristics to maneuver through the SST interface, they are more likely to be curious about the service innovation and thus more willing apply effort to understand and apply its features.

On the basis of the previous discussion of the different processing strategies employed by customers, we expect that novice participants will achieve greater perceived control and higher interface evaluations when they are exposed to a single-feature design, whereas the experienced participants will not. Furthermore, because the experienced are less susceptible to cognitive overload, they may not sense a loss of control or give higher evaluations in a combined-feature-design condition than the novices. We propose a three-way interaction among comparative information, interactivity, and prior experience.

Hypothesis 3 A single-feature design has a higher positive effect on perceived control than a combined-feature design for novice consumers but not for experienced consumers.

Hypothesis 4 A single-feature design has a higher positive effect on interface evaluations than a combined-feature design for novice consumers but not for experienced consumers.

Technology readiness

Parasuraman (2000) defines TR as a person's general tendency to adopt new technologies to accomplish goals.

Unlike self-efficacy, which refers to a belief in one's ability to use a particular new technology, TR denotes a general predisposition to embrace any new technology (Dabholkar and Bagozzi 2002). Thus, a person's TR level is relatively stable over time and in a range of circumstances. In addition, TR differs from prior experience; the latter is a behavioral variable that does not serve as a stable indication of a person's willingness to accept a new technology. Customers of a service firm in one region could be more experienced than those in another area, simply because the firm rolls out the SST earlier in the first region. Customers might have been exposed to or even used SSTs in various situations, but in general, their propensity to accept a technology remains the same regardless of their experience level.

A person's cognitive involvement in an SST task varies according to his or her general tendency to approach or avoid technology innovations. In the self-services literature, Bowen (1986) found that participative, high-TR users of self-services are more likely to be impatient with human contact and to enjoy playing with machines than are low-TR consumers. Studies of the "personalness" of interactive media (e.g., Cowles and Crosby 1990) also indicated that people have different tolerances for replacing humans with machines. Because low-TR customers are more biased against technology, they often avoid technologies and choose to skip or withdraw from using empowering technical features (Dabholkar 1996). This tendency may greatly reduce resource demands when completing an SST task and thus leave low-TR customers with significant idle resources under a single-feature design. But when they use a combined-feature design, the avoidance propensity serves as a protective mechanism, reducing cognitive tension in this over-challenging service condition. Conversely, high-TR customers hold more optimistic views of the benefits of technology and are willing to take more initiative in adopting innovations. They may allot more resources to use and elaborate on either of the two features, which leads them to perceive greater control over and form better attitudes toward the SST. However, their enthusiasm of and dedication to technological exploration have a potential downside: over-exposure to technical features that overwhelm their cognitive capabilities. As a result, they may experience a loss of effectiveness under a combined-feature condition. Accordingly, we posit a three-way interaction among comparative information, interactivity, and TR on SST effectiveness.

Hypothesis 5 A single-feature design has a higher positive effect on perceived control than a combined-feature design for high-TR consumers but not for low-TR consumers.

Hypothesis 6 A single-feature design has a higher positive effect on interface evaluations than a combined-feature design for high-TR consumers but not for low-TR consumers.

Experiment 2

Materials and methods

We tested Hypothesis 3 through Hypothesis 6 by using a computer-simulated intelligent automated teller machine (ATM) interface, which was designed on the basis of prototypes of the next generation of intelligent ATMs, such as NCR's Personas series and Triton's Web-based ATM series. We selected the ATM setting for this experiment not only because ATMs have been used as the context in prior perceived control and self-service studies (e.g., Bateson 1985b), but also because they are readily accessible and highly relevant to participants. We expected to observe a wide spectrum of experience levels with the new features in the ATM interfaces, as is necessary to test the hypotheses. Moreover, the ATM technology interface represents the customer-service type of SST, which differs from the transaction type as exemplified by the car-rental kiosk in Experiment 1. Testing the proposed relationships in related but distinct SST contexts should enhance the generalizability of the findings. Similar to the control in Experiment 1, we used a hypothetical brand for the intelligent ATM.

Stimuli

We developed four intelligent ATM interfaces for Experiment 2 (presence versus absence of comparative information × interactive versus static interface). We manipulated the comparative information levels by providing two types of information in the present conditions but not in the absent ones. The first type of comparative information clarifies the locations and availability of other ATM stations and interpersonal bank services on the screen during the service process. The second type assists the self-ticketing service by providing other consumers' comments about movies and theaters allied with the ATM vendor. Such information offers comparative reference for the participants.

Similar to Experiment 1, three features of interactivity (real-time interaction, responsiveness, and user control) were injected into the interactive ATM interfaces. First, no response delay occurred for page changes or hyperlink connections for the interactive interface, whereas for the static interface, a 3-s delay occurred. Second, to supply more navigation power in the interactive setting, hyperlinks allowed users to retrieve different layers of details for the reviews and comments on the movie and theater choices through the intelligent ATM. Third, the pop-up images changed spontaneously with the position of the mouse pointer in the interactive ATMs only. For example, when customers began to choose locations, directions to the movie theater appeared on the screen. In

Panel B of the Appendix, we illustrate the features of the comparative information and interactivity designs. The customers' experience and TR levels were not manipulated but were measured and classified after the experiment was completed.

Participants, task, and procedure

One hundred twenty-seven customers in four shopping centers were successfully approached, screened, and invited to participate in the experiment. Participants of different ages, genders, education levels, ethnicities, and income levels were recruited to fit a quota frame similar to that used in Experiment 1. Participants were led to the experiment area in the shopping center and assigned randomly to one of the four ATM interfaces. The procedure started with an introduction to the technology. Next, participants were asked to purchase two movie tickets through the intelligent ATM. To avoid a time lapse in attitude measurement, participants' perceived control and interface evaluations were measured immediately upon task completion through the computer interface. We performed manipulation checks and measured participants' experience with similar ATM functions and their TR levels through a paper-and-pencil questionnaire after the experiment. To provide added verification of customers' cognitive involvement levels in the self-service process, we tracked the number of screens browsed by each participant and the time they spent using the SST features through the computer interface. On average, participants took 10 min to complete the study. Finally, participants were thanked, debriefed, and given a $5 gift.

Manipulation checks

The measures and process for checking the ATM simulations were similar to those for the car-rental kiosks in Experiment 1. The correlation between the two items measuring comparative information was 0.45, and Cronbach's alpha for the seven items measuring interactivity was 0.85. We used a full ANOVA to verify the manipulation effectiveness. As we expected, participants in the present- and absent-comparative-information conditions differed significantly in their perceptions of comparative information availability ($M_{\text{present}}=4.79$, $M_{\text{absent}}=4.17$; $F(1, 123)=5.55$, $p<0.05$). Participants in the interactive and static conditions differed significantly in their perceptions of interactivity ($M_{\text{interactive}}=5.46$, $M_{\text{static}}=4.84$, $F(1, 123)=8.75$, $p<0.01$). Again, none of the other effects were significant.

Measures

We measured participants' experience levels with the intelligent ATM functions by their prior usage of ATM functions other than cash withdrawal (1 = *never*, 4 = *occasionally*, 7 = *regularly*). Of the 127 participants, 52 had never used an ATM to purchase tickets, cash checks, pay bills, or perform functions other than simple cash withdrawal. We coded these participant as "novices" ($M=1.00$). The other 75 participant had used an ATM for functions similar to ticket purchases at least once, and therefore we coded them as "experienced" users ($M=4.59$). On average, the experienced group had significantly greater exposure to intelligent ATM functions than did the novice group ($t=18.01$, $p<0.001$).

We adopted four items with 7-point Likert scales from an original TR scale (Parasuraman 2000) to measure users' discomfort with technology in general (1 = *strongly disagree*, and 7 = *strongly agree*; Cronbach's $\alpha=0.68$). The four items were as follows: "When I get technical support from a company of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do," "If I buy a high-tech product or service, I prefer to have the basic model over one with a lot of extra features," "It is embarrassing when I have trouble with a high-tech gadget while people are watching," and "Technology always seems to fail at the worst possible time." We split the sample into two categories (high TR and low TR) according to participants' average means for the four measures. The high-TR group ($M=3.11$) had a significantly lower negative attitude toward technology than did the low-TR group ($M=5.06$, $t=14.58$, $p<0.001$). Neither the Pearson correlation between prior experience and discomfort with technology nor the chi-square test for the categorical groups of the two variables was significant ($r=0.08$, $p>0.35$; $\chi^2_{(1)}=1.58$, $p>0.05$, respectively). These findings indicate that prior experience and TR are conceptually different and empirically uncorrelated.

A supplementary analysis of participants' browsing behaviors also demonstrated differences in cognitive involvement between the novice and experienced groups. The novice group browsed slightly more screens (39% more, $p>0.05$) but spent 221% more time checking the frequently asked questions and help functions than did the experienced group ($F(1, 126)=3.26$, $p<0.05$). Consistent with our prediction, the high-TR group browsed 98% more screens ($F(1, 126)=4.05$, $p<0.05$) and spent 98% more time in the technology interface than did the low-TR group ($F(1, 126)=3.28$, $p<0.05$). These findings support our assumptions that novice users and high-TR users are cognitively more engaged in information processing during the SST interaction than experienced users and low-TR users.

We used the same scales from Experiment 1 to measure perceived control (Cronbach's $\alpha=0.88$) and interface evaluation (Cronbach's $\alpha=0.93$). All items loaded significantly on the expected constructs in a confirmatory factor analysis of six constructs (perceived comparative information, perceived interactivity, perceived control, interface evaluation, experience, and TR) ($\chi^2_{(157)} = 231.56$, $p<0.05$; RMSEA=0.05; SRMR=0.07; GFI=0.86; and CFI=0.95). We again confirmed that perceived control and interface evaluation were distinct constructs with a discriminant validity test $\left(\Delta\chi^2_{(1)} = 25.25, p < .01\right)$.

Impacts of prior experience and technology readiness

To test Hypothesis 3 through Hypothesis 6, we conducted two full ANOVA models with comparative information, interactivity, experience, and TR as the independent variables, the five demographic features as the covariates, and perceived control and interface evaluation as the dependent measures. The ANOVA revealed a non-significant four-way interaction for both perceived control ($F(1, 106)=0.66$, $p>0.05$, $\eta=0.06$) and interface evaluation ($F(1, 106)=0.10$, $p>0.05$, $\eta=0.01$). Experience and TR, respectively, had significant three-way interactions with comparative information and interactivity on perceived control and interface evaluation. We also found a significant, negative main effect of experience ($F(1, 106)=4.33$, $p<0.05$, $\eta=0.20$) on perceived control. We report cell sizes, means, standard deviations, and contrasts among conditions for Experiment 1 and Experiment 2 in Table 1.

Table 1 Experimental conditions and results of contrasts for experiment 1 and experiment 2

Experimental conditions					Perceived control		Interface evaluation	
		Interactivity	CI	N	Mean (S.D.)	Contrasts	Mean (S.D.)	Contrasts
Exp. 1	1—Null feature	Static	Absent	35	4.75 (1.61)	D_{12}: F=2.31*	4.84 (1.50)	D_{12}: F=2.89**
	2—Interactivity only	Interactive	Absent	32	5.32 (1.41)	D_{13}: F=8.50***	5.44 (1.50)	D_{13}: F=8.93***
	3—CI only	Static	Present	36	5.81 (1.29)	D_{24}: F=0.61	5.90 (1.29)	D_{24}: F=0.13
	4—Combined feature	Interactive	Present	38	5.04 (1.76)	D_{34}: F=4.77**	5.04 (1.76)	D_{34}: F=2.69**
Exp. 2: Novice Group	1—Null feature	Static	Absent	16	4.60 (1.45)	D_{12}: F=4.42**	4.85 (1.69)	D_{12}: F=3.65**
	2—Interactivity only	Interactive	Absent	11	5.88 (.85)	D_{13}: F=4.01**	6.03 (.84)	D_{13}: F=1.45
	3—CI only	Static	Present	13	5.77 (1.36)	D_{24}: F=2.79**	5.59 (1.10)	D_{24}: F=4.32**
	4—Combined feature	Interactive	Present	12	4.94 (2.13)	D_{34}: F=2.37*	4.72 (2.15)	D_{34}: F=2.00*
Exp. 2: Experienced Group	1—Null feature	Static	Absent	16	4.6 (1.79)	D_{12}: F=0.12	4.60 (1.62)	D_{12}: F=0.04
	2—Interactivity only	Interactive	Absent	21	4.43 (1.65)	D_{13}: F=0.48	4.71 (1.79)	D_{13}: F=0.42
	3—CI only	Static	Present	22	4.95 (1.43)	D_{24}: F=1.52	4.94 (1.60)	D_{24}: F=1.92*
	4—Combined feature	Interactive	Present	16	5.06 (1.44)	D_{34}: F=0.05	5.44 (1.32)	D_{34}: F=0.93
Exp. 2: High-TR Group	1—Null feature	Static	Absent	18	4.30 (1.58)	D_{12}: F=5.95***	4.37 (1.76)	D_{12}: F=8.61***
	2—Interactivity only	Interactive	Absent	15	5.60 (1.09)	D_{13}: F=4.25**	5.96 (.90)	D_{13}: F=4.13**
	3—CI only	Static	Present	18	5.31 (1.42)	D_{24}: F=3.91**	5.35 (1.48)	D_{24}: F=4.50**
	4—Combined feature	Interactive	Present	13	4.44 (1.90)	D_{34}: F=2.53*	4.72 (1.90)	D_{34}: F=1.24
Exp. 2: Low-TR Group	1—Null feature	Static	Absent	14	5.00 (1.59)	D_{12}: F=1.46	5.19 (1.38)	D_{12}: F=1.67*
	2—Interactivity only	Interactive	Absent	17	4.33 (1.72)	D_{13}: F=0.11	4.47 (1.85)	D_{13}: F=0.12
	3—CI only	Static	Present	17	5.20 (1.51)	D_{24}: F=3.83**	5.00 (1.45)	D_{24}: F=3.09**
	4—Combined feature	Interactive	Present	15	5.51 (1.45)	D_{34}: F=0.15	5.49 (1.53)	D_{34}: F=0.63

Degrees of Freedom for the F tests are (1, 132) in Experiment 1 and (1, 103) in Experiment 2.
*$p<0.10$, ** $p<0.05$, *** $p<0.01$, one-tailed for the contrast tests.
CI = Comparative Information; TR= Technology Readiness; N = cell size
D_{ij} = contrast between $Cell_i$ and $Cell_j$ (e.g., D_{12} = contrast between $Cell_1$ and $Cell_2$)

Impact of prior experience Hypothesis 3 and Hypothesis 4 predicted that the interaction between comparative information and interactivity on perceived control and interface evaluation would occur to novice customers, but not to experienced customers. We found that experience had a significant three-way interaction with comparative information and interactivity on perceived control ($F(1, 106)=5.23$, $p<0.05$, $\eta=0.23$) and on interface evaluation ($F(1, 106)=5.33$, $p<0.05$, $\eta=0.23$). As we predicted, the interactions between comparative information and interactivity on perceived control and interface evaluation were significant for the novice group ($F(1, 106)=6.65$, $p<0.01$; $F(1, 106)=5.54$, $p<0.02$, respectively), but not for the experienced group ($F=0.15$, $p>0.05$; $F=0.28$, $p>0.05$). Contrast analyses showed that for the novice group, the single-feature design resulted in greater perceived control (5.82 vs. 4.94, $F(1, 106)=4.41$, $p<0.01$) and higher interface evaluation (5.79 vs. 4.72, $F(1, 106)=4.84$, $p<0.05$) than the combined-feature design. However, such comparisons were not significant for the experienced group (for perceived control: 4.70 for the single vs. 5.06 for the combined, $F(1, 106)=1.26$, $p>0.05$; for interface evaluation: 4.83 for the single vs. 5.44 for the combined, $F(1,106)=1.92$, $p>0.05$).[3] These results provide support for Hypothesis 3 and Hypothesis 4.

Impact of technology readiness We predicted in Hypothesis 5 and Hypothesis 6 that the interaction between comparative information and interactivity would affect SST effectiveness among the high-TR group but not the low-TR group. The results of Experiment 2 revealed a three-way interaction among TR, comparative information, and interactivity on perceived control ($F(1, 106)=5.23$, $p<0.05$, $\eta=0.22$) and on interface evaluation ($F(1, 106)=6.72$, $p<0.01$, $\eta=0.24$). The interaction between comparative information and interactivity on the dependent variables was significant for the high-TR group (for perceived control: $F(1, 106)=8.11$, $p<0.01$; for interface evaluation: $F(1, 106)=8.62$, $p<0.01$) but not for the low-TR group (for perceived control: $F(1, 106)=1.31$, $p>0.05$; for interface evaluation: $F(1, 106)=2.21$, $p>0.05$). High-TR customers perceived greater control and gave higher interface evaluations in single-feature interfaces than in the combined-feature design (5.44 vs. 4.44, $F(1, 106)=4.64$, $p<0.05$; 5.63 vs. 4.72, $F(1, 106)=4.04$, $p<0.05$, respectively). The contrasts were not significant for the low-TR group (for perceived control: 4.76 for the single vs. 5.51 for the combined, $F(1, 106)=1.97$, $p>0.05$; for interface evaluation: 4.74 for the single vs. 5.49 for the combined, $F(1, 106)=1.6$, $p>0.05$).[4] These results provide evidence in support of Hypothesis 5 and Hypothesis 6.

Consistent with Experiment 1, we recruited actual shoppers from four geographic areas based on the U.S. population census. None of the demographic covariates affected perceived control at the $p<0.05$ level. For the effects on interface evaluation, only gender differences showed a significant impact ($M_{\text{male}}=5.43$, $M_{\text{female}}=4.78$, $F(1, 106)=4.19$, $p<0.05$). None of the covariates interacted with interface designs, experience, or TR on the dependent variables. As such, after controlling for the potentially higher variation in the sample due to its general population profile, we conclude that our findings on SST designs are robust and generalizable.

The results of Experiment 2 show that the interactive effects of interactive design and comparative information are moderated by a customer's experience and discomfort with technology. Novice customers or those that are highly technology ready allot a sizable portion of their cognitive resources to the SST task. On the one hand, their high involvement vivifies available cognitive resources in the single-feature-design conditions, thus triggering high perceived control and interface evaluation. On the other hand, in the combined-design condition, the resources needed to execute a thorough and systematic processing strategy become untenable, given limited cognitive resources. The effectiveness of SSTs is thus diminished. In contrast, when customers are either experienced or technologically uneasy, they are not motivated to experiment with the interactivity functions of the SST or to substantiate the price and service options in the comparative feature. Their low investment of cognitive resources in the SST task does little to create a sense of control over or favorable evaluation of the technology, regardless of whether it is a single- or a combined-feature design.

[3] Contrast tests showed that single-feature designs led to significantly greater perceived control (5.82 vs. 4.60, $F(1, 106)=3.09$, $p<0.01$) and higher interface evaluations (5.79 vs. 4.85, $F(1, 106)=2.03$, $p=0.08$) than did the null design condition for the novice group but not for the experienced-user group (for perceived control: 4.70 for the single vs. 4.60 for the null, $F(1, 106)=0.01$, $p>0.05$; for interface evaluation: 4.83 for the single vs. 4.60 for the null, $F(1, 106)=0.01$, $p>0.05$).

[4] Contrast tests indicated that single-feature designs resulted in greater perceived control (5.44 vs. 4.30, $F(1, 106)=5.64$, $p<0.01$) and higher interface evaluations (5.63 vs. 4.37, $F(1, 106)=5.09$, $p<0.05$) than did the null design condition for the high-TR group but not for the experienced–user group (for perceived control: 4.76 for the single vs. 5.00 for the null, $F(1, 106)=0.25$, $p>0.05$; for interface evaluation: 4.74 for the single vs. 5.19 for the null, $F(1, 106)=0.74$, $p>0.05$).

Discussion

As theorized in the technology-based services and self-services literature, interactive information searching and choice comparisons in technology-enhanced self-services both offer great value to customers (Alba et al. 1997). However, previous empirical studies of SST design features have generally focused on the benefits of a single technology feature and its main effects on customer outcomes. Yet as SSTs proliferate, the reality is that most of these systems are designed with multiple features and with little understanding of the combined impact of these features on users. Thus, we advance the SST literature by assessing the effectiveness of single- and multiple-feature designs.

We conceptually grounded our work in resource-matching theory as well as the technology-based services and self-services literature. The theory posits that whether SST features enhance or undermine consumers' perceived control or interface evaluations individually or jointly depends on (1) the resource demand side-that is, the amount of cognitive effort required to apply and process the interactive navigation and/or the comparative information in the SST interface; (2) the resource supply side-that is, consumers' motivation to perform the self-service tasks, which changes the level of available resources; and (3) the match between the two sides—that is, customers' cognitive resources that are actively used but not stretched beyond their limit for the tasks.

In Experiment 1, we tested the influence of the single and combined SST feature designs on effectiveness. As Hypotheses 1 and 2 predicted, interactivity and comparative information interferred with each other's positive impact on SST effectiveness. Overall, customers experienced a greater sense of control over and gave more favorable evaluations of the technology when they were offered a single SST feature than when both features were provided. On the basis of the resource-matching theory, we believe that on its own, either comparative information or interactivity can activate customers' information processing capacity and satisfy the need for cognitive activity during the self-service process. However, when comparative information and interactive features are both present in an SST interface, total demand for cognitive resources from the two tasks exhausts available resources, resulting in a cognitive deficit. The two feature designs likely compete for cognitive resources, thereby inhibiting the overall processing and decisional benefits. Insufficient cognitive resources in an over-challenging condition lead to the loss of perceptions of control and a decrease in interface evaluation.

In Experiment 2, we examined the moderating roles of two individual traits: prior experience and TR. We surmised from resource-matching theory that customers who are more activated or engaged by the service task (i.e., novices and high-TR users) apply a systematic strategy for SST task processing, whereas those who are less activated in the service process (i.e., experienced users and low-TR users) employ a peripheral or incomplete processing strategy. Because processing strategy influences the resource availability for cognitive tasks, SST effectiveness may differ between the two groups. In support of the corresponding hypotheses (Hypotheses 3–6), we found moderating effects of the individual traits on SST effectiveness in two three-way interactions. The interaction patterns found in Experiment 1 were replicated for the active group but not for inactive group in Experiment 2. An interesting exception to this pattern is that when the low-TR group was exposed to the combined-feature design, their perceived control and interface evaluations improved over the single-feature condition. Presumably, customers who were unwilling or unable to explore comprehensively a combined-feature design simply took the multiple-feature design as a heuristic cue signaling superiority. This finding provides further support of resource-matching theory's notion that unmotivated users either are fairly immune to stimulation or use a peripheral route in processing tasks to make judgments (e.g., Meyers-Levy and Peracchio 1995).

Findings from the two experiments provided strong and convergent support for the non-additive and moderated nature of the impacts of combined-feature designs on customer outcomes. Consequently, we must recognize that the insertion of more features can overtax users, resulting paradoxically in a loss of SST effectiveness. In extreme cases, customers' experiences with an SST can be tempered if even one single feature is overplayed in the interface because of their finite cognitive resources. By applying the resource-matching theory in the study, we are able to explain the interplay between multiple SST features and better understand the complex consumer responses induced by SSTs.

Managerial implications

Our study offers several promising implications for service firms attempting to develop and apply SSTs in their marketing strategies. First, the loss of SST effectiveness often stems from managers' misunderstanding of the appropriate metrics for measuring design outputs from the customer's perspective. A ubiquitous mistake in SST development occurs when firms attempt to apply the most cutting-edge technologies to compete for market attention but fail to consider customers' competence and preferences. Not surprisingly, such an investment can have an adverse impact on perceived control and customer satisfaction. Furthermore, service managers should understand that the same customers who are most frustrated or discouraged by excessive technologies are also the most active participants in service co-production—valuable customer groups in the diffusion of any service technology. Managers should learn that SSTs must be customer-centric. Our study clearly distinguishes objective design features from customers' psychological reactions, a distinction that suggests the need to use customers' perceived control and interface evaluations as metrics that can guide SST designs.

Second, our results indicate that there are multiple ways to build users' sense of control over SSTs. Although service firms with superior technological resources can depend on interactive tools to attract potential customers, our study indicates that providing informed service choices and comparisons can be equally effective. For companies with limited resources available to develop eye-catching technologies, providing comparative information can be a potent competitive strategy. In support of this, Forrester Research reported that price comparison has become more prevalent in online financial sites; the paybacks for providing such information in SSTs include more engaged and satisfied customers and a highly desirable, customer-oriented service image (Ensor et al. 2006).

Third, segmenting markets according to customers' behavioral and psychological characteristics has important implications for the diffusion strategies of SSTs. Currently, SSTs remain in their early stages, and most users can be characterized as highly technology ready. Although many customers are well motivated and relatively capable of handling the technical challenges of ever-evolving SSTs, as human beings, they nonetheless will have difficulty mastering interfaces that demand cognitive resources that exceed their limits. Only technologies that are responsive to users' capacity limits will be adopted quickly. As customers become more accustomed to SSTs over time, a greater proportion of experienced users will fill the market. Our findings suggest that managers should continue to improve SST technology and update comparative information to maintain the necessary novelty that motivates use. Meanwhile, a parallel challenge is to make the technology increasingly user-friendly to reach out to the many individuals who are less ready or tech savvy.

Finally, although our study centers on design features in the context of SSTs, we believe that the proposed effects of combined-feature design apply to other business contexts as well. For example, these effects should be readily found in various online purchase settings, for packaged goods and for services alike. "E-tailors" such as Amazon.com and E*Trade Financial are eagerly exploring mechanisms to streamline their offerings and promote greater online customer satisfaction. In line with our findings, cluttered interface designs that fail to understand customers' psychological reactions to technical tasks are doomed to drive them away. As more firms move their customer-support functions to cyberspace, the importance of understanding the effectiveness of interface designs will be increasingly evident.

Limitations and future research directions

We conducted our experiments in a laboratory setting, which limits the influence of any third party. In an actual SST setting, there are often third parties present, such as friends, family members, and other customers, who can modify the service process and outcomes by interacting with or assisting the user. If these peers share their knowledge and experiences of SSTs, the user may perceive greater control. Alternatively, the user could choose not to explore the technology interface to avoid embarrassing failures in front of the third party. Thus, the inclusion of third parties in further research on SSTs could elevate their realism.

In addition, our study explains customers' psychological outcomes by relying on resource-matching theory. We acknowledge that our study does not directly test this theory and that the dynamics of resource matching are inferred. Additional research should take direct measures of cognitive loading and demands and should explore other variables relevant to information processing, such as customer mood or affect. Some consumer behavior research has suggested the effect of mood on perceived control and service satisfaction (e.g., Keller et al. 2003). Along the same lines, further research might examine customers' prior experiences by assessing their expertise on SSTs. This would provide an alternative but more direct cognitive measure of internal knowledge in testing resource-matching theory.

In summary, this study demonstrates the influence of combined interface characteristics, as well as their interactions with individual traits, on SST effectiveness. Careful design of these interfaces, along with consideration of the differences that exist among users, can lead to more effective new technologies.

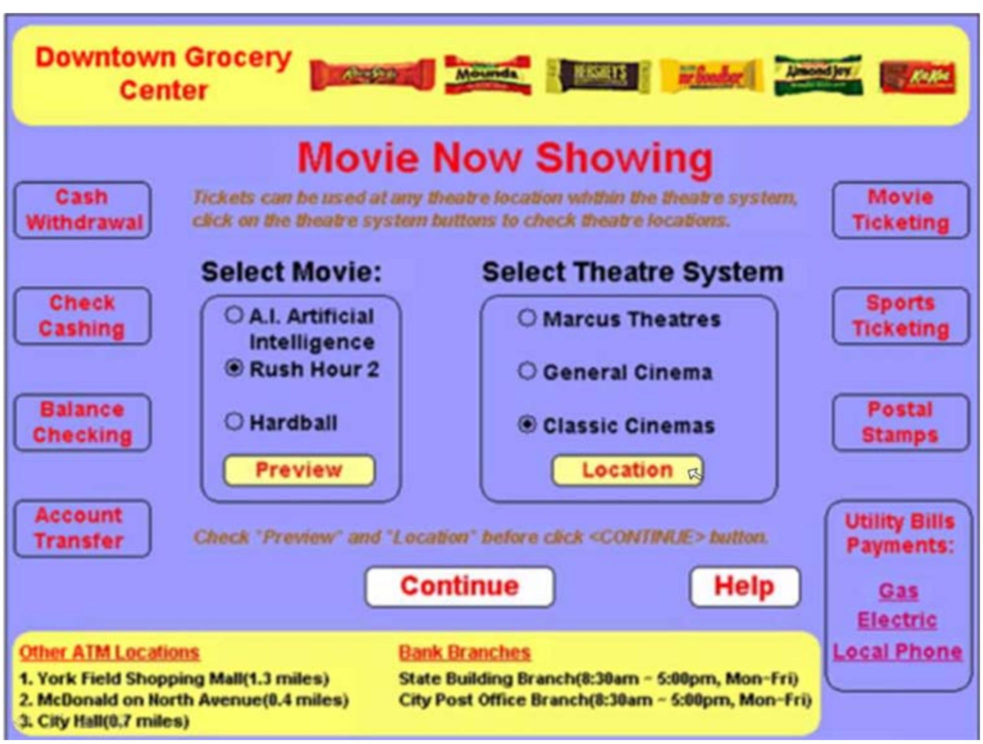
Acknowledgements The authors acknowledge a research grant from the Center for Research in Information Management at the University of Illinois at Chicago. They also thank the anonymous JAMS reviewers for their constructive comments and suggestions.

Appendix

Stimuli for the combined-feature designs

A: Experiment 1: Car-rental kiosk

B: Experiment 2: Intelligent ATM



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