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RESEARCH ARTICLE

FREEDOM OF CHOICE, EASE OF USE, AND THE FORMATION OF INTERFACE PREFERENCES[1]

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How does users' freedom of choice, or the lack thereof, affect interface preferences? The research reported in this article approaches this question from two theoretical perspectives. The first of these argues that an interface with a dominant market share benefits from the absence of competition because users acquire skills that are specific to that particular interface, which in turn reduces the probability that they will switch to a new competitor interface in the future. By contrast, the second perspective proposes that the advantage that a market leader has in being able to install a set of non-transferable skills in its user base is offset by a psychological force that causes humans to react against perceived constraints on their freedom of choice. We test a research model that incorporates the key predictions of these two theoretical perspectives in an experiment involving consequential interface choices. We find strong support for the second perspective, which builds upon the theory of psychological reactance.

Keywords: Interface preferences, ease of use, usability, user skills, consumer choice, psychological reactance, human capital, user based learning, psychological theory

Introduction

A great deal of attention has been focused on the potential power held by certain information technology companies that have gained dominant market shares (e.g., Microsoft, Google, Apple, etc.). Understandably, regulators have a keen interest in monitoring such companies and, where necessary, intervening to ensure a minimum amount of market competition. In the case of interfaces,[2] for instance, having a dominant market share can create the opportunity for a firm to, in effect, train its customers to develop user skills that are specific to its proprietary technology. Once people have learned to use the firm's unique interface, it may be difficult for them to switch to another interface that requires the acquisition of new skills and/or allows only for limited transfer of current skills. This type of competitive advantage can be characterized as "lock-in" based on firm-specific training (Shapiro and Varian 1999).

This notion has been formalized in models of human capital, which suggest that the acquisition of firm-specific user skills

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

[2]In this article, we use the terms *computer interface* and *interface* as defined by Benyon et al. (2005) to refer "those parts of the system with which people come into contact physically, perceptually and conceptually" (p. 12). Physical contact includes pushing buttons and clicking on the functional features of the interface (e.g., radio buttons, pull down menus, and hyperlinks). Perceptual contact refers to what the user sees. Conceptual contact refers to the user's efforts to try to work out what the interface does and what it should be doing, including messages from the device that help the user to figure it out. From this general perspective, the interface is an integral part of how people interact with computer systems and, thus, understanding how small changes in the functional design of the interface affect use and preference is important to the management of information systems (e.g., Benyon et al. 2005; Card et al. 1983; Murray and Häubl 2003).

tends to result in an incumbent firm or product gaining a dominant market position because this renders customers more likely to use the incumbent[3] in the future (Ratchford 2001; Stigler and Becker 1977) and, compounding this effect, less likely to consider alternative products (Wernerfelt 1985). The bottom line of this body of research is that skill acquisition is a powerful determinant of user preference, with the key to success being the ability to install in a customer base a set of non-transferable user skills before exposure to a competitor (Gefen et al. 2003; Kim and Son 2009; Murray and Häubl 2002; Venkatesh et al. 2002). An early mover with a dominant market share is in an ideal position to provide the necessary interface-specific training that creates this type of competitive advantage. This leads us to our fundamental research question: *How does freedom of choice, or the lack thereof, affect interface preferences?*

We approach this question from two theoretical perspectives. The first, outlined above, argues that an interface with a dominant market share benefits from the absence of competition because people acquire interface-specific user skills. This, in turn, reduces the probability that users will switch to a new competitor interface in the future. In contrast, the second perspective proposes that the advantage that a market leader has in being able to install a set of non-transferable user skills in its customer base is offset by a psychological force that causes humans to react against perceived constraints on their freedom of choice. Using an experiment that requires people to make consequential interface choices, we test a research model that incorporates the key predictions of these two theoretical perspectives (see Figure 1). The hypotheses illustrated in Figure 1 are discussed in detail in the following section.

The remainder of this article is organized as follows. The next section develops the hypotheses illustrated in the top portion of Figure 1, depicted in grey with dashed lines, which were derived from the human capital model (H1, H2, and H3). These predictions are based on the idea that repeated experience with an incumbent interface can lead to a preference for that interface via the development of user skills that are specific to it. Following that, we develop the hypotheses derived from the theory of psychological reactance, which are illustrated in the bottom portion of Figure 1 using solid black lines (H4, H5, H6, and H7). These predictions are based on the idea that perceived constraints on users' freedom of choice may counteract the positive effects of the development of non-transferable skills on preference for a particular interface. We then present the method and results of two studies—a pretest and the main experiment—that were designed to test the different predictions of these two theoretical perspectives. The paper concludes with a discussion of the theoretical and practical implications of our findings.

User Skills and Interface Preferences ■

Human skill acquisition is characterized by a particular pattern: task performance improves as a power function of the extent of practice (Card et al. 1983; Snoddy 1926). That is, practice at a task results in improved performance, and more practice leads to greater improvement, but it does so at a decreasing rate. This pattern is so ubiquitous in the performance of cognitive and motor tasks that it has been established as a psychological law: the *power law of practice* (for a review, see Newell and Rosenbloom 1981). In addition to improvements in task performance, practice also results in a decrease in the variance in performance across people as actions become automated and task completion times are minimized. Specifically, it has been demonstrated that, in addition to describing the decrease in the mean task completion time over trials, the power law also characterizes the decrease in the standard deviation (across people) of task completion times as a function of practice (Logan 1988). The power function improvement in performance has been accepted as a nearly universal description of skill acquisition. It is, in fact, commonly required as a benchmark prediction that theories of human skill acquisition must make to be taken seriously[4] (see, e.g., Anderson 1982; Crossman 1959; Logan 1988, 1992; MacKay 1982; Newell and Rosenbloom 1981).

Applied to understanding how freedom of choice affects interface preferences, the power law of practice has important implications. Specifically, it suggests a potentially critical difference in skill acquisition between those who are free to choose the interface that they will use for a given task and those who are constrained to using a particular interface.[5]

[3]Following Murray and Häubl (2007), we define an incumbent interface as the one that an individual has used most frequently in the past, prior to a new alternative becoming available.

[4]Although ubiquitous in studies of skill acquisition, there has been some debate over the psychological processes that drive the power-function shape of the learning curve (see Kirsner and Speelman 1996; Logan 1988; Palmeri 1999; Rickard 1997).

[5]To address our primary research question (i.e., *How does freedom of choice, or the lack thereof, affect interface preferences?*), our focus is on a comparison between users who are free to choose the interface that they use to complete a given task and those who do not have such freedom (i.e., those who are constrained). The literature motivating this comparison is discussed in detail in the following section, "Psychological Reactance and Interface Preferences."

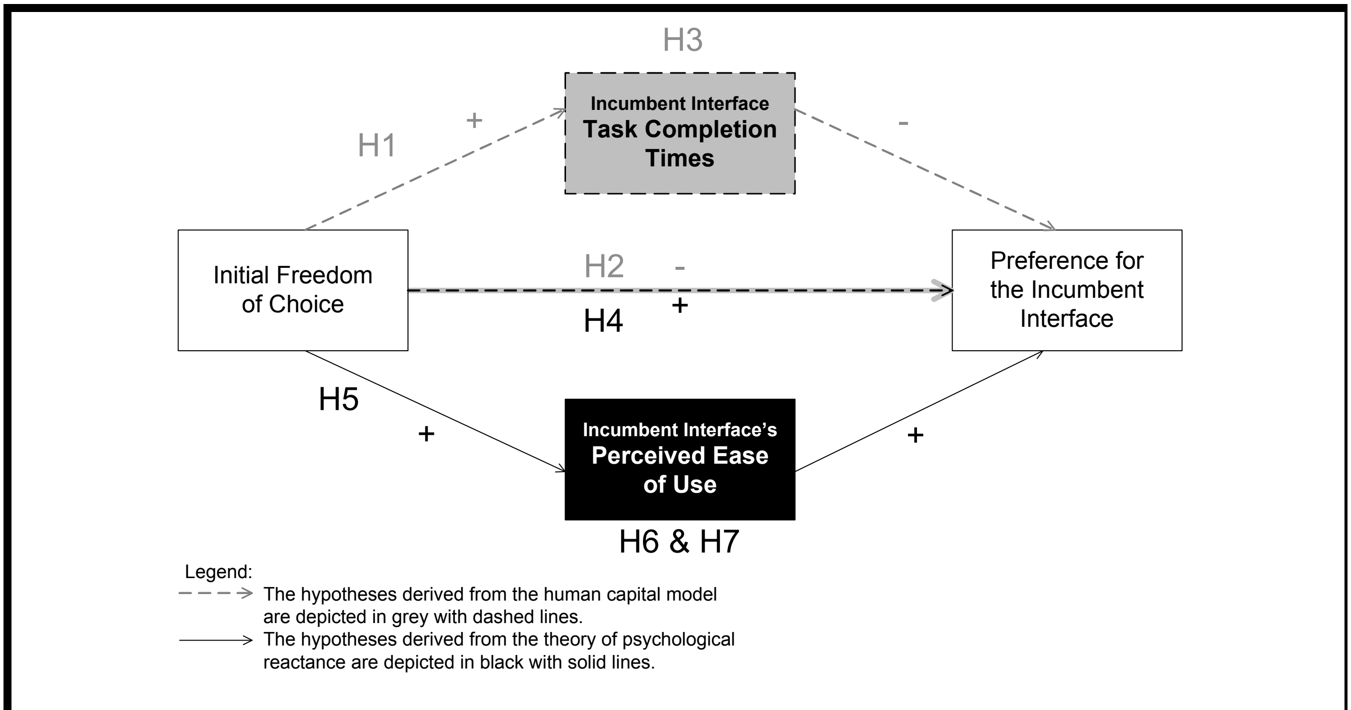

Figure 1. Research Model

Holding the total number of completed tasks constant for both the free and constrained users—and assuming that being free to choose among different interfaces leads people to use more than one interface—those users who are constrained will have more practice with a particular interface. As a result, in accordance with the power law of practice, task completion times will be lower for constrained users than for free users, because the constrained users will have had more practice with the interface. Therefore,

H1: Task completion time is lower for individuals who were initially constrained to using one interface, as compared to individuals who were always free to choose which interface they used.

Interestingly, although the power law of practice has traditionally played an important role in understanding the psychology of human–computer interaction (e.g., Card et al. 1983), only recently have the improvements in user performance that come with practice been related to users' interface preferences (e.g., Choudhury and Karahanna 2008; Gefen et al. 2003). Specifically, recent evidence links the efficiency gains made through practice with a particular interface to a strong preference for that interface (Johnson et al. 2003; Murray and Häubl 2003, 2007). This is especially true when the skills acquired during practice with an incumbent interface do not easily transfer to other, competing interfaces (Morris et al. 1999; Murray and Häubl 2002; Polson et al. 1987; Venkatesh et al. 2002). The underlying rationale for this type of loyalty is based on the notion of switching costs. To the extent that individuals would have to acquire new skills in order to use a competitor, a switching cost exists that locks them in to the incumbent (Wernerfelt 1985). As a result, an incumbent with an installed customer base possessing non-transferable user skills has a competitive advantage. In fact, this type of switching cost can be critical in developing a first-mover advantage (Carpenter and Nakamoto 1989; Lieberman and Montgomery 1988; Morris et al. 1999). Such switching costs may even be relevant in highly competitive markets, where choice is restricted by contractual commitments, organizational standards, or compatibility with existing assets (e.g., computer software and/or hardware) (Kim and Kankanhalli 2009; Shapiro and Varian 1999; Venkatesh et al. 2002).

In situations where skills that are specific to the incumbent are acquired over an extended period of time, resulting in substantial switching costs, finding a preference for the incumbent may not be overly surprising. For example, if an analyst is asked to switch from using one statistical software package to another (e.g., from SPSS to SAS), days or possibly even weeks of productivity may be lost as the user learns to complete familiar tasks using an unfamiliar interface. However, even extremely short periods of time and minuscule switching costs can have a significant impact on interface users' experiences and reactions. For instance, it has been shown that people can form an evaluation of a website within 50 milliseconds (Lindgaard et al. 2006). Of particular relevance to the current research are recent findings by Murray and Häubl (2007), which demonstrate that an incumbent website can gain a market share as large as 100 percent by saving consumers as little as 15 to 20 seconds. Thus, even very small differences in the amount of time required to complete a task can have a substantial impact on user choice.

The idea that the acquisition of skill, knowledge, or expertise—through education, training, or simply by doing—creates switching costs that affect the choices people make has been formalized in the human capital model (Becker 1996; Ratchford 2001; Wernerfelt 1985). From this perspective, the time savings that accrue as a result of the power law of practice have an economic value. The reduced time required to repeat practiced behaviors in the future means that things in which people have invested human capital (i.e., for which they have accumulated relevant skill and knowledge) will have a lower cost. Consequently, the human capital model predicts that, to the extent that repeated experience with an interface results in the acquisition of non-transferable user skills, people will tend to prefer the interface with which they have had the most experience.

Studies of online buying behavior have provided empirical evidence that links the power of law of practice to interface preferences as predicted by the human capital model (Johnson et al. 2003; Kull et al. 2007; Murray and Bellman 2010; Murray and Häubl 2003). When users learn to complete a task with the market leader's interface, without the opportunity to experience competing offerings, this creates a customer base that has an ingrained set of non-transferable user skills. As a result, if and when competitors enter the market, they are faced with the challenge of attracting users who have already invested time and effort in learning to use the incumbent's interface, which creates a switching cost and a potential barrier to entry. At the individual level, users who are constrained to a particular interface will develop a greater preference for it, as compared to people who are free to choose the interface they initially use, because through practice they have become more efficient at using it—that is, they will have had more practice with it and they will be able to complete tasks more rapidly with that particular interface than with other interfaces that they have not had as much practice using. Therefore,

H2: Preference for a particular interface is higher among individuals who were initially constrained to using that interface than among those who were free to choose which interface they used.

H3: The effect of freedom of choice on interface preference is mediated by (incumbent interface) task completion times.

Simply put, the above hypotheses predict that people who are constrained to use a particular interface while learning to complete a task will acquire more skill specific to that interface than people who learn to complete the same task using different interfaces. Interface preference is then determined by the amount of interface-specific skill that a user has acquired. Although this theory of interface preference is intuitively appealing, and well supported by prior research, in the following section we present an alternative set of hypotheses, which predict that freedom of choice has the opposite effect on users' preferences. Specifically, based on the theory of psychological reactance, we predict that being constrained to use a particular interface reduces the perceived ease of use of, and preference for, that interface.

Psychological Reactance and Interface Preferences

While the unavailability of competing interfaces should benefit a market leader by fostering the development of user skills that are specific to it, we propose that markets with limited choice also trigger an opposing force that has a detrimental effect on users' perception of, and preference for, the market leader. This force, known as *psychological reactance*, is set in motion by the lack of freedom of choice, and we propose that it can inhibit the formation of a strong preference for the market leader's interface. In this section, we discuss the theory of psychological reactance and outline how it leads to the hypothesis that, contrary to the predictions made above, greater freedom of choice while learning to use an incumbent interface actually has a *positive* influence on users' eventual preference for that interface.

According to the theory of psychological reactance, individuals react negatively when their freedom of choice is constrained (Brehm 1966; Brehm and Brehm 1981). For instance, if people believe that they should be free to choose between alternatives *a* and *b*, then being constrained to using alternative *a* can create psychological reactance. In a classic experiment, Hammock and Brehm (1966) led children to believe that they would be able to choose a toy in exchange for participating in an experiment. However, the children were randomly assigned to either a free-choice or a no-choice condition. In the free-choice condition, each child could choose between two available toys. In the no-choice condition, one of the two toys was selected for the child by the experimenter. The key comparison was between ratings of the toys' attractiveness before and after the children were either given a toy or allowed to choose a toy. When the choice was made for the children, the perceived attractiveness of the toy that they were given decreased and the attractiveness of the toy that they could not have increased. However, when children were allowed to choose a toy for themselves, the attractiveness of the toy that was chosen did not change, while the toy that was not chosen decreased in attractiveness.

Reactance effects have been observed in a number of different domains, including adults' resistance to persuasion attempts (e.g., Brehm and Sensenig 1966) and taxation (Wicklund 1970), responses to scarcity (Brehm and Brehm 1981; Brock and Mazzocco 2004), reactions to unsolicited recommendations (Fitzsimons and Lehmann 2004), health behavior (Gibbons et al. 2004), and clinical psychology (Brehm 1976; Shoham et al. 2004). This research has clearly established that, when people are constrained to one alternative, that alternative becomes less attractive to them than it would have been had it been freely chosen.

In an early study that is particularly relevant to the current work, Brehm and Rozen (1971) randomly assigned adults to one of two experimental conditions. In the first condition, participants were free to choose, from a selection of three novel foods (i.e., Argentinean desserts that were unfamiliar to them), one item that they would like to taste on each of five successive days. In the second condition, one dessert was selected for participants to taste on each of the five days—that is, their freedom of choice was constrained. On the sixth day, a new dessert alternative (i.e., cherry cheesecake), which was rated as highly attractive in pretesting, was also made available, and participants in both conditions were then asked to rate the attractiveness of all of the dessert options. The Argentinean dessert alternatives were rated as more attractive after the introduction of the cheesecake in the free choice condition, but they were rated as less attractive after the introduction of the cheesecake in the constrained choice condition. In other words, those participants who were free to choose among desserts during the first phase were more attracted to the initial alternatives than those who did not have such freedom of choice.

Similarly, we predict that when individuals are free to choose among competing interfaces, they will demonstrate a greater preference for an incumbent interface relative to an attractive new interface. Conversely, we expect that users who have had their freedom of interface choice restricted will tend to perceive the incumbent interface that they were constrained to use to be less desirable, as compared to an attractive new alternative. Therefore, in contrast to H2, psychological reactance predicts that

H4: Preference for a particular interface is lower among individuals who were initially constrained to using that interface than among those who were always free to choose which interface they used.

It is important to note that the prediction being made in H4 is expected to hold even if H1 is also supported—that is, even though constrained users are more skilled at using a particular interface, their preference for that interface will be lower than it is for free users (who are less skilled with that interface).

Psychological Reactance and Perceived Ease of Use

Although the majority of prior research into the phenomenon of reactance has focused on the perceived attractiveness of alternatives, studies have demonstrated that reactance can also affect individuals' perceptions of the *process* of acquiring, or interacting with, alternatives (e.g., Carver 1977; Edwards et al. 2002; Snyder and Wicklund 1976). Evidence from a variety of fields suggests that the extent to which people are free to make their own choices can affect critical decision process measures. For example, in an examination of consumers' responses to products that are out of stock in a retail setting, Fitzsimons (2000) demonstrated that reactance to constraints on consumers' freedom of choice can negatively affect individuals' satisfaction with the decision process. Research also suggests that patients are more satisfied with their medical care (Kalda et al. 2002) and they exhibit higher levels of trust (Kao et al 1998) when they can choose their physician. Similarly, both job performance and satisfaction are enhanced when people believe they have greater decisional control (Greenberger et al 1989).

Extrapolating from this research, we expect that freedom of choice will also affect peoples' perceptions of the process of using a computer interface. Specifically, we are interested in the effect that psychological reactance will have on a critical process measure in human–computer interaction: perceived ease of use (Carroll and Carrithers 1984; Karat 1997; Morris and Dillon 1997; Morris and Turner 2001; Venkatesh et al. 2003). Building on prior work in other fields (e.g., Greenberger et al 1989; Fitzsimons 2000; Kalda et al. 2002), we predict that constraining freedom of choice will not only affect the perceived attractiveness of the interface to which a user is restricted, but that it will also influence the interface's perceived ease of use. That is, individuals whose initial choice of interface is restricted will tend to perceive the incumbent interface that they must interact with as more difficult to use than individuals whose choice is not restricted. Therefore, in contrast to H3, the theory of psychological reactance suggests that

H5: The perceived ease of use of a particular interface is lower for individuals who were initially constrained to using that interface than for those who were always free to choose which interface they used.

Once again, this hypothesis (H5) is expected to hold even if H1 is also supported—that is, we are predicting that psychological reactance can decrease *perceived* ease of use even though constraining users to a particular interface may decrease the time it takes to complete a given task using that interface. Put another way, in contrast to H3, the theory of psychological reactance implies that the effect of freedom of choice on interface preferences is mediated by perceived ease of use rather than task completion time (as illustrated in Figure 1). Therefore,

H6: The effect of initial freedom of choice on interface preference is mediated by the incumbent's perceived ease of use.

In addition, the theory of psychological reactance implies a more specific prediction on where the differences in perceived ease of use will have the greatest effect. We have predicted that because constrained users are more likely to experience psychological reactance, they will tend to perceive the incumbent as more difficult to use than free users (H5). Therefore, H5 should only hold for those constrained users who do experience reactance—that is, it should only hold for those who demonstrate a dislike for the incumbent.

Now, imagine that a new interface is introduced into the market and all users—both those that were previously constrained to one interface and those who were previously free to choose among different interfaces—are given the option of switching from what they are currently using to that new interface. In this scenario, we are predicting that among the users who were initially constrained, those who decide to use the new competing interface for future tasks are the ones who have experienced psychological reactance and should perceive the incumbent to be much more difficult to use (as compared to free participants). However, we do not expect to see a difference between participants who were initially constrained and those who were initially free if they choose to continue using the incumbent for future tasks, because if they were experiencing high levels of psychological reactance when given the opportunity to switch they would not have chosen to stay with the incumbent. Therefore,

H7: Among individuals who *ultimately* choose the competitor, those who always had freedom of choice perceive the incumbent interface to be easier to use than those who were initially constrained, whereas there is no such difference among individuals who ultimately prefer the incumbent.

In the preceding sections, we have presented two sets of hypotheses that make distinctly different predictions about how freedom of choice affects interface preference. These hypotheses are summarized in our research model (Figure 1). In the following sections, we present the method and results of two laboratory studies (a pretest and the main experiment) that were designed to test the proposed research model, and the divergent predictions of the two theoretical perspectives that the model encapsulates, under controlled conditions.

Method

This research aims to shed light on the question of how freedom of choice, or the lack thereof, affects interface preferences. That is, a central objective of this research is to investigate the potential causal effect of freedom of choice on users' interface preferences. A critical advantage of laboratory experiments is the ability to control the general research environment, while systematically manipulating key variables between the groups to which participants have been randomly assigned. This approach allows for a direct test of causal relationships (Fromkin and Streufert 1976; Kardes 1996).

To investigate the potential effects of psychological reactance on perceptions of ease of use, and ultimately interface choice, we adopted an experimental design that is analogous to the one used in the classic research on reactance by Brehm and Rozen (1971). As described above, participants in that study were either asked to choose from a selection of three desserts or they were informed that only one dessert was available to them. Of course, people know that there is more than one type of dessert in the world and realize that having no alternatives available to them is a restriction of their freedom of choice. In fact, this is a more conservative test of reactance than the more heavy-handed approach used in some studies in which people are first shown a number of alternatives, and then have their freedom of choice constrained as a result of some of these alternatives being removed or becoming unavailable (e.g., Hammock and Brehm 1966). Moreover, in Brehm and Rozen's paradigm, after multiple trials consuming desserts (in either a free or constrained condition), a new dessert was introduced. They found that participants in the constrained condition had a much stronger preference for the new dessert than did those in the free condition.

In our main experimental procedure (see below), participants also either (1) have a choice between multiple alternative interfaces (free choice condition) or (2) they are required to use the one interface that we assign to them (constrained choice condition). Logically, participants know that there is more than one type of website interface in the world and realize that having no choice in the interface that they use to complete the tasks assigned to them is a restriction of their freedom of choice. As in the Brehm and Rozen paradigm, after a number of trials, we make a new option available and we examine participants' preference for the new alternative.

We have defined the incumbent as the interface that participants use most frequently prior to the new alternative being made available. In the experiment reported below, we operationalize this definition as follows: in the constrained choice condition, the incumbent is the interface that a participant is assigned to use; in the free choice condition, the incumbent is the interface that a participant chooses to use most often. The critical choice task then requires the participant to select either the incumbent or the new "competitor" alternative for use on the remaining rounds of the task. In addition, we extend previous work on reactance into the domain of user choice among interfaces and test the mediating role of perceived ease of use in the effect of freedom of choice on interface preference.

Experimental Design

Our main experiment employs a single factor design wherein freedom of choice was manipulated at one of two levels—that is, participants were randomly assigned to one of two conditions that differed only in terms of whether (or not) they were free to choose the interface they used to complete the nine "incumbent" trials.[6] In the *free* condition, subjects were allowed to choose, before each incumbent trial, which of two interfaces (Interface A or Interface B) they wished to use for that trial. By contrast, participants in the *constrained* condition had to complete all nine of the initial trials with the same incumbent interface (Interface A). Therefore, A and B are the incumbent interfaces in our experiment.

After using interfaces A and/or B, participants are given the opportunity to switch to a new competitor interface (C). Specifically, in both conditions, the nine incumbent trials were followed by one additional round of the search task—the competitor trial—for which participants used Interface C, an interface that they had not seen before and that had been found to be superior to both Interfaces A and B in the pretest (reported below). This was followed by the critical choice task, which was designed to measure participants' ultimate interface preference. In this task, all subjects were asked to choose one interface that they then had to use for each of a number (unknown to them at that point) of final rounds of the information search task. Specifically, they chose between the competitor (Interface C) and an incumbent interface. For those participants who were free to choose between Interface A and Interface B on each of the nine incumbent trials, whichever of the two they had used most frequently was designated as the incumbent for the purpose of the preferential choice task. For subjects in the constrained condition, Interface A was the incumbent. The detailed procedure for the main experiment is reported below. Next, we describe the pretest that was used to evaluate the three interfaces before their use in the main experiment.

Pretest

The purpose of the pretest was to examine users' *a priori* evaluation of, and task performance in connection with, the three interfaces required for the main experiment (Straub et al. 2004; Trochim and Donnelly 2008) (see the sample screen shots of the three interfaces in Appendix A). Consistent with the design objectives for these three interfaces, the pretest results demonstrate that Interfaces A and B are *not* perceived to be any different from each other, while Interface C *is* perceived to be superior to both A and B.

Following Murray and Häubl (2007), we designed Interfaces A and B in such a way that the key difference between them was that Interface A used pull-down menus for navigation and Interface B used radio buttons for this purpose. Interface C was designed to be objectively superior—and based on the results of the pretest reported below it is objectively superior—to Interfaces A and B, in terms of its usefulness (i.e., effectiveness at completing the task) and ease of use. Interface C used hyperlinks for navigation. Also following Murray and Häubl (2007), the interfaces differed in the organization of information on the first page. All three interfaces had the same three main categories of information (i.e., News, Opinions, and Features). However, these categories were presented in different orders. For Interface A the order was News, Opinions and Features; for Interface B the order was Features, Opinions, and News; for Interface C the order was Opinions, News, and Features. Within each of these main categories, the subcategories were always the same, but the order of these also varied across interfaces. The interfaces

[6]As described in detail below, each time a participant interacted with one of the experimental interfaces, a variety of measures were taken (e.g., which interface was being used, how long the participant took to complete the task, etc.). These measures allowed us to examine the nature of the learning that the participant engaged in; however, the critical data point is the user's eventual interface choice, which is a between-subjects comparison.

had different navigation features and information orderings so as to encourage the development of small, yet meaningful, differences in acquired skill. These differences are very important if we are to adequately test the predictions of the human capital model. Specifically, the human capital model predicts preferences based on differences in skill acquisition. If there are no differences in acquired skill between the competing interfaces, then users would not have to learn anything new in order to switch from one interface to another and the human capital model would not be relevant (i.e., we could not test hypotheses 1 through 3). As prior work has clearly demonstrated (e.g., Lindgaard et al. 2006; Murray and Häubl 2007), even a small difference in acquired skill can result in a large difference in preference.

However, designing the interfaces to include differences that require some learning also raises a potential threat to the experiment. Specifically, it is critical that these differences provide users with the opportunity to acquire skills that are specific to that interface without affecting the equivalency of Interfaces A and B on key dimensions. For example, if users demonstrated a preexisting preference for radio buttons versus pull-downs menus, then Interfaces A and B could not be considered equivalent. The results of the pretest clearly demonstrate that Interfaces A and B are equivalent (upon initial use) on a number of key dimensions, while Interface C is superior to both of them.

Pretest Procedure

Sixty-three individuals were recruited from a volunteer subject panel at a large North American research university to participate in this experiment. Of these participants, 29 were female and 34 were male. They ranged in age from 18 to 48, with a mean age of 22.1 years. Participants also reported their "experience with the Internet" using a scale that ranged from 1 (very little experience) to 10 (substantial experience); participants reported an average rating of 8.3, with responses ranging from 5 to 10. Participants completed the experiment in a research laboratory equipped with networked computers in groups of approximately 10, with the experimenter present at all times. Each subject was randomly assigned to evaluate one of the three interfaces in a between-subjects design. The task itself was held constant so that the only difference between the three treatments was which interface was used to complete the task.

The task instructions were displayed at the top of the screen throughout the study. Participants were required to navigate through a website with the goal of locating a particular piece of information and entering it into a text box. Regardless of which interface participants were using, they were told that their task was to navigate through the website to find the November Science Column entitled "Seeking Deeper Meaning" and enter the age (in months) of the baby mentioned in the first paragraph. To find this information, participants had to navigate through a sequence of web pages, as follows: Portal Homepage → Science Articles → Select Article → Article: "Seeking Deeper Meaning" (the full article and a text box for entering the answer were available on this page). Once the correct information was entered into the text box, the task was considered complete. Although the information that users were seeking differed from task to task, the navigation path up to finding the article was identical on each trial. Therefore, to assess learning, task completion times were measured as the amount of time taken by each participant to complete the navigation portion of the task (times were recorded using a client-side JavaScript program).

If a participant navigated down the wrong path at any stage, s/he was presented with an error message ("The articles you requested are currently not available. Please click here to return to the previous page."). The number of times each subject navigated down the wrong path was recorded.

Once the task had been completed successfully, participants were referred to a page that asked them to rate the interface in terms of (1) its effectiveness in completing the task, (2) the ease of navigation throughout the task, and (3) their enjoyment of using the interface, each on a 10-point rating scale with end points 0 = "very poor" to 9 = "outstanding."

The design of the interfaces and the navigation paths that participants followed were adapted from Murray and Häubl (2007), who found that after two trials with an incumbent interface, switching from navigating with radio buttons to navigating with pull-down menus (or vice versa) increased mean task completion times between 15 and 20 seconds, which resulted in a significantly greater preference for the incumbent. Although one might think that such small differences in the skill required to navigate one interface versus another are too trivial to have a meaningful effect on users' interface preferences, the results reported below are consistent with the empirical evidence reported in prior research (Lindgaard et al. 2006; Johnson et al. 2003; Murray and Häubl 2007) and provide strong support for the notion that even small differences in human capital can have a powerful effect on the interface choices that users make.

Pretest Results

The results of the pretest are summarized in Figure 2. First, the mean ratings of effectiveness are 6.5 (Interface A), 6.4 (Interface B), and 7.6 (Interface C). The difference between

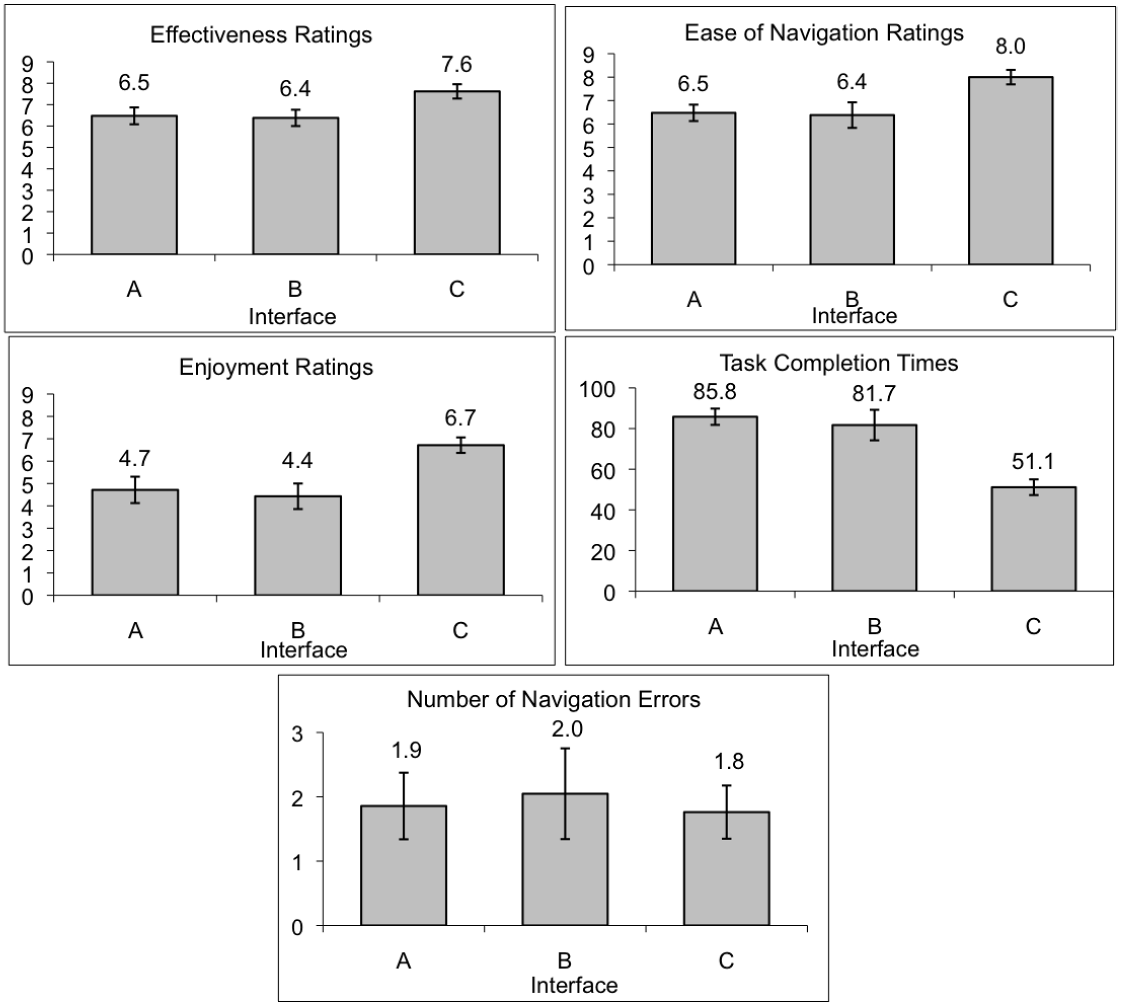

Figure 2. Summary of Pretest Measures

Interfaces A and C is statistically significant (two-tailed $t = -2.211$, $df = 40$, $p = 0.033$), as is that between B and C ($t = -2.443$, $df = 40$, $p = 0.019$), while the difference between A and B is not ($t = 0.174$, $df = 40$, $p = 0.863$). The mean ratings of ease of navigation are 6.5 (A), 6.4 (B), and 8.0 (C). The pairwise differences are again significant between A and C ($t = -3.269$, $df = 40$, $p = 0.002$), as well as between B and C ($t = -2.583$, $df = 40$, $p = 0.014$), but not between A and B ($t = 0.147$, $df = 40$, $p = 0.730$). Finally, the mean enjoyment ratings are 4.7 (A), 4.4 (B), and 6.7 (C). The difference between B and C is significant ($t = -2.923$, $df = 40$, $p = 0.006$), that between A and C is also significant ($t = -3.422$, $df = 40$, $p = 0.014$), but between A and B the difference is not significant ($t = 0.348$, $df = 40$, $p = 0.286$). Thus, the overall pattern of results in terms of these three rating-scale measures indicates that Interfaces A and B are not perceived to be any different from each other, while Interface C is perceived to be superior to both A and B.

Task completion time was measured from the beginning of the task (when the participant was presented with the task description) until the navigation portion of the task was completed (when the subject arrived at the target article). The mean task completion times are 85.8 seconds for Interface A, 81.7 seconds for Interface B, and 51.1 seconds for Interface C. The difference between Interfaces A and B is not significant ($t = 0.481$, $df = 40$, $p = 0.633$), and Interface C led to significantly shorter task completion times than both A ($t = 6.231$, $df = 40$, $p < 0.001$) and B ($t = 3.621$, $df = 40$, $p < 0.001$). This corroborates the rating-scale results indicating that Interfaces A and B are about equivalent, while Interface C is superior to both.

The final measure was the number of times a participant navigated down the wrong path while completing the task. The average number of such usage errors is 1.9 for Interface A, 2.0 for Interface B, and 1.8 for Interface C. On this measure, there is no statistically significant pairwise difference between any of the three interfaces ($p > 0.7$ in all cases). The number of participants who made at least one error, out of a total of 21 participants that used each interface, was 9 for Interface A, 8 for Interface B, and 10 for Interface C.

Discussion of Pretest Results

In sum, the pretest results indicate that (1) Interfaces A and B are not significantly different in terms of the five aspects measured here and (2) Interface C is clearly superior to both Interfaces A and B on all dimensions except the number of usage errors. These results provide us with an important set of baseline measures for the main experiment (Straub et al. 2004). Since Interfaces A and/or B are used during the main experiment's training trials, it is important to establish that they do not differ significantly on these five measures. When asked to make the critical choice in the main experiment, participants will be choosing between the incumbent interface (either A or B) and Interface C. The fact that Interface C is no different from the other two interfaces in terms of the number of errors people make and superior on the other measures indicates that it is a significant competitor to the incumbent interface, which makes for a more robust test of hypotheses that predict an advantage for the incumbent.

Main Experiment

The research model depicted in Figure 1 outlines two different effects of freedom of choice on users' interface preferences and two different routes (i.e., mediating variables) through which that effect occurs. If preference is driven by skill acquisition then constrained users should tend to choose the incumbent. This perspective motivated hypotheses 1, 2, and 3. However, if the unavailability of competing interfaces during the initial experience with an incumbent interface arouses psychological reactance in users, then constrained users should tend to choose the competitor. This perspective motivated hypotheses 4, 5, 6, and 7. The main experiment was designed to test these two sets of competing hypotheses.

Eighty-two different subjects[7] were recruited from the same volunteer subject panel used in the pretest to participate in this experiment in exchange for monetary compensation. Of these participants, 36 were female and 46 were male. They ranged in age from 18 to 50, with a mean age of 24.2 years. Participants also reported their experience with the Internet, using a scale that ranged from 1 (very little experience) to 10 (substantial experience), participants reported an average rating of 8.3, with responses ranging from 4 to 10. Each participant was paid $20 (Canadian) for attending the study, regardless of performance. Participants completed the experiment in a research laboratory equipped with networked computers in groups of approximately 10, with the experimenter present at all times.

Procedure

As described above, each participant was randomly assigned to either the *free* or *constrained* condition. Then, following Murray and Häubl (2007), the basic paradigm used in this experiment is outlined in Table 1. After receiving detailed instructions, participants completed a series of information search tasks of the type used in the pretest. The navigation path from the "Portal Homepage" to the "Select Article" page was identical across all of the information search tasks in this experiment: Portal Homepage → Science Articles → Select Article → Article. For each task, the target article was unique and, therefore, a different piece of information was to be retrieved. In all cases, once participants had navigated to the correct article, the target information could be found within the first 90 words. If subjects navigated down the wrong path, they were presented with the following message: "The articles you requested are not currently available. Please click here to return to the previous page." These error messages occurred regardless of which experimental group a participant was in and they were, therefore, constant across conditions. The task was designed to last a maximum of 3 minutes from arrival at the "Portal Homepage" to entering the correct information in the text box. The entire experiment was designed to take participants between 25 and 40 minutes to complete (no participant took more than 45 minutes, from the time they entered the lab until they left).

In the first phase of the experiment (the *incumbent trials*), subjects performed nine such searches (as previously described). After that, they completed one additional search task of the same kind, but with a superior interface (Interface C) that they had not seen before (the *competitor trial*). This was followed by a task designed to measure participants' eventual interface preference. In line with random utility theory (McFadden 1981, 1986), and with the economic theory of choice more generally (Luce 1959), we used a discrete-

[7]Four participants were extreme outliers with regard to the number of mistakes that they made (more than 10 navigation errors as compared to the average of 1.3 errors). These participants were excluded from all of the following analyses.

Table 1. Overview of the Experimental Design and Procedure

	Experimental Condition (Initial Freedom of Choice)	
	Free	**Constrained**
Incumbent Trial #1	Use Interface A or Interface B	Use Interface A
Incumbent Trial #2	Use Interface A or Interface B	Use Interface A
Incumbent Trial #3	Use Interface A or Interface B	Use Interface A
Incumbent Trial #4	Use Interface A or Interface B	Use Interface A
Incumbent Trial #5	Use Interface A or Interface B	Use Interface A
Incumbent Trial #6	Use Interface A or Interface B	Use Interface A
Incumbent Trial #7	Use Interface A or Interface B	Use Interface A
Incumbent Trial #8	Use Interface A or Interface B	Use Interface A
Incumbent Trial #9	Use Interface A or Interface B	Use Interface A
Competitor Trial	Use Interface C	Use Interface C
Preferential Choice Task (and Measurement of Strength of Preference)	Incumbent Interface versus Interface C	Incumbent Interface versus Interface C
Remaining Trials	Use Chosen Interface	Use Chosen Interface

choice paradigm to measure preference for the incumbent interface relative to the competitor. The basic idea underlying this approach is that an individual's choice reveals the alternative of highest utility (among the alternatives available at the time). In the *preferential choice task*, participants selected an interface to use during the final phase of the study, where they were told that they would have to complete an unspecified number of additional information search tasks of the familiar type.

Following their choice, subjects were asked to indicate the extent of their preference for the interface that they had selected on a scale from 1 = "weakly prefer" to 10 = "strongly prefer." This measure allows us to examine the *strength of the preference* that underlies users' interface choices. This is important, because our design requires participants to choose one of two interfaces; therefore, although a participant's choice tells us which interface they prefer, it provides no information on the strength of that preference. With the addition of the strength of preference measure, we are able to distinguish between very weak preferences—that is, participants who make a choice because they have to, but really are almost indifferent between the two alternatives (e.g., a rating near 0)—and very strong preferences (e.g., ratings closer to 10). In addition, we can see if the strength of users' preferences differs by condition (free or constrained) and/or between those who choose particular interfaces (e.g., do people who choose interface A have a stronger preference for it than do those who choose Interface B or C?).

Participants were then required to complete a final trial using the interface they had selected. After that, they responded to a series of questions (see the table in Appendix B), which included measures of the perceived ease of use of each of the interfaces they had used in the experiment, the extent of their prior experience using the Internet, as well as participants' age and gender. We used a single-item measure[8] (Bergkvist and Rossiter 2007; Drolet and Morrison 2001; Rossiter 2002) of perceived ease of use – "I found Interface _ easy to use." (1 = "strongly disagree" to 10 = "strongly agree") – adapted from multi-item measures extensively validated in prior work (e.g., Davis 1989; Gefen and Straub 2000; Venkatesh and Davis 1996). After responding to these scale items, participants were debriefed, paid, and dismissed.

Results

At the end of each trial, a participant's task completion time was measured (using a JavaScript program) for the "navigation" portion of the task only (i.e., from being presented with the information search goal for the current round to arriving at the page containing the target article's text). This operationalization ensures full comparability of task completion times across trials, because the navigation portion of the task was not affected by the specific content questions and articles used.

[8]Further discussion on this single item measure, and the threat of a mono-operational bias (e.g., Cook and Campbell 1979), is included in Appendix C.

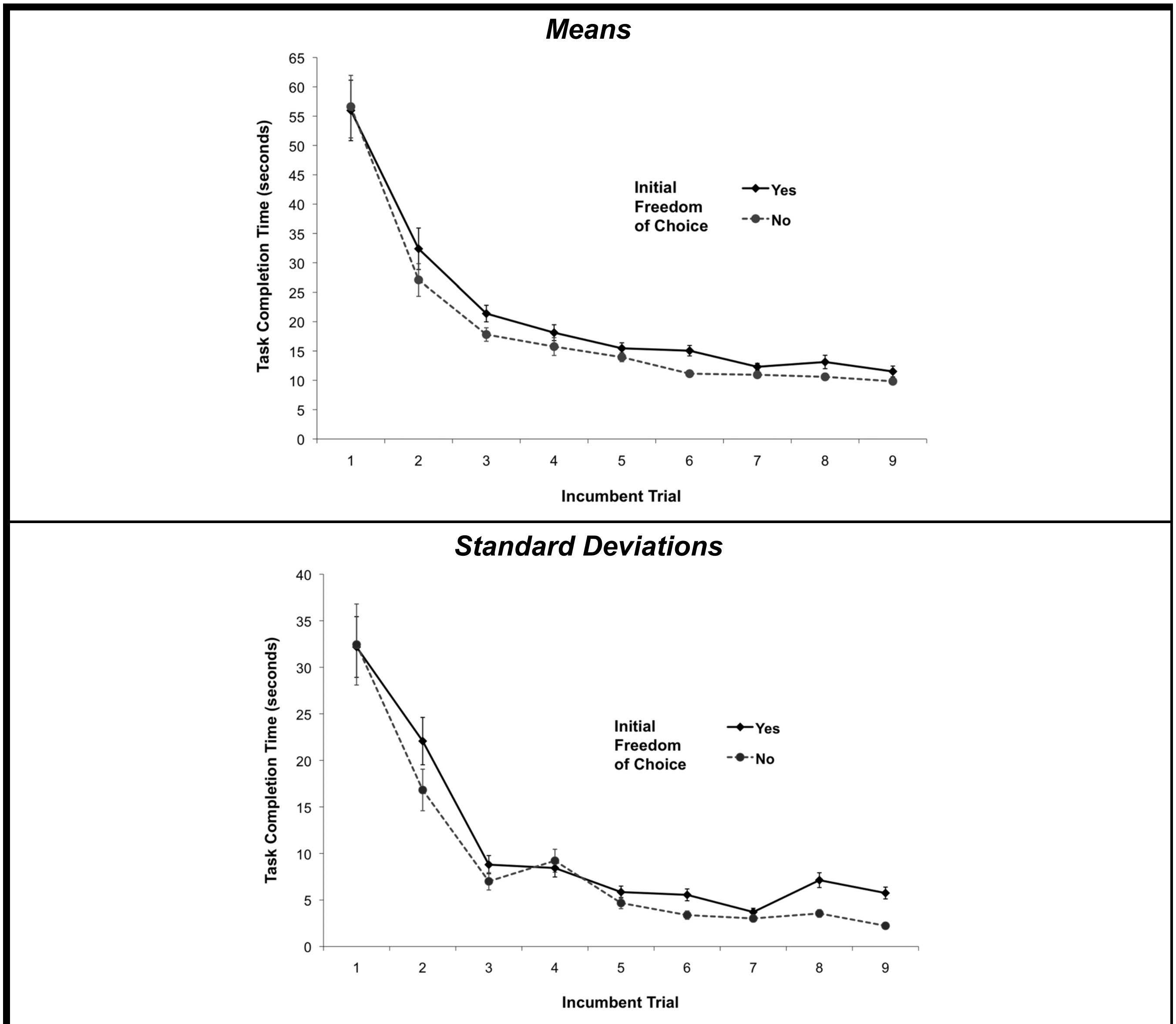

Figure 3. Task Completion Times for the Nine Incumbent Trials by Freedom of Choice

The time measurements taken in connection with subjects' task performance provide clear evidence of skill acquisition consistent with the power law of practice across the nine incumbent trials. Figure 3 shows the means (top panel) and standard deviations (bottom panel) across participants' task completion times for each of the nine incumbent trials by experimental condition (i.e., whether users were free to choose one of two available interfaces on each trial or constrained to using the same incumbent interface for all nine trials). The results indicate that the bulk of the improvement in task performance occurred on the first few trials (i.e., the rate of improvement decreased with experience). In both conditions, the decrease in the task completion times and the standard deviations of these times over incumbent trials, are very well approximated by a power function, as compared to a linear model or an exponential model (see Table 2).

Differences in Task Completion Times. Hypothesis 1 predicted that task completion times would be lower for individuals who were initially constrained to using one interface than for those who were always free to choose which interface they used. A key assumption underlying this hypothesis is

Table 2. Task Completion Times Across the Nine Incumbent Trials: Model Fit (R^2) for Competing Functional Forms

	Mean Task Completion Times			Standard Deviation of Task Completion Times		
	Linear	*Exponential*	*Power*	*Linear*	*Exponential*	*Power*
Free	0.592	0.795	0.965	0.607	0.665	0.844
Constrained	0.602	0.800	0.970	0.654	0.873	0.950

Table 3. Number of Times the Eventual Incumbent Was Used During the Nine Initial Trials in the Free Condition

Number of Times the Incumbent Was Used	Number of Participants
5	11
6	1
7	9
8	15
9	5

that the vast majority of users who are free to choose which interface they wish to use to complete a task will use more than one interface. We found that, of the 41 participants in the free condition, 36 tried both of the available interfaces at least once. More importantly, follow-up tests indicate that the number of times that participants used the incumbent in the free choice condition (ranging from 5 to 9 times) had no effect on choice (β = .095, *Wald* = .136, p = .712) or perceived ease of use (β = .184, t = .692, p = .493). A breakdown of how many participants used the interface that was eventually designated their incumbent a total of 5, 6, 7, 8, and 9 times during the initial trials is provided in Table 3.

To test Hypothesis 1, we examine three different pieces of evidence. First, we look at the total incumbent task completion times by experimental condition (see Table 4). We find a significant effect of freedom of choice during the incumbent trials, which was to be expected. Given that most of these participants used more than one interface, they would not be expected to be as efficient at completing the tasks as those who used only Interface A. Second, we look at the task completion times between conditions on a trial by trial basis. We find that users in the free condition were *never* more efficient than those in the constrained condition and, in two cases, they were significantly less efficient. These first two pieces of evidence provide support for H1.

The third test examines the difference between participants in the free and constrained conditions on the completion time for the last task completed with the incumbent interface. For all participants in the constrained condition, the last task they completed with the incumbent was the ninth trial. For participants in the free condition, the incumbent was the interface that the participants used most often over the initial nine trials. Consequently, in the free condition, the last trial with the incumbent was not necessarily the ninth trial. In fact, all but two of the participants in the free condition used (what we later designated) the incumbent on the ninth trial. Those two participants who did not use the incumbent on the ninth trial used it for the last time on the eighth trial and, therefore, we took their time on the eighth trial to test H1. Although constrained users completed the last incumbent task in less time (M = 9.84 seconds) than the free participants (M = 11.24), which is directionally consistent with H1, this difference is not statistically significant (F = 2.434; p = .123, η^2 = 0.031).

Interface Preference. We have proposed two hypotheses that predict different effects of freedom of choice on users' interface preferences. Hypothesis 2 predicts that preference for the incumbent interface would be *lower* when people are free to choose. In contrast, Hypothesis 4 predicts the opposite result: preference for the incumbent interface will be *higher* when people are free to choose. To test H2 and H4, we estimated a logistic regression model with interface choice as the dependent variable (coded as 1 = "incumbent" and 0 = "competitor") and freedom of choice during the incumbent trials (coded as 1 = "yes" and -1 = "no") as the

Table 4. Task Completion Times on Each Incumbent Trial by Initial Freedom of Choice

Incumbent Trial	Task Completion Time (seconds)		p
	Free Condition	*Constrained Condition*	
1	55.97	56.62	.315
2	32.38	27.08	.286
3	21.38	17.81	.055
4	18.13	15.76	.230
5	15.46	13.95	.114
6	15.05	11.14	.000
7	13.31	10.95	.085
8	13.13	10.59	.044
9	11.51	9.84	.109
Total Task Completion Time	195.33	173.73	.044

independent variable. We find that initial freedom of choice had a significant positive effect on preference for the incumbent interface ($R^2 = .084$, $\beta = 0.529$, *Wald*= 4.810, $p = 0.028$); that is, consistent with H4, preference for the incumbent interface is *higher* when people are free to choose. The choice shares of the incumbent and competitor interfaces in the two experimental conditions are shown in Figure 4 (30 out of 41 chose the incumbent in the free condition and 18 out of 37 choose the incumbent in the constrained condition). Moreover, the strength of preference data are entirely consistent with the binary choice data and indicate that the binary choice measure reflects strong preferences for the chosen interface, regardless of which interface was selected or to which experimental condition the user was randomly assigned (see Appendix D). Given these findings, we focus the remainder of our analysis and discussion on the more conservative binary choice measure that for this data reflects a strong preference for the interface that was chosen. In sum, the interface preference results do not support H2; however, they do provide strong support for H4.

The Mediating Role of Ease of Use. Our research model details two different routes by which freedom of choice may affect users' interface preference. The top route in Figure 1 suggests that task completion times, when using the incumbent interface, will determine users' interface preferences. This prediction is captured in H3, which contends that the effect of freedom of choice on interface preference is mediated by incumbent interface task completion times. Although we find partial support for H1, which indicates that being constained does reduce incumbent interface task completion times, we did not find support for H2, which predicted that initial freedom of choice would have a negative impact on users' preference for the incumbent. In addition, we find that completion time (for the last task completed with the incumbent) does not have a positive effect on preference for the incumbent interface ($\beta = 0.38$, *Wald*= .354, $p = 0.552$). Therefore, we do not find support for H3.

However, we do find support for H5, which predicted that perceived ease of use would be lower among those who were not free to choose the interface that they used during the incumbent trials. The results indicate that the incumbent's perceived ease of use was significantly higher for participants who were free to choose among two available interfaces on each of the nine initial trials (mean rating = 7.15) than for those who were constrained to using a single incumbent interface during these trials (mean rating = 5.49; ANOVA: $F_{(1,77)} = 9.551$, $p = 0.003$, $\eta^2 = 0.112$) (see Figure 5). This is true even though the mean task completion time was never lower in the free condition than in the constrained condition (and in a few cases it was significantly higher in the free condition; see Table 4).

Moreover, the results of a regression analysis reveal that participants' ratings of the incumbent's ease of use cannot be explained by their task completion time on the final incumbent trial ($\beta = 0.200$, $t = 1.777$, $p = .08$), nor by their total task completion time across all nine incumbent trials ($\beta = 0.126$, $t = 1.110$, $p = .270$).

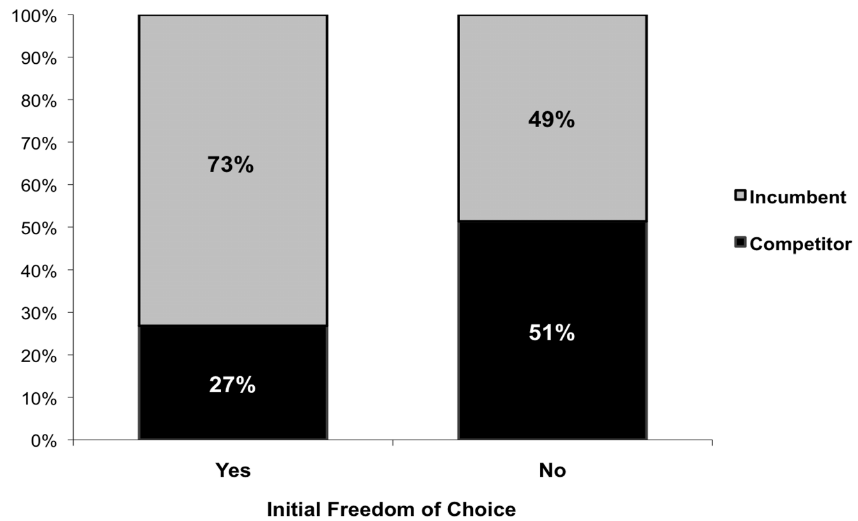

Figure 4. Choice Shares by Experimental Condition

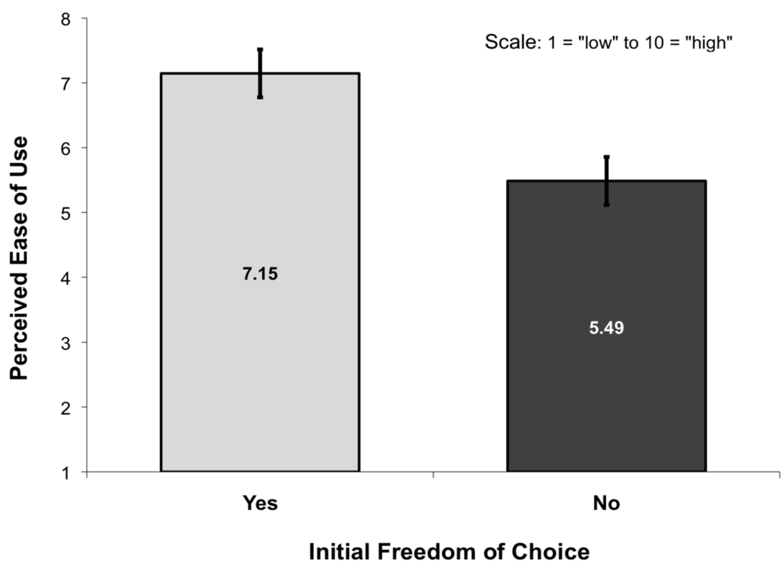

Figure 5. Perceived Ease of Use of the Incumbent Interface

Hypothesis 6 proposes that the effect of freedom of choice on interface preference is mediated by the *perceived* ease of using the incumbent (rather than task completion time). To test this predicted mediating effect, we use the standard four-step procedure proposed by Baron and Kenny (1986; see also Judd and Kenny 1981). The first step is to establish that there is an effect that may be mediated by examining the relationship between the exogenously manipulated variable (freedom of choice during the initial incumbent trials) and the ultimate outcome variable (eventual preference for the incumbent interface). Consistent with H4, this effect was established above ($p = 0.028$). The second step is to demonstrate that the exogenous variable (initial freedom of choice) affects the proposed mediator (ease of use of the incumbent interface). This effect was predicted by H5 and it is clearly supported by our data (p = 0.003, see above).

The third step of the mediation analysis is to demonstrate that the proposed mediator (ease of use of the incumbent) affects the ultimate outcome variable (eventual preference for the incumbent interface), while controlling for the impact of the exogenous variable (initial freedom of choice). The fourth and final step is to test for complete mediation, which is established if the (direct) effect of the exogenous variable on the ultimate outcome variable is eliminated when the mediator is included in the model. The effects pertaining to these last two steps were estimated in a single logistic regression model (R^2 = .293). The results of this analysis show that the incumbent interface's perceived ease of use has a significant positive effect on users' eventual preference for it, as reflected in participants' consequential interface choices (β = 0.413, *Wald* = 11.592, p = 0.001), while the effect of freedom of choice during the initial trials is no longer significant in this model (β = 0.298, *Wald* = 1.231, p = 0.267). This indicates that perceived ease of use *completely* mediates the effect of freedom of choice during the initial trials on preference for the incumbent interface, thus providing strong support for Hypothesis 6.

To test H7, we examined the perceived ease of use of the incumbent by initial freedom of choice and the interface chosen (see Figure 6). The purpose of this test was to better understand the mediating role of perceived ease of use. As discussed above, if psychological reactance is driving these results, then we should find a significant difference in perceived ease of use between free and constrained participants among those who chose the competitor interface (i.e., those participants who reacted against having their freedom constrained and chose to switch away from the incumbent), but not among those who chose the incumbent (i.e., those participants who did not react against having their freedom constrained). Consistent with this prediction, we find no significant difference between free and constrained participants' perceptions of ease of use when they chose the incumbent interface ($F_{(1,47)}$ = 1.219, p = 0.275, η^2 = 0.026); however, among those who chose the competitor, we find that constrained participants' perceive the incumbent to be significantly less easy to use than do free participants ($F_{(1,29)}$ = 4.996, p = 0.034, η^2 = 0.151). These results provide strong support for H7.

Discussion of the Results of the Main Experiment

Overall, the results of the main experiment indicate that constraining users' initial freedom of interface choice has a negative impact on their preference for that interface, because such constraints reduce the perceived ease of using that interface. The results of the hypothesis tests are summarized in Table 5. Supporting H1, the data indicate that the users in the free condition never have an advantage in task completion times over those in the constrained condition. Therefore, from the perspective of the theory that predicts preference based on the acquisition of user skills we would expect no differences in the incumbent's choice share between the free and constrained conditions. Yet, the data indicate that people in the free condition are much more likely to choose the incumbent than are people in the constrained condition. Moreover, the effect of initial freedom of choice on users' interface preference is *fully* mediated by perceived ease of use. Finally, as predicted by psychological reactance (H7), the difference in perceived ease of use between the free and constrained users is only significant among those who chose the competitor. Overall, these results provide strong support for the role of psychological reactance in the development of users' interface preferences.

In addition, Appendix E reports a series of analyses that dig deeper into the data from the main experiment to explore a set of potential alternative explanations for the results that we have reported. In doing so, we rule out accounts based on user error, individual differences (e.g., Internet usage, gender, age, and familiarity), cognitive dissonance, order of information processing, preexisting preferences, opportunity for comparison, and ease of switching. Nevertheless, although the results of the reported experiment provide strong support for our research model, and reject a number of alternative explanations, a single experiment cannot rule out all possible alternative theories. We hope that future research will further examine this question and explore other potential determinants of preference in the face of choice constraints.

General Discussion

In this article, we have introduced and tested a model that links the freedom to choose among interfaces, the ease of interface use, and users' interface preferences. The results of an experiment involving consequential interface choices provide strong support for the hypotheses motivated by the theory of psychological reactance. The key contribution of this work is the counterintuitive finding that, relative to being able to choose among competing interfaces, being constrained to using a single interface to complete a task decreases users' perception of the interface's ease of use and renders them less likely to have a preference for it once an attractive alternative interface becomes available. This is the case despite the fact

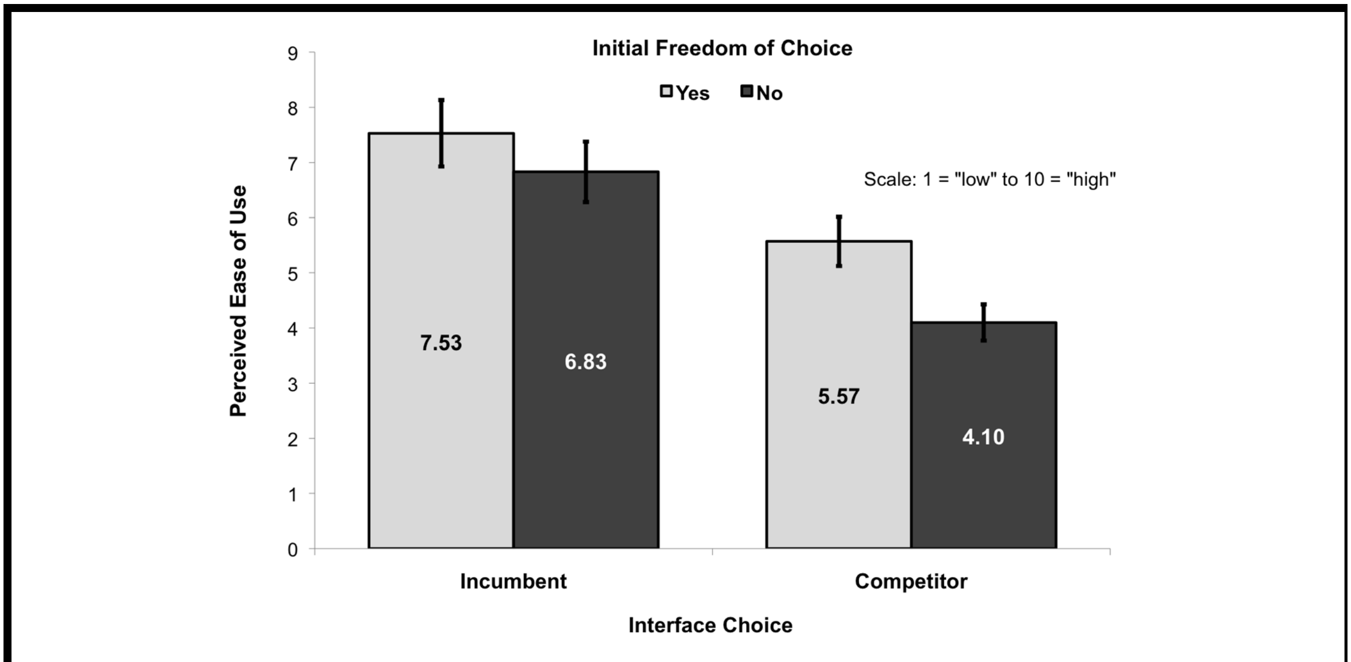

Figure 6. Perceived Ease of Use of the Incumbent by Initial Freedom of Choice and Chosen Interface

Table 5. Summary of Hypothesis Tests

	Dependent Measure	Finding
Hypotheses based on skill acquisition:		
H1	Task completion times are lower for individuals who were initially constrained to using one interface than for those who were always free to choose which interface they used.	Supported Users in the free condition were *never* more efficient than those in the constrained condition and, in many cases, they were significantly less efficient.
H2	Preference for a particular interface is higher among individuals who were initially constrained to using that interface than among those who were free to choose which interface they used.	Not Supported In contrast with H2, preference for the incumbent interface was significantly greater in the free condition than in the constrained condition.
H3	The effect of freedom of choice on interface preference is mediated by (incumbent interface) task completion times.	Not Supported
Hypotheses based on psychological reactance:		
H4	Preference for a particular interface is lower among individuals who were initially constrained to using that interface than among those who were always free to choose which interface they used.	Supported
H5	The perceived ease of use of a particular interface is lower for individuals who were initially constrained to using that interface than for those who were always free to choose which interface they used.	Supported
H6	The effect of initial freedom of choice on interface preference is mediated by the incumbent's perceived ease of use.	Supported
H7	Among individuals who ultimately choose the competitor, those who always had freedom of choice perceive the incumbent interface to be easier to use than those who were initially constrained, whereas there is no such difference among individuals who ultimately prefer the incumbent.	Supported

that unconstrained users have less experience with (and are never more efficient at using) the incumbent interface than constrained users, which has been identified as a critical determinant of interface preference (e.g., Gefen et al. 2003; Johnson et al. 2003; Venkatesh et al. 2002). Moreover, unconstrained users have the opportunity to develop more general skills, which could allow them to switch to a new interface more easily than constrained users, who have experience with only one interface.

This is an important finding that illustrates a key boundary condition on prior research, which has demonstrated the power that habit (Murray and Haubl 2003, 2007), learning (Johnson et al. 2003), human capital (Ratchford 2001; Wernerfelt 1985) and other switching costs (Kim and Kankanhalli 2009; Kim and Son 2009) have to lock users in to an incumbent interface. Although each of these drivers of choice have been shown to be important factors in the interface choices that users make, our research demonstrates that these effects, which are driven by the efficiency generated through learning, can be offset by a psychological force that causes humans to react against perceived constraints on their freedom of choice.

In addition, it is apparent from the results of our mediation analysis that the effect of initial freedom of choice on the eventual preference for the incumbent interface is completely mediated by users' perceptions of the incumbent's ease of use. Being constrained to using a single interface arouses psychological reactance, which reduces perceived ease of use and, ultimately, increases the probability that the user will switch to a competing interface. In this way, the findings reported here provide insight into the psychological mechanism that underlies the counterintuitive result that competition can actually increase user loyalty by demonstrating that users tend to react negatively to a lack of choice.

To test our theory, we had participants complete a simulated web-based information search task. Our experimental design and procedure provide participants with an experience that closely resembles the use of an online news website. However, our experimental interfaces were simplified to allow us to more definitively assess causation, with participants that are randomly assigned to a condition and who complete the required tasks within the controlled context of a laboratory experiment (Fromkin and Streufert 1976; Kardes 1996). The results of our experiment also corroborate, and are consistent with, recent research that has shown that the acquisition of interface-specific user skills can lead to high levels of loyalty (Gefen 2003; Johnson et al. 2003; Morris and Turner 2001; Murray and Häubl 2003). Specifically, we found that a large portion of participants (62 percent overall) ultimately preferred an interface that they had learned to use through repeated experience over a more recently introduced, objectively superior, competitor interface that they had used only once.

While this is the first study to demonstrate that psychological reactance can have an important impact on users' interface choices, a wide variety of studies in other domains have shown similar results (e.g., Brehm and Sensenig 1966; Brehm 1976; Brehm and Brehm 1981; Brock and Mazzocco 2004; Fitzsimons and Lehmann 2004; Gibbons et al. 2004; Shoham et al. 2004; Wicklund 1970). In addition, evidence exists at the macro level, albeit without the experimental control and rigorous evidence of causation of the current research, that psychological reactance can affect customer loyalty in industries with limited competitive choice (Lightfoot 2003).

Although our results are consistent with prior work, and our experimental paradigm provides high internal validity, some may still wonder to what extent these results will generalize into other contexts. In this regard, we agree with Fromkin and Streufert (1976), who argued that

> generalization *always* requires extrapolation to realms *not* represented in one's sample, for example, to other populations, to other representations of the independent variables (X), to other representations of the dependent variable (Y), and so forth…in the course of the history of science we learn about the "justification" of generalizing by the cumulation of our experience in generalizing, but this is not deducible from the details of the original experiment (p. 431).

This is why replication and extension of prior work is an integral part of the scientific method (Kardes 1996), and exploring the role of psychological reactance outside of the laboratory setting would clearly be a valuable extension of the current research.

For example, to simplify the experimental task, we made all of the interfaces in the current experiment somewhat easier to use, by including error messages that helped participants stay on the correct path, than is typically the case for real-world interfaces (e.g., nytimes.com, cnn.com, etc.). We did so to minimize user frustration and to allow participants to effectively learn to use the interface in the relatively short period of time available within the experiment. As it turned out, navigation errors were very rare in our experiment, and they had no effect on either perceived ease of use or interface choice (see Appendix E). However, it would be useful to examine the impact of allowing users to experience interfaces with more elaborate navigation paths that may result in higher error rates—which may, for example, increase the probability of users getting "lost" or frustrated (and increase the probability of switching to a competitor interface), or it may deepen the users' learning and understanding of the website (thus increasing loyalty). Prior research suggests that navigation errors tend to reduce perceptions of ease of use and increase the probability of switching (e.g., Murray and Häubl 2007). Whether and how such errors interact with the effects of psychological reactance is an interesting avenue for future exploration.

Similarly, we are not suggesting that psychological reactance will cause users to switch regardless of the amount of interface-specific human capital (i.e., non-transferable user skill) that has been accumulated. In fact, there are likely to be many cases where even though users react against a particular interface they are not able to switch because it would be too much of a burden to do so. However, our results point out that psychological reactance can reduce loyalty to an incumbent interface that users are required to work with, relative to an incumbent that is freely chosen, even though the constrained users have more practice with the incumbent.

Theoretical and Practical Implications

This work has important theoretical and practical implications. First, it outlines a specific mechanism through which the power of companies with a dominant market share may be abated. In doing so, it extends current theories of user acceptance of technology to include the key role that the perception of freedom of choice plays in the formation of users' interface preferences. Our empirical evidence suggests that, even when a product is relatively easy to use (i.e., performance has reached an asymptote along the learning curve), it may not be as attractive if users perceive that their freedom to try alternative products was constrained. This does point out a vulnerability that may be inherent to market-leading interfaces, and it adds credence to "second-mover" strategies that maximize skill transferability, while at the same time targeting a market position as an attractive alternative to the incumbent (see Warlop and Alba 2004).

These results also suggest some interesting practical implications. For example, users might experience reactance toward a product like Microsoft Word, which has had a dominant market share for a long period of time. As a result, they may be negatively biased in their perceptions of ease of use and more likely to switch to a competing product. This could create a market opportunity for alternative products—such as OpenOffice's Writer or Google Docs' Document. Under such conditions, the competitors (e.g., OpenOffice, Google Docs, etc.) may want to point out that they represent an alternative to the dominant option with ads that ask "Shouldn't you be free to choose the best tools for your work?" Historically, there is anecdotal evidence to suggest that this type of approach can be very successful for smaller players in markets dominated by competitors with large market shares. For example, Apple's "Think Different" campaign has been credited with creating a cult around the Apple brand (Belk and Ginur 2005), which has allowed it to survive—and even thrive—with a small market share and a product line that tends to be incompatible with the competition's technology (e.g., transferring user skill between Apple's OS and Windows is more difficult than it is between two different Windows-based machines).

At the same time, this example raises an important boundary condition, which could limit the effect of psychological reactance; for example, although a user might prefer to use Apple computers or OpenOffice's Writer, the users' employer could mandate the use of Dell products or Microsoft Word. It is also possible that reactance is aroused when a particular product feature or design decision is believed to restrict users' freedom of choice; for example, when Apple decides not to incorporate Macromedia's Flash technology into its products or a website fails to work with a user's favorite browser. The current research is a first step toward better understanding the role of freedom of choice in interface preferences. Nevertheless, additional exploration into the nature of this type of psychological reactance and its effects on users' preferences for information systems, and technology acceptance more generally, is clearly warranted.

This article highlights what appears to be an important human defense mechanism that reduces the risk of inadvertently neglecting attractive opportunities by provoking individuals to seek variety and to try novel things, which may improve their welfare. Applied to interface preferences, our findings identify a crucial boundary condition on the development of user loyalty as a result of human capital acquisition. Psychological reactance limits the ability of a firm to create loyal customers by restricting their use of interfaces. Indeed, this may create a competitive dilemma. Developing interfaces, built on proprietary technology, that require the acquisition of non-transferable skills can improve customer retention to the extent that users acquire such skills and perceive a cost in switching to alternative interfaces. And, in some cases the development of non-transferable skills may be powerful enough to keep users locked in to the incumbent, even when their freedom to choose has been restricted. However, our data indicate that when users feel that their freedom of choice has been constrained, they tend to react negatively and become more likely to choose a competitor.

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