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Commercializing new technologies: consumers' response to a new interface

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Abstract

Successful commercialization of new technologies is the riskiest and most rewarding form of new product development activity. New technologies are often commercialized using innovative interfaces that determine how consumers interact with a new product to obtain its functionality. Consumers' perception of uncertainty about the performance of a novel interface is a key issue in the acceptance of new products involving new interfaces. Specifically, when firms commercialize a new interface, they face two major challenges: First to identify the optimal functionality for the new interface, and second, to effectively communicate with consumers in order to reduce uncertainty about the performance of the new interface and increase adoption intentions. Despite the theoretical and managerial importance of research on consumers' response to a novel interface, very little empirical research has been conducted in this area. Building on prior research on new product development, human-computer interaction, and consumer decision-making, this article examines the factors that influence consumers' judgments of uncertainty about the performance of a new interface and consumers' adoption intentions. Specifically, we conducted an experiment to investigate the effect of the newness of the functionality of a new product and the effect of imagery on consumers' uncertainty about the performance of a novel interface and consumers' adoption intentions. Our results show that consumers perceive lower uncertainty about the performance of a new interface and higher intentions to adopt a new product when the new interface is introduced with a new (vs. pre-existing) functionality. Furthermore, our results suggest that when a new interface is introduced with a new functionality, imagining the product in use increases consumers' uncertainty about the performance of the new interface and decreases their intention to adopt the new product. In contrast, when a new interface is introduced with a pre-existing functionality, imagining the product in use decreases consumers' uncertainty about the performance of the new interface and increases their intention to adopt the new product. Our findings provide valuable guidelines for marketers in formulating new product development and communication strategies for new products involving a new interface. © 2002 Elsevier Science Inc. All rights reserved.

1. Introduction

In the last decade, rapid and radical technological developments in the computer and telecommunications industries have spurred the emergence of new technologies. Speech recognition, handwriting recognition, and motion tracking are examples of such technologies. Successful commercialization of new technologies is the riskiest and most rewarding form of new product development activity [18]. A new technology is essentially a new 'capability' that can be used in a variety of products and its ultimate value lies in the applications in which it gets incorporated [17]. For firms commercializing new technologies, considerable uncertainty characterizes the type of consumer needs that can be satisfied by a new technology. As a result of such high levels of uncertainty, marketers face two major challenges: First, the need to identify the optimal functionality for the new technology, and second, the need to effectively communicate with consumers in order to reduce performance uncertainty and increase adoption intentions [17,19,41,42]. Despite the theoretical and managerial importance of research on consumers' response to new technologies, very little empirical research has been conducted in this area [10,11].

Prior research suggests that new technologies are often commercialized using innovative interfaces that determine how consumers interact with a new product to obtain its functionality [16]. By *interface* we refer to the means by which the consumer interacts with the product to obtain a particular functionality [14]. By *functionality* we refer to what the product does for the consumer [4]. For example, consider a wireless handheld device that incorporates speech recognition technology and allows the consumer to access local news (i.e., up to the minute hometown news on any topic, any time). In this case, speech recognition is the

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interface, and local news-on-demand is the functionality of the product.

A great deal of uncertainty is associated with the performance of new interfaces since such interfaces are likely to imply novel tasks for the consumer [11,38,39]. In our example of a wireless handheld device described above, the device implies a novel interface (i.e., speech recognition) for the consumer. In order to obtain the functionality of the new product (i.e., local news), consumers need to perform a certain task (i.e., speaking to the device and being understood) that is prescribed by the novel interface (i.e., speech recognition). A question that naturally arises is: What factors drive consumers' assessment of uncertainty regarding the performance of a new interface, and as a result, consumers' adoption intentions? The goal of this research is to explore two factors that influence and moderate consumers' response to a new interface. An understanding of these factors can help managers to design better their marketing strategies so as to reduce uncertainty and improve the chances for customer adoption [41].

One of the major challenges for managers commercializing a new interface is to find the optimal functionality this new interface will provide the consumer. Prior research suggests that when firms commercialize a novel interface, new product development teams may opt for introducing this interface for a pre-existing functionality, or for a new functionality [25,37]. In the first case, the consumer can obtain the same functionality from an existing product, while in the latter case, products that provide the same functionality are not available [2]. In our example of a wireless device incorporating speech recognition technology, the device could provide the consumer with a variety of functionalities such as voice-dialing or local news-on-demand. In the case of voice-dialing, consumers are familiar with the functionality of the new product (i.e., a phone call) since they generally obtain this functionality from an existing product category (i.e., telephone), via an existing and familiar interface (i.e., dialing mechanism). In the case of local news-on-demand, the functionality of the new product (i.e., up to the minute hometown news on any topic, any time) is relatively new to the consumers. We suggest that the newness of the functionality introduced with a new interface is likely to influence consumers' uncertainty about the performance of the new interface.

The second important challenge for firms introducing products that involve a novel interface is to communicate effectively with consumers such that performance uncertainty regarding the interface is reduced [17]. In this research, we examine the role of imagery (i.e., asking consumers explicitly to imagine the product in use) on consumers' judgments of uncertainty and adoption intentions. Prior research in consumer behavior suggests that the use of imagery is likely to be critical to consumers' perceptions of performance uncertainty and adoption intentions for new products [21,32,38]. When faced with an innovative concept, consumers may find it difficult to form their own evaluative criteria concerning the new product [33]. Consequently, managers may have the opportunity to shape the judgment process by educating consumers about the appropriate evaluative criteria through the use of imagery [32].

In this research, we employ prior theorizing and research in the areas of new product development, human-computer interaction, and consumer decision making to investigate consumers' response to a novel interface. We argue that the effects of imagery on performance uncertainty of a new interface and consumer adoption intentions of the new product are moderated by the degree of newness of the particular functionality that is delivered by the new product. We conclude with a discussion of the theoretical and managerial implications of this research.

2. The effect of functionality newness

When consumers encounter a technology-based new product, they encode information on both the interface and the functionality [44]. First consider a new product that incorporates a new interface and provides the consumer with a new functionality. Such new products are more likely to offer a compelling advantage over existing products [37]. Because the functionality of such products is perceived to be valuable and cannot be obtained, at least as efficiently, in any other way, consumers are likely to focus on the functionality and ignore the novel task resulting from the new interface [7,29,45]. The first spreadsheet, Visicalc, for example, was very successful despite its novel and complex interface. As Norman [29] points out its success was attributed to the compelling advantage of its functionality (i.e., analyses could be done over and over again and the results of the analysis could be seen immediately). Conversely, when a new interface is introduced with a pre-existing functionality, a different type of process is likely to be triggered. Specifically, existing product categories that provide a similar functionality are likely to be cued [35,39]. Further, consumers are likely to compare the new interface with known and familiar interfaces that are associated with current products that deliver the same functionality. As a result, consumers should give considerable attention to the interface itself because it is discrepant from existing product category schemas [15,20]. As a consequence, they are likely to question whether it will work as intended, and thus perceive higher uncertainty [40,45]. We hypothesize that:

> Hypothesis 1: When a new interface is introduced with a new (vs. pre-existing) functionality, consumers will perceive less uncertainty about the performance of the new interface.

3. The effect of imagery

Research on mental imagery suggests that an individual asked to imagine a particular event, may use that evoked

scenario as a basis for subsequent judgments (see [21] for a review). Specifically, findings from psychological research indicate that imagining a hypothetical future event may render this event more likely. For example, Caroll [6] found that subjects who were asked to imagine themselves experiencing the occurrence of a social event (i.e., the election of a political candidate) come to believe more strongly that the event will take place. Specifically, subjects who were asked to imagine Carter winning perceived a higher likelihood of the event occurring than did subjects who did not imagine the future event. In a similar vein, Gregory, Cialdini, and Carpenter [13] found that homeowners who were induced to imagine themselves using cable television were more likely to subscribe to such a service in the future. But what if an outcome is difficult to imagine? Sherman et al. [36] examined this question. Specifically, Sherman et al. [36] demonstrated that imagining a hypothetical outcome might increase its subjective likelihood, but *only if* the images can be arrived at easily and without a great deal of conscious effort. In contrast, if an outcome is difficult to envision, the attempt to imagine it may actually reduce the perceived likelihood that it will occur. In their study, subjects were told about a new disease that was becoming increasingly prevalent on campus. In the easy-to-imagine condition, the symptoms of the disease were concrete and probably experienced by most students (e.g., severe headaches). In the difficult-to-imagine condition, the symptoms were less concrete (e.g., a malfunctioning nervous system). The results of this study suggest that difficult to imagine events are difficult to retrieve, and as a result subjects may infer that such events must be more unlikely. Specifically, compared to a group that was not asked to imagine a particular event, those who were given the difficult-to-imagine symptoms judged the likelihood of contracting the disease as smaller than any other group. In contrast, those given the easy-to-imagine symptoms actually increased their perceived likelihood of contracting the disease.

We now extend these results to examine the effect of imagery on consumers' uncertainty about the performance of a novel interface and adoption intentions. Prior research suggests that an individual asked to imagine a product in use is likely to use that evoked scenario as a basis for subsequent judgments [21]. Individuals, however, may have difficulty in imagining themselves using a novel product for which they do not have adequate stored knowledge structures [32, see also 27]. In that case, asking individuals explicitly to imagine a product in use is likely to elicit an unfavorable response about the new product [43].

When a new product involves a new functionality, this functionality cannot be related to existing knowledge structures [35], and therefore it will be difficult for an individual to imagine him/herself interacting with the new interface and obtaining this new functionality. Because a new functionality is difficult to imagine, individuals may infer that it is unlikely that the new interface will perform as promised and deliver the particular functionality, thereby increasing uncertainty about the performance of the new interface. Furthermore, because of higher levels of uncertainty about the performance of the new interface, consumers' intention to adopt the new product will be lower in the imagining condition.

In contrast, when a new interface is introduced with a pre-existing functionality, consumers are familiar with this functionality since they generally obtain this functionality from an existing product category (i.e., an easy-to-construct outcome). The ease of imagining the product in use is likely to increase individuals' estimated likelihood that the new interface will perform as promised and provide the particular functionality, thereby decreasing perceived uncertainty about the performance of the new interface. In addition, because of lower levels of uncertainty, consumers' intention to adopt the new product will be higher. Based on the preceding arguments, it is proposed that:

> Hypothesis 2: When a new interface is introduced with a *new* functionality, imagining the product in use will increase consumers' uncertainty about the performance of the new interface. Conversely, when a new interface is introduced with a *pre-existing* functionality, imagining the product in use will decrease consumers' uncertainty about the performance of the new interface.
>
> Hypothesis 3: When a new interface is introduced with a *new* functionality, imagining the product in use will decrease consumers' intention to adopt the new product. Conversely, when a new interface is introduced with a *pre-existing* functionality, imagining the product in use will increase consumers' intention to adopt the new product.

4. Method

4.1. Study design and subjects

The hypotheses were tested in an experiment with a 2 Functionality (Pre-Existing vs. New) × 2 Imagery (No Imagery vs. Imagery) factorial design. Subjects were 146 undergraduate students majoring in business. Subjects were randomly assigned to one of the experimental conditions. Participation was part of a course requirement.

4.2. Stimuli development and independent variables

In all conditions, the new product was described as a wireless device that enabled users to access information. The nondescriptive name "S-100" was used across conditions. Speech recognition technology was the new interface selected for this study. Products using speech recognition technology recognize every sentence spoken by the user, parse the sentence into grammatical elements, understand the meaning, and act on it [46]. Speech recognition has already seen some dramatic breakthroughs in recent years and is the interface most ready to explode for practical

applications. The description of the functionality was followed by a brief description of how the new interface provides this functionality. This brief description was developed based on existing literature on speech recognition technology [9,46]. The new interface was the same in all the experimental conditions.

We conducted a pretest with a group of 20 subjects drawn from the same student population as the main study to assess familiarity with products incorporating speech recognition technology. The familiarity scale was adapted from previous research [31]. Three nine-point items were averaged ($\alpha = 0.94$): (1) How familiar are you with products that incorporate speech recognition technology? (1 = Not familiar at all to 9 = Very familiar), (2) Would you consider yourself informed or uninformed about products that use speech recognition technology? (1 = Not at all informed to 9 = Highly informed), (3) Would you consider yourself knowledgeable about products that use speech recognition technology? (1 = Know nothing at all to 9 = Know a great deal). The overall familiarity for products using speech recognition technology was 2.46 suggesting that the technology was relatively unfamiliar to the subjects.

4.3. Manipulation of functionality newness

In all conditions, the functionality of the new product was chosen to be relevant to the student population. Furthermore, in all conditions, the functionality was described in terms of four specific benefits for the consumer. The pre-existing functionality was labeled "Library Information." Specifically, the user was able to: (a) Access and search the library catalogues by author, title, subject, or keyword, (b) Access and search course reserves, (c) Access library information such as library hours, circulation loan rules and so forth, and (d) Access his/her circulation record.

The new functionality was labeled "Entertainment and Local Information." The user was able to access: (a) A combination of recent magazine and newspaper articles on various topics of interest to students, (b) Information on new stores, new products, new trends, upcoming events, (c) Detailed directions to various venues, for example, best type of transportation to use, bus stops, overview maps for route display, (d) Interactive games to play alone, with friends, or against S-100 (see Figs. 1A and 2A).

In a pretest with a separate group of 40 subjects drawn from the same student population as the main study, we asked them to indicate the degree to which the functionality was novel to them. Functionality newness (pre-existing vs. new) was manipulated as a between-subjects factor. Subjects' ratings of the perceived newness of the functionality were elicited on a 9-point scale by asking the following question: "How would you rate the functionality provided by this product? (By functionality we refer to what the product does for the consumer) (1 = Not at all novel to 9 = Very novel). The results of this pretest confirmed that respondents perceived the "Library Information" functionality as much less novel than the "Entertainment and Local Information" functionality ($M = 4.05$ vs. 7.05, $t_{(38)} = 4.90$, $p < .0001$).

We conducted another pretest with a separate group of 20 subjects to verify that the pre-existing and the new functionality were both relevant for the subjects. Half of the subjects were presented with a description of the new product concept that provided "Library Information" and the other half were presented with a description of the new product concept that provided "Entertainment and Local Information." Specifically, subjects were asked to indicate the degree to which S-100's functionality was desirable to them. Subjects' ratings were elicited on a 9-point scale (1 = Not at all desirable to 9 = Very desirable). The results confirmed that subjects did not perceive any differences in desirability between the two functionalities ($M = 5.9$ vs. 5.8, $t_{(18)} = 0.11$, $p = .91$).

4.4. Manipulation of imagery

After reading the new product description, subjects in the imagery conditions were asked to imagine themselves using the product. Imagery instructions were based on the scenario used by Gregory, Cialdini, and Carpenter [13] (see Figs. 1B and 2B).

We conducted a pretest with a group of 24 subjects to assess the effect of the imagery instructions (adapted from McGill and Anand [24]). These subjects participated in a 2 (Pre-Existing vs. New Functionality) x 2 (No Imagery vs. Imagery) study. After reading the description of the new product concept, subjects were asked to "please write down what you were thinking as you were looking over the new product description." Subjects were instructed to list whatever thoughts came to mind. We expected subjects in the imagery conditions to list a greater number of attributes and provide more detailed descriptions [24]. Subjects' open-ended responses were content analyzed by a judge who was blind to experimental conditions. The results of the pretest indicated that subjects in the imagery conditions described a greater number of attributes than subjects in the no imagery conditions ($M = 3.30$ vs. 0.45, $F_{(1,22)} = 31.39$, $p < .0001$). Furthermore, subjects in the imagery conditions provided more detailed descriptions than did subjects in the no imagery conditions, as indicated by the total number of words used ($M = 59.93$ vs. 21.54, $F_{(1,22)} = 17.30$, $p < .0005$).

In another pretest, a group of 34 subjects were asked to indicate how easy it was to imagine the product in use. Subjects were randomly assigned to the two functionality newness conditions. They were asked to indicate how easily they could imagine themselves using the product and obtaining the particular functionality (1 = Not at all easily to 9 = Very easily; adapted from Sherman et al. [36]). The results of this pretest revealed that using the new product and obtaining the expected functionality was easier to imagine in the pre-existing (vs. new) functionality condition ($M = 7.05$ vs. 4.60, $t_{(32)} = 3.59$, $p < .001$).

FIGURE 1A
PRE-EXISTING FUNCTIONALITY / NO IMAGERY

S-100

S-100 is a **new**, **wireless** communication device using **state-of-the-art speech recognition technology**. S-100 can be carried around, understands **your spoken commands** and provides you "**Library Information**."

With **S-100** you can:

- Access and search the library catalogues by author, title, subject, or keyword
- Access and search course reserves
- Access library information such as library hours, circulation loan rules etc
- Access you circulation record

Here is how speech recognition works
Thanks to speech recognition technology, S-100 **understands** your spoken commands. You simply need to **speak** your request. A research algorithm that is resident in the device **compares the characteristic features** of your words to a "database" of characteristics that are stored in the device's memory and selects the best match. In addition to "recognizing" speech, the algorithm also **"understands" speech**. The information you requested is then **retrieved** from a constantly updated database and **displayed** on S-100's screen.

FIGURE 1B
PRE-EXISTING FUNCTIONALITY / IMAGERY

[The following information was added in the pre-existing functionality/imagery condition]

S-100
Now, take a moment and imagine how S-100 will provide you with "**Library Information**." Take a moment and **think of yourself** asking S-100 for "**Library Information**." Take a moment and **think of how** you will be able to access the information you requested. **Imagine** yourself easily obtaining this information on S-100's screen.

Fig. 1.

FIGURE 2A
NEW FUNCTIONALITY / NO IMAGERY

S-100

S-100 is a **new**, **wireless** communication device using **state-of-the-art speech recognition technology**. S-100 can be carried around, understands **your spoken commands** and provides you "**Entertainment and Local Information**."

With **S-100** you can access:

- A Combination of Recent Magazines and Newspaper Articles on Various Topics of Interest to Students
- Information on New Stores, New Products, New Trends, Upcoming Events
- Detailed Directions to Various Venues, for example, Best Type of Transportation to Use, Bus Stops, Overview Maps for Route Display
- Interactive Games to Play Alone, with Friends, Against S-100

Here is how speech recognition works
Thanks to speech recognition technology, S-100 **understands** your spoken commands. You simply need to **speak** your request. A research algorithm that is resident in the device **compares the characteristic features** of your words to a "database" of characteristics that are stored in the device's memory and selects the best match. In addition to "recognizing" speech, the algorithm also **"understands" speech**. The information you requested is then **retrieved** from a constantly updated database and **displayed** on S-100's screen.

FIGURE 2B
NEW FUNCTIONALITY / IMAGERY

[The following information was added in the new functionality/imagery condition]

S-100
Now, take a moment and **imagine** how S-100 will provide you with "**Entertainment and Local Information**." Take a moment and **think of yourself** asking S-100 for "**Entertainment and Local Information**." Take a moment and **think of how** you will be able to access the information you requested. **Imagine** yourself easily obtaining this information on S-100's screen.

Fig. 2.

Table 1
Means and cell sizes categorized by independent variables

	New Functionality			Pre-Existing Functionality		
	No Imagery $n = 37$	Imagery $n = 36$	t-value	No Imagery $n = 37$	Imagery $n = 36$	t-value
Uncertainty about the performance of the interface	3.55	4.38	3.20*	4.80	3.95	3.28*
Adoption intention	5.02	4.30	1.71**	3.18	3.91	1.73**

* $p < .005$.
** $p < .05$.
NOTE: Higher means indicate higher uncertainty and higher intention to adopt. Theoretical scales ranges for both variables were 1 to 9.

4.5. Procedure

Subjects were informed that a major (anonymous) manufacturer was planning to introduce a technology-based product into the market and was interested in consumers' reactions to its product. No brand names were provided so that subjects could not search internally for brand-specific information [34]. Subjects were then handed out booklets that included the new product description as well as the questionnaire with all dependent measures. The first page of the booklet stated that on the next page they would find the new product description. After reading the new product description in a self-paced manner, subjects completed the dependent measures. About 20 min were required to complete the study. Subjects were debriefed by the experimenter. Before beginning the debrief, the experimenter asked subjects several questions to determine if they suspected the true nature of the study. None of the respondents guessed the true nature of the study. Subjects were then debriefed and thanked for their participation in the study.

4.6. Dependent variables

Subjects' uncertainty about the performance of the new interface was measured using two nine-point scale items: (1) How likely do you think it is that the speech recognition technology used in this product will work as promised? (1 = Very likely to 9 = Very unlikely), and (2) How certain are you that the speech recognition technology used in this product will perform as described? (1 = Very certain to 9 = Very uncertain). The dependent variable was the average of the ratings on the two items ($r = 0.78$, $p < .0001$). These items were adapted from previous research [30]. Subjects' intentions to adopt the new product were measured by asking the question: How likely are you to buy S-100? (1 = Very unlikely to 9 = Very likely). The coefficient of correlation between the summated uncertainty scale and the intention measure was negative and statistically significant ($r = -0.72$, $p < .0001$).

5. Results

We predicted that when a new interface is introduced with a new (vs. pre-existing) functionality, consumers are likely to perceive less uncertainty about the performance of the new interface (H1). Our results support this hypothesis. Consumers' uncertainty about the performance of the new interface was significantly lower when the new interface was introduced with a new (vs. pre-existing) functionality ($M = 3.55$ vs. 4.80, $t_{(142)} = 3.38$, $p < .005$). These results support H1. Table 1 shows the mean values for the dependent variables.

We also predicted a significant functionality newness by imagery interaction. The results of a MANOVA supported the hypothesized interaction ($F_{(1,142)} = 5.85$, $p < .003$). We followed up the significant interaction by using ANOVAs in order to examine if our results hold equally for both dependent variables. As predicted, the results revealed a significant functionality by imagery interaction in regard to consumers' uncertainty about the performance of the new interface ($F_{(1,\ 142)} = 4.26$, $p < .006$). Follow-up contrasts (t tests) confirmed that when the new interface was introduced with a new functionality, imagining the product in use increased subjects' uncertainty about the performance of the new interface ($M = 3.55$ vs. 4.38, $t_{(142)} = 3.20$, $p < .005$). In contrast, as anticipated, when the new interface was introduced with a pre-existing functionality, imagining the product in use decreased subjects' uncertainty about the performance of the new interface ($M = 4.80$ vs. 3.95, $t_{(142)} = 3.28$, $p < .005$). These results offer support for H2. In the case of this dependent variable, none of the main effects were significant (p's > 0.20).

H3 predicted a significant functionality by imagery interaction in regard to consumers' intention to adopt a new product incorporating a new interface. The results of the ANOVA confirmed the predicted interaction between functionality and imagery in regard to adoption intentions ($F_{(1,142)} = 5.82$, $p < .01$). Follow-up contrasts revealed that imagining the product in use decreased consumers' intentions to adopt the new product when the new interface was introduced with a new functionality ($M = 5.02$ vs. 4.30,

$t_{(142)} = 1.71$, $p < .05$). In contrast, imagining the product in use increased consumers' intentions to adopt the new product when the new interface was introduced with a pre-existing functionality ($M = 3.18$ vs. 3.91, $t_{(142)} = 1.73$, $p < .05$). These data offer support for H3. The analysis also revealed a significant functionality newness main effect, such that respondents expressed a higher intention to adopt the new product when the new interface was introduced with a new (vs. pre-existing) functionality ($M = 4.66$ vs. 3.55, $F_{(1,145)} = 13.75$, $p < .0003$).

5.1. Conclusions and implications

Successful commercialization of new technologies is the riskiest and most rewarding form of new product development activity [18]. But despite the growing stream of research on high-technology markets in the marketing literature, our understanding of consumer decision making in such markets is limited [10,11]. Glazer [10] highlights the fact that, in the consumer behavior literature, both theoretical and empirical work have mainly involved product categories that have essentially remained unchanged for many years with respect to their underlying technologies. This research attempts to address this gap by investigating consumers' response to a novel technological interface.

In this research, we integrate concepts from the human-computer interaction literature (see e.g., [4,8,37]), the new product development literature (see e.g., [25,41,42]), and the decision-making literature (see e.g., [6,13,36]) for examining the effect of imagery and the effect of the newness of the functionality of a new product on consumers' uncertainty about the performance of a novel interface and consumers' adoption intentions. Overall, our results were consistent with our predictions. Specifically, our findings suggest that consumers perceive lower uncertainty about the performance of a new interface and higher intentions to adopt the new product when the new interface is introduced with a new (vs. pre-existing) functionality. This finding is consistent with previous research on human-computer interaction suggesting that the nature of the functionality of a new product is a critical determinant of consumers' reaction to it [4,37].

Furthermore, prior research has suggested that the use of imagery is likely to be critical to perceptions of uncertainty and adoption intentions for new products [21,32,38]. We argue that for products involving a new interface, the benefit of imagery is contingent upon the newness of the functionality of the new product. Specifically, our results suggest that when a new interface is introduced with a new functionality, imagining the product in use increases consumers' uncertainty about the performance of the new interface and decreases intentions to adopt the new product. In contrast, when a new interface is introduced with a pre-existing functionality, imagining the product in use decreases consumers' uncertainty about the performance of the new interface and increases intentions to adopt the new product.

5.2. Managerial implications

This research provides valuable guidelines for firms commercializing new technologies that result in a novel interface for consumers. An understanding of the factors that influence consumers' performance uncertainty about a novel interface can help managers to design better their marketing strategies so as to reduce uncertainty and to improve the chances for customer adoption [41]. From a managerial perspective, it is important to understand how consumers form judgments about the performance of a novel interface. Instead of treating consumers' uncertainty as fixed and defining the role of marketing as devising programs to reduce such uncertainty, a constructive view of consumer learning will allow firms to influence perceptions of uncertainty, thereby creating a source of competitive advantage [5,33].

Conceptually, as Capon and Glazer [3] point out, a single technology can map onto multiple products. These products may differ in the degree to which they provide a new functionality or a pre-existing functionality through a novel interface. Our results suggest that to the extent that uncertainty associated with the performance of a new interface varies with the newness of the functionality, new product development teams should consider the novelty of the functionality introduced with the novel interface.

Consider for example speech recognition. Wireless devices incorporating speech recognition technology have been introduced recently into the market. Examples of such devices include: Philips' *Genie* mobile voice dial phone, IBM's *Via Voice* dictation system, VOS's *Intelavoice* that allows consumers to turn on and off lights and electrical appliances, and Dragon Systems' *NaturallySpeaking* mobile organizer that allows consumers to schedule meetings. Our results suggest that introducing speech recognition with a *new* functionality is likely to reduce consumers' uncertainty about the performance of the new interface and increase adoption intentions for the new product.

Our findings also suggest implications for designing communication strategies. Advertising practitioners often encourage imagery on the part of consumers, in the reasonable belief that imagery enhances the effectiveness of an appeal [32]. Consider, for example, a recent ad that appeared in various business magazines where Bellsouth promotes "Interactive Messaging" provided to the consumers via a wireless palm-sized device. This ad explicitly asks consumers to imagine themselves using the product with sentences such as "Imagine a palm-sized wireless device that can access the Web, send and receive e-mail and interactive messages, and can now keep you organized with a calendar, address book and task list that can sync up with your PC." Another recent TV ad campaign from AT&T uses imagery to reduce uncertainty about the performance of its Internet business services. Viewers are induced to imagine how AT&T will help them solve a particular problem [1].

The question of interest here is, does imagery help when a new product involves a novel interface?

This research suggests that from a managerial standpoint one needs to be sensitive to the nature of the functionality when determining whether to use imagery. Our findings suggest that when a new interface is introduced with a pre-existing functionality, consumers can easily imagine the new functionality, and as a result, imagery can be used to reduce consumers' uncertainty about the performance of the new interface and increase adoption intentions. However, the use of imagery is likely to increase consumers' uncertainty about the performance of the new interface in the case of a new functionality, since the new functionality is difficult to imagine, and therefore should not be used.

5.3. Future research directions

This study suggests several avenues for future research. First, future research could examine how the use of analogies can affect consumers' learning about a novel interface. The central focus in analogical learning is on the comparison of one domain to another and, more specifically, on what can be learned as the result of this comparison [12]. Previous research suggests that the use of analogies in advertisements is likely to enhance consumers' ability to process the information in the ad and influence consumers' judgments [22,23]. Future research could examine, for example, the effect of ads containing analogies between a novel interface and something more familiar on consumers' uncertainty and adoption intentions. For example, it is possible that the acceptance of a new interface can be promoted by relational comparisons that educate the consumer on how the interface works, thereby producing analogical learning.

Second, prior research also suggests that when consumers encounter a new product for which prior knowledge is unavailable, it is possible to increase consumers' ability to process novel information by using concrete words as opposed to more abstract information [23]. An area for future research of interest to both consumer researchers and advertising practitioners is to examine the effect of different types of information regarding a new product interface on consumers' uncertainty about the performance of the new interface and adoption intentions. Furthermore, prior research shows that when a novel interface is introduced with a new functionality, providing high levels of information on the interface increases consumers' uncertainty about its performance [45]. Future research may reveal important insights on the issue of quality versus quantity of information in regard to reducing performance uncertainty of new products involving a novel interface.

Third, future research could also investigate order of entry effects for a novel interface. Research on order-of-entry effects on consumers' judgments suggests that the positioning decisions of pioneering brands in a new category define a context, which systematically affects consumer preferences for all brands in the new category [5]. In the case of a novel interface, the functionality defines a context in which the new interface will be evaluated. Specifically, the novelty of the functionality initially introduced with a novel interface is likely to influence the evolution of consumer preferences for the interface.

Fourth, future research could also examine the psychological implications of using a novel interface. For example, Mick and Fournier [26] suggest that new technologies can facilitate feelings of intelligence or efficacy but can also lead to feelings of ignorance or ineptitude. Future research could investigate how the nature of the functionality introduced with a novel interface is likely to affect consumers' psychological reactions to the new interface. For example, our research suggests that when a new interface is introduced with a new (vs. pre-existing) functionality, consumers are likely to focus on the functionality and ignore the novel task resulting from the new interface. As a result, they may be less likely to experience feelings of ignorance or ineptitude when interacting with the novel interface.

Fifth, prior research suggests that interacting with a novel interface is likely to have social implications as well. For example, Nardi and O'Day [28] point out that in a work environment, the introduction of a new product involving a novel interface is likely to create anxiety and tensions. This is likely to happen when the novel interface addresses the needs of only a few specialists at the expense of others. The authors suggest that in order to avoid tense situations at work, prospective users should have the opportunity to offer their opinions on a novel interface and their suggestions on how to improve the design of the new product involving the new interface before the product is actually introduced. While the focus of this article was on individual processes, future research could examine how the social context moderates our findings.

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References

[1] Arndorfer JB, Snyder B. AT&T calls up Net imagery to sell its business services. Advertising Age 1999;February8:4.
[2] Bettis RA, Hitt MA. The new competitive landscape. Strategic Management Journal 1995;16:7–19.
[3] Capon N, Glazer R. Marketing and technology: A strategic coalignement. Journal of Marketing 1987;51:1–14.
[4] Card SK, Moran TP, Newell A. The psychology of human-computer interaction. Hillsdale, NJ: Lawrence Erlbaum, 1983.
[5] Carpenter GS, Nakamoto K. Consumer preference formation and pioneering advantage. Journal of Marketing Research 1989;26:285–98.

[6] Carroll JS. The effect of imagining an event on expectations for the event: An interpretation in terms of the availability heuristic. Journal of Experimental Social Psychology 1978;14:88–96.
[7] Cooper A. The inmates are running the asylum: Why high-tech products drive us crazy and how to restore the sanity. Indianapolis, IN: Macmillan Computer Publishing, 1999.
[8] Faulkner C. The essence of human-computer interaction. New York, NY: Prentice-Hall, 1998.
[9] Glass J, Flammia G, Goodine D, Phillips M, Polifroni J, Sakai S, Seneff S, Zue V. A bilingual voyager system. Speech Communication 1995;17:1–18.
[10] Glazer R. Consumer behavior in high-technology markets. In: Kardes FR, Sujan M, editors. Advances in Consumer Research. Provo, UT: Association for Consumer Research, 1995. p. 224.
[11] Glazer R. Winning in smart markets. Sloan Management Review 1999;40:59–69.
[12] Gregan-Paxton J, Roedder JD. Consumer learning by analogy: A model of internal knowledge transfer. Journal of Consumer Research 1997;24:266–84.
[13] Gregory WL, Cialdini RL, Carpenter K. Self-relevant scenarios as mediators of likelihood estimates and compliance: Does imagining make it so? Journal of Personality and Social Psychology 1982;43: 89–99.
[14] Hackos JT, Redish JC. User and task analysis for interface design. New York, NY: Wiley, 1998.
[15] Hastie R. Causes and effects of causal attribution. Journal of Personality and Social Psychology 1981;46:4–56.
[16] Hoque AY, Lohse GL. An information search cost perspective for designing interfaces for electronic commerce. Journal of Marketing Research 1999;36:387–94.
[17] Jolly VK. Commercializing new technologies: Getting from mind to market. Boston, MA: Harvard Business School Press, 1997.
[18] Lehmann DR, Winer RS. Product management. Boston, MA: Irwin, 1997.
[19] Leifer R, McDermott CM, Colarelli O'Connor G, Peters LS, Rice M, Veryzer RW. Radical innovation: How mature companies can outsmart upstarts. Boston, MA: Harvard Business School Press, 2000.
[20] Lynch JG, Srull TK. Memory and attentional factors in consumer choice: Concepts and research methods. Journal of Consumer Research 1982;9:18–37.
[21] MacInnis DH, Price LL. The Role of imagery in information processing: Review and extensions. Journal of Consumer Research 1987; 13:473–91.
[22] MacInnis DJ, Jaworski BJ. Information processing from advertisements: Toward an integrative framework. Journal of Marketing 1989; 53:1–23.
[23] MacInnis DJ, Moorman C, Jaworski BJ. Enhancing and measuring consumers' motivation, opportunity, and ability to process brand information from ads. Journal of Marketing 1991;55:32–53.
[24] McGill AL, Anand P. The effect of vivid attributes on the evaluation of alternatives: The role of differential attention and cognitive elaboration. Journal of Consumer Research 1989;16:188–96.
[25] Meyer MH, Roberts EB. New product strategy in small technology-based firms: A pilot study. Management Science 1986;32:806–21.
[26] Mick DG, Fournier S. Paradoxes of technology: Consumer cognizance, emotions, and coping strategies. Journal of Consumer Research 1998;25:123–43.
[27] Morris PE, Hampson PJ. Imagery and consciousness. London: Academic Press, 1983.
[28] Nardi BA, O'Day VL. Information ecologies: Using technology with heart. Cambridge, MA: The MIT Press, 1999.
[29] Norman DA. The invisible computer. Cambridge, MA: MIT Press, 1998.
[30] Nowlis SM, Simonson I. The effect of new product features on brand choice. Journal of Marketing Research 1996;33:36–46.
[31] Oliver RL, Bearden WO. Crossover effects in the theory of reasoned action: A moderating influence attempt. Journal of Consumer Research 1985;12:324–40.
[32] Oliver RL, Robertson TS, Mitchell DJ. Imaging and analyzing in response to new product advertising. Journal of Advertising 1993;22: 35–51.
[33] Olshavsky RW, Spreng RA. An exploratory study of the innovation evaluation process. Journal of Product Innovation Management 1996; 13:512–29.
[34] Ozanne JL, Brucks M, Grewal D. A study of information search behavior during the categorization of new products. Journal of Consumer Research 1992;18:452–63.
[35] Ratneshwar S, Shocker AD. Substitution in use and the role of usage context in product category structures. Journal of Marketing Research 1991;28:281–95.
[36] Sherman SJ, Cialdini RB, Schwartzman DF, Reynolds KD. Imagining can heighten or lower the perceived likelihood of contracting a disease: The mediating effect of false imagery. Personality and Social Psychology Bulletin 1985;11:118–27.
[37] Shneiderman B. Designing the user interface: Strategies for effective human-computer interaction. 3rd ed. Reading, MA: Addison-Wesley, 1998.
[38] Smith TR, Mitchell AA, Meyer R. A computational process model of evaluation based on the cognitive structuring of episodic knowledge. In Mitchell AA, editor. Advances in consumer research. Provo, UT: Association for Consumer Research, 1982. p. 136–43.
[39] Sujan M. Consumer knowledge: Effects of evaluation strategies mediating consumer judgments. Journal of Consumer Research 1985; 12:31–46.
[40] Tversky A, Kahneman D. Judgment under uncertainty: Heuristics and biases. Science 1974;185:1124–31.
[41] Veryzer RW. Key factors affecting customer evaluation of discontinuous new products. Journal of Product Innovation Management 1998; 15:136–50.
[42] Veryzer RW. Discontinuous innovation and the new product development process. Journal of Product Innovation Management 1998; 15:304–21.
[43] Wanke M, Bohner G, Jurkowitsch A. There are many reasons to drive a BMW: Does imagined ease of argument generation influence attitudes? Journal of Consumer Research 1997;24:170–7.
[44] Young RM. Surrogates and mappings: Two kinds of conceptual models for interactive devices. In: Gentner D, Stevens AL, editors. Mental models. New Jersey: Lawrence Erlbaum, 1983. p. 35–52.
[45] Ziamou P, Ratneshwar S. Promoting consumer adoption of high-technology products: Is more information always better? Journal of Consumer Psychology 2002 (forthcoming).
[46] Zue VW. Navigating the information superhighway using spoken language interfaces. IEEE 1995;October:39–43.

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