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Arjun Chaudhuri  
Rev. Thomas R. Fitzgerald S.J. Professor of Marketing  
Charles F. Dolan School of Business  
Fairfield University  
North Benson Road  
Fairfield, CT 06824-5195  
(203) 254-4000, ext. 2823  
fax: (203) 254-4105  
achaudhuri@fairfield.edu

Khaled Aboulnasr  
Assistant Professor of Marketing  
Lutgert College of Business  
Florida Gulf Coast University  
10501 FGCU Boulevard South  
Fort Myers, Florida 33965  
(239) 590-7598  
fax: (239) 590-7330  
kaboulna@fgcu.edu

Mark Ligas  
Associate Professor of Marketing  
Charles F. Dolan School of Business  
Fairfield University  
North Benson Road  
Fairfield, CT 06824-5195  
(203) 254-4000, ext. 3117  
fax: (203) 254-4105  
mligas@fairfield.edu
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Arjun Chaudhuri (Ph.D., University of Connecticut), Rev. Thomas R. Fitzgerald S.J. Professor of Marketing, Charles F. Dolan School of Business, Fairfield University, Fairfield, CT, achaudhuri@fairfield.edu.

Khaled Aboulnasr (Ph.D., University of Houston), Assistant Professor of Marketing, Lutgert College of Business, Florida Gulf Coast University, Fort Myers, FL, kaboulna@fgcu.edu.

Mark Ligas (Ph.D., University of Connecticut), Associate Professor of Marketing, Charles F. Dolan School of Business, Fairfield University, Fairfield, CT, mligas@fairfield.edu.

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ABSTRACT

Recent research advocates the importance of emotions in new product development. We investigate whether initial exposure to either a hedonic or utilitarian description of an innovation increases willingness to try the innovation. We extend Wood and Moreau’s (2006) expectations-emotions-evaluation model to include the role of arousal, perceived risk (a negative evaluation) and willingness to try. We find that the model is significantly different for hedonic and utilitarian descriptions of a radical innovation (automated highway). We also find that the impact of arousal on positive (optimism) and negative (anxiety) emotions is greater for hedonic rather than utilitarian descriptions. Finally, we replicate our results using real world descriptions of two radical innovations. We discuss our results and provide managerial implications and limitations of our research.
Successful diffusion of innovation has been shown to be a key determinant to a firm’s long term financial performance and corporate well being (Pauwels et al. 2004). While launching new products may promise great financial rewards, it also represents a considerable financial risk depending on how the market responds to such products. Given the importance of the innovation process to individual firms as well as to the vitality of the economic system, considerable research has been conducted investigating the determinants of successful diffusion of new products and the processes that motivate consumers’ adoption of new technologies (Ram and Sheth 1989; Mahajan, Muller and Bass 1990; Rogers 2003; Hoeffler 2003; Wood and Moreau 2006; Herzenstein, Posavac and Brakus 2007).

Despite the plethora of research on consumers’ adoption of new products, very few studies have considered the underlying role of consumers’ emotional responses in the diffusion of innovations literature (for notable exceptions see Chandy et al 2001; Wood and Moreau 2006). While the role of emotions has been widely accepted in consumer information processing of persuasive messages, such as advertising, the innovations literature has often overlooked emotions as a cause of successful diffusion. For instance, Rogers’ (2003) classic text on the diffusion of innovations does not directly suggest that emotions are evoked in the formulation of consumer perceptions of innovations.

The role of emotions is particularly eminent in the context of new products that represent radical innovations. In accordance with Chandy and Tellis (1998), we define a radical innovation as a new product or service that possesses two properties. First, it arises from a new technology and, second, it is a distinct improvement in meeting consumer needs. Radical innovations are also referred to in the innovation literature as discontinuous innovations, true innovations and really new products. We contend that understanding emotional responses is critical to the success
of radical innovations. Such innovations are, by their very nature, extremely incongruous with existing products. Extreme incongruity has been proposed as a determinant of the generation of strong positive and negative affect, as well as positive and negative evaluation of phenomena (Mandler 1982). Hence, the emotions generated in response to a radical innovation may guide the evaluation of such product.

Radical innovations present both a greater opportunity and a greater threat for consumers compared to other product introductions. The hybrid car, for example, provides fewer harmful emissions and holds the promise of a cleaner environment. At the same time the hybrid car has been beset with questions about the recycling of its batteries, the possible danger from its electric motor in the event of a crash and even its excessive quietness which prevents the seeing impaired from sensing its presence (Brown 2007; Flandez 2007; Moran 2005). If such innovations can produce both optimistic and anxiety-inducing situations for consumers, it is important to ask which aspect is likely to prevail in the successful adoption of an innovation.

Given the potentially significant role of affect in shaping consumers’ acceptance and consequently adoption of radical innovations, the incorporation of consumers’ emotional responses into new product diffusion models is essential for more precise business decisions. From a managerial perspective, arriving at a more accurate representation of how consumers respond to the launch of a radical innovation is particularly important knowing that the combined cost of the development and introduction as well as the potential market returns for radical innovations may be in the billions of dollars (Sorescu, Chandy and Prabhu 2003). Upon the introduction of a radical innovation, if managers were able to illicit positive emotional reactions from consumers and avoid negative ones, this may prove beneficial to the successful diffusion of such a product.
As such, the main goal of the current research is to investigate the role of consumers’ emotions in the adoption of radical innovations. We seek to make the following contributions to the literature on the adoption of radical innovations. First, we address a gap in the literature on radical innovations by attending to the important role consumers’ emotions may play in the adoption of radically innovative products. We develop a model of information processing for initial exposure to radical innovations that includes consumers’ emotional responses. Specifically, we build on ideas from Mandler’s theory of value and the E3 model of emotional influence to develop hypotheses about the effect of arousal and emotions such as optimism and anxiety on consumers’ willingness to try radical innovations and their risk perceptions of these products. Second, we develop hypotheses that, to some extent, challenge prior literature which has suggested that moderate incongruity is more effective than extreme incongruity in the diffusion of new products (Myers-Levy Tybout 1989; Ozanne, Brucks and Grewal 1992; Peracchio and Tybout 1996; Stayman, Alden and Smith 1992). In contrast, we argue that extreme incongruity leads to the generation of emotions that may facilitate successful adoption. Third, we further extend the literature on radical innovations by considering the role of hedonic and utilitarian values, a relatively unexplored area in the context of radical innovations. Overall, we suggest that the nature of the message (hedonic or utilitarian) during initial exposure to an innovation may affect the emotional responses which then shape the consumer’s willingness to try the innovation. Although the role of hedonic and utilitarian values has been studied in a variety of contexts (Babin, Darden and Griffin 1994; Chandon, Wansink and Laurent 2000; Dhar and Wertenbroch 2000; Hill et al. 2004; Mano and Oliver 1993; Okada 2005; Pham 1998; Ramanathan and Williams 2007; Voss, Spangenberg & Grohmann 2003), it has not been examined in the literature on diffusion of radical innovations. We suggest that it is incumbent
upon innovation researchers to continue to improve on their understanding of the emotional effects of extremely new, radically different products. The alternative is to ignore that consumers’ discovery of such imaginative products is inevitably fraught with feelings that may be vital to the diffusion of such innovations.

The remainder of this paper is organized as follows. In the next section, we provide an overview of the diffusion of innovations literature. Then, we present a conceptual framework from which we develop a model and state specific hypotheses. We describe our research methods and operationalization of variables and present the results. Finally, we conclude the paper by identifying possible limitations and discussing managerial implications.

**LITERATURE REVIEW**

Diffusion is defined as “the process by which an innovation is communicated through certain channels over time among the members of a social system,” (Rogers 2003). According to Rogers, the key determinants to new product adoption include the perceived attributes of the innovation, social norms and individual characteristics. As such, most of the literature on the diffusion of innovations has focused on the effect of these variables, in addition to the communication channels through which information about the innovation is transmitted (Mahajan, Muller and Bass 1990). Interestingly, while these variables highlight the cognitive (perceived attributes, social norms) and behavioral (social norms, individual characteristics) factors that influence adoption, there appears to be no explanation for the role of affect in the diffusion process. We define affects as subjective feelings that are qualitatively different (Buck 1988) such as happiness, sadness, anger. We use the terms affect or emotion according to their use in the literature that we cite. Otherwise, we use the more inclusive term, emotion.
Specific attributes of the innovation, such as its relative advantage, compatibility, complexity, trialability and observability (Rogers 2003) have traditionally explained the rate of adoption and have been updated and expanded upon in further research (e.g., Moore and Benbasat 1991). Some studies have also examined the degree of perceived risk and the learning costs associated with the innovativeness of new products as important attributes that may influence the rate of adoption. Ram and Sheth (1989) outlined four different types of perceived risks associated with innovations, which may affect their rate of diffusion; namely economic, functional, social consequences and physical risks. This is in-line with our work, as we also consider the impact of an innovation’s incongruity on the customer’s perception of risk. Mukherjee and Hoyer (2001) observed that the addition of novel attributes leads to better product evaluation for less complex products but reduces the evaluation for more complex ones because of the learning costs involved with the latter type of products. The type of product, as well as the information that corresponds to each product (i.e., its attributes) will influence customers’ evaluations of the innovation. Thus, the model and resultant research that we present below takes into account the influence of differing information (hedonic versus utilitarian) on customers’ responses to innovations.

Recent studies have examined the effect of brand communities as well as the role of social networks in the adoption of innovations (Goldenberg et al. 2009; Thompson and Sinha 2008). Further, specific social characteristics are evidenced in the various adopter categories that are presented in most marketing texts (e.g., innovators, early adopters, etc…). For example, prior studies have demonstrated that younger, better educated consumers with higher incomes are more likely than others to adopt innovations early (Gatignon and Robertson 1985). Other psychographic attributes such as innovative predisposition, attitude towards risk and opinion
leadership are shown to influence the rate of innovation adoption (Wang, Dou and Zhou 2008). Herzenstein, Posavac and Brakus (2007) suggested that risk perceptions for really new products may be a function of self-regulatory focus. They found that promotion focused individuals were more likely than prevention focused ones to adopt new and really new products. What is not apparent in this stream of research is whether one’s affective state could assist in shaping his/her attitudes and opinions, and ultimately his/her behavior toward an innovation.

While the literature has provided insightful views into the determinants of the diffusion of innovations, it gave little consideration to the influence of consumers’ emotions in the innovation adoption process (see Wood and Moreau 2006). In the following sections, we develop an argument for further investigating the critical and often overlooked role of consumers’ emotional responses upon discovery of a radical innovation.

**CONCEPTUAL FRAMEWORK**

Emotion is defined as “a valenced affective reaction to perceptions of situations” (Richins 1997). The role of emotions has been well documented in the context of advertising (Young 2004), the use of products and services (Chitturi, Raghunathan, and Mahajan 2007; Chaudhuri 2002) and in various aspects of the consumption experience (Holbrook and Hirschman 1982). While results from this research stream have demonstrated that consumers’ emotional states may influence attitude formation, intentions, behavior as well as decision making (MacInnis and De Mello 2005; Richins 1997; Sherman, Mathur and Belk Smith 1997), the literature on the diffusion of radical innovations has been mostly silent on any emotional processes that may underlie consumers’ adoption of such products.

While their introduction may promise great financial rewards, radical innovations suffer from the liability of newness and the associated risks inherent in their discontinuous nature. Min,
Kulwani and Robinson (2006) suggest that really new products (where the level of perceived incongruity with existing products is high) have a disadvantage leading from their high levels of market and technological uncertainty. Similarly, Hoeffler (2003) argues that cost-benefit tradeoffs in utility functions for radical innovations are generally more uncertain compared to incremental innovations because of consumers’ lack of understanding of “attribute-to-benefit” linkages in radical innovations. He reasoned that consumers perceive the benefits of radical innovations as more uncertain and that they may need to make significant changes in their consumption patterns to achieve such benefits. Weighing the costs of these uncertainties combined with the anticipated change in behavior leads consumers to have greater perceptions of risk for radical innovations (Herzenstein, Posavac and Brakus 2007).

While prior research suggests that the incongruous nature of radical innovations may hinder consumers’ perceptions of value and heighten their risk perceptions, we suggest that the perceived incongruity of radical innovations may lead to the generation of emotions that may help shape the adoption process. We base our arguments on the ideas of Mandler (1982) on the structure of value. According to Mandler, evaluations are formed by individuals on the basis of interactions between external events and their existing schemas. A schema is a cognitive structure or abstract representation of reality, which individuals use to guide thought and behavior, and it functions to provide an understanding of the environment. It is developed through repeated encounters with the environment. Value is a function of schema congruity or schema incongruity with an encountered stimulus. Mandler asserts that events or objects that are congruous with existing schemas create evaluations involving positive or negative liking but are not accompanied by emotion. On the other hand, schema incongruity may combine with physiological arousal to create the subjective experience of affects such as anger, joy and other
qualitative affects. Such arousal and consequent affect occurs only when a stimulus is incongruous with existing schema. As such, we suggest that the incongruous nature of radical innovations will lead to the generation of arousal and emotions that may play a significant role in the shaping of consumers’ risk preferences and willingness to try radical innovations.

Furthermore, we also investigate whether the nature of the innovation’s description (hedonic or utilitarian) affects the nature of the relationships among some of our constructs of interest. Voss, Spangenberg & Grohmann (2003) define consumer attitudes in terms of a hedonic dimension that is derived from the sensations of using a product and a utilitarian dimension that is derived from the functions performed by a product. Based on this, we define hedonic product descriptions as descriptions that provide sensations of pleasure and utilitarian product descriptions as descriptions that function to solve everyday problems in consumers’ lives. Hedonic product descriptions emphasize sensory gratification and promise more fun, pleasure and excitement in the consumption experience. In contrast, utilitarian product descriptions deliver more cognitively-oriented benefits and serve, primarily, as an instrumental means to an end (Holbrook and Hirschman 1982; Oliver 1999; Woodruff and Gardial 1996).

Hedonic and utilitarian product descriptions may also be distinguished by the notions of immediacy and concreteness (Pham 1998). While conventionally we may think of utilitarian products as offering more concrete attributes and hedonic products offering more abstract attributes, we suggest the opposite for hedonic and utilitarian product descriptions based on their verbal communication properties and not the properties of a specific product. Hedonic product descriptions, which describe the pleasurable sensations of using a product, employ sensory cues that are concrete (e.g., “the feel of the warm summer wind on your face” for the description of a convertible car) and offer immediate gratification of pleasure. On the other hand, utilitarian
product descriptions describe the functional aspects of a product that are based on abstract cues (e.g., gas mileage) since their promise can only be fulfilled on a future date (e.g., the promise of gas mileage would only be revealed upon actual trial and continued use of the product). Thus, hedonic product descriptions provide concrete cues and immediate gratification, while utilitarian product descriptions promise abstract cues and delayed gratification.

**MODEL & HYPOTHESES**

The model we present in the current research (Figure 1) suggests that, upon initial exposure, perceived incongruity of an innovation with the idea it replaces may lead to a favorable outcome, willingness to try (WTT henceforth), for the innovation. This depends on whether the incongruity evokes a strong and positive emotional response (optimism) from consumers. Such a positive emotional response increases WTT and also reduces the perception of risks that may be associated with the innovation. However, at the same time, a negative emotional response (anxiety) can increase the perception of risks associated with the innovation, which in turn decreases WTT. For example, radical innovations usually involve significant changes in consumer behavior (Robertson 1967). Any anxiety about having to adapt their future behaviors to such constraints (the “Frankenstein effect”; see Zachary 2008) may lead consumers to focus more on the perceived risks of the innovation, which consequently lowers their willingness to try it.

However, we also suggest that a radical innovation generates an extreme level of incongruity with the preceding technology which leads to arousal (Mandler 1982). Such arousal in combination with a hedonic type of description (defined later) of the innovation will raise the level of optimism and lower the level of anxiety. Thus, we follow the E³ model (Wood and
Moreau 2006) which depicts paths from disconfirmation of expectations (included in our conceptualization of incongruity) to positive and negative emotions (optimism and anxiety) and from emotions to evaluation (perceived risk). Further, we extend the $E^3$ model by introducing a variable, arousal, which intervenes between incongruity and emotions (Figure 1). We discuss each path in the model and the nature of the relationships between the type of product description and these paths in the hypotheses section.

Note that optimism and anxiety, as presented in our model, are not the raw, crude, immediate emotional responses to stimuli that also take place on first exposure. These crude visceral emotions have been described as “low-road” instinctive emotions that are immediately experienced in response to a stimulus. In contrast, the emotions we examine in our model are “high-road” anticipated emotions which are typically experienced subsequent to “low-road” emotions. They are associated with expected consequences and outcomes of objects or events (Loewenstein et al. 2001). We examine emotional responses after consumers have read two or three columns of news content about an innovation. Therefore, unlike “low-road” processes, which include basic emotions like surprise, disgust, etc. (see Buck 1988; Pham et al. 2001 for descriptions of different types of emotions), we only consider “high road” emotional processes that are generated subsequent to the “low road” processes (Shiv and Fedorikhin 1999). Optimism, for instance, would appear to be a “high road” emotion. It is not categorized as a basic emotion since there is no facial expression uniquely associated with emotions like optimism (Ekman and Friesen 1975). Furthermore, in our model, optimism and anxiety are emotions that are associated with the potential outcome of using or adopting a radical innovation.

The temporal ordering of emotion and cognition (evaluation) has long been debated (Lazarus 1991; Zajonc 1980). This controversy is not central to our paper. Instead, we
acknowledge that the state of knowledge in emotion theory presently acknowledges various types of emotions and various sources of these emotions.

**Hedonic and Utilitarian Descriptions**

Based on the work of Pham (1998) we suggest that the emotional process depicted in our model (see Figure 1) will be stronger when the innovation is described as hedonic rather than utilitarian. Pham contends that affect is used as a source of information in making evaluative judgments. He also asserts that a consumer’s reliance on such feelings is greater under “consummatory” (hedonic) motives than under “instrumental” (utilitarian) motives. The greater reliance on feelings is attributed to the use of a “how do I feel about it” (hdif) heuristic to picture the focal object/event. This heuristic, in turn, creates feelings which serve as input for the formulation of evaluations. In addition, feelings are likely to be greater for hedonic descriptions because they have more concrete attributes than utilitarian descriptions. Pham cites the work of Strack, Schwarz and Gschneidinger (1985) who found that people recall hedonic experiences only to the extent that such experiences are vivid and concrete rather than pallid and abstract. Thus, hedonic descriptions allow for more visual processing than utilitarian descriptions, resulting in greater feelings. Hence, there are likely to be differences between hedonic and utilitarian descriptions in the various paths leading to and from the emotional constructs in our model. These hypotheses are developed next.

**Hypotheses**

Perceived incongruity has been described as the degree to which an encountered stimulus is different from an individual’s schema (Mandler 1982). Utilizing this description, we define perceived incongruity as the degree of perceived difference between the innovation (representing the stimulus) and the current idea, technology or product that the innovation replaces. The
current idea or technology forms the basis for consumers’ existing schemas. Our notion of perceived incongruity includes both the level of perceived uniqueness of the innovation relative to the current idea and the disconfirmation of expectations construct used by Wood and Moreau (2006) in formulating the $E^3$ model. The current idea or product sets the expectations of consumers and a radical innovation generally disconfirms these expectations. Accordingly, we include disconfirmation of expectations as an item in our measure of perceived incongruity (discussed later).

Change in self-reported arousal is defined as the change in the individual’s self-reported physiological condition as a result of changes in the environment. Arousal consists of a combination of a person's levels of mental alertness and physical activity and serves as a “bridge between psychology and physiology,” (Thayer 1989, p.31). High-information (i.e., complex, changing, novel and/or unexpected) situations or events increase arousal whereas low-information situations reduce arousal (Mehrabian and Russell 1974). For instance, reading about a radical innovation with unexpected product attributes will present a high-information event (it involves something novel, unexpected, and possibly complex). People react to such an event with greater concentration and greater physical activity (e.g., facial expressions, more bodily tension). Also, according to Berlyne (1960) and others (e.g. Mandler 1982) changes in the environment in the form of a novel or incongruous stimulus result in arousal. Thus, we expect that there will be a positive relationship between incongruity of the innovation and arousal.

**H1:** Perceived incongruity of the innovation will be positively related to change in self-reported arousal.

Optimism is defined as a positive anticipated emotion of general confidence about future outcomes that is evoked in response to changes in the environment. Anticipated emotions “are expected to be experienced in the future,” (Loewenstein et al. 2001). Further, emotions like
optimism and hope occur in an uncertain environment that is potentially rewarding (MacInnis and DeMello 2005) and radical innovations present such an environment. Anxiety, defined as a negative anticipated emotion of general unease about future outcomes, is also evoked in response to changes in the environment. However, in this case the environment is fraught with uncertainty and some of the future consequences are expected to be punitive in nature. Anxiety also represents a counterpoint to optimism and hope because it arises from a lack of hope or hopelessness (Mandler 1982). Both of these emotions are different from arousal which is a non-valenced physiological state.

As stated earlier, the level of perceived uniqueness as well as the disconfirmation of expectations are key components in our notion of perceived incongruity. Wood and Moreau (2006) suggest that consumers’ expectations represent an important element in predicting their emotional responses to innovative new products. They theorize that the nature of the disconfirmation of expectations leads to the valence of the emotion such that positive disconfirmation leads to the generation of positive affect. Since by definition, a radical innovation provides an unexpected and a significant improvement in fulfilling consumer needs, positive disconfirmation is likely to occur during the construction of perceptions of incongruity. Hence, we predict that such positive disconfirmation will account for the positive valence of the emotion that follows.

However, in order to originate, emotion needs magnitude (strength) as well as valence (direction). We suggest that the magnitude of emotion results from the innovation’s level of perceived uniqueness. A radical innovation is by definition very different from what it replaces and as described earlier, the initial exposure to such a product creates arousal - the intensity aspect of emotional responses. Thus, perceived incongruity will create arousal leading to an
emotional response. Accordingly, in our model, optimism and anxiety are indirectly related to perceived incongruity via the construct of arousal. This is consistent with the literature on emotion within and outside of marketing which has viewed arousal as a necessary component of an emotional circumplex (Mehrabian and Russell 1974; Mano and Oliver 1993; Watson et al. 1999) and, specifically, as the intensity of the affective experience.

Optimism and anxiety are expected to influence each other. There is evidence that positive and negative emotions exhibit bipolarity rather than independence, especially at intense levels (Diener and Iran-Nejad 1986; see also Watson et al. 1999 and Andrade and Cohen 2007). Hence, on initial exposure to an innovation, if arousal is high due to extreme incongruity, we predict that as positive emotions increase, negative emotions will decrease. Arousal has also been linked to bipolarity in the evaluation of ads (Gorn, Pham and Sin 2001). Overall, in the case of a radical innovation, we postulate that arousal produces both higher positive emotions (optimism) and lower negative emotions (anxiety).

Chitturi, Raghunathan and Mahajan (2008) suggest that product benefit dimensions (hedonic vs. utilitarian) may qualitatively influence the type of emotion generated. This is because consumers associate different types of goals with hedonic versus utilitarian product benefits. Specifically, they posit that utilitarian benefits are perceived as necessities that help fulfill goals such as safety and security while hedonic benefits are viewed as luxuries that fulfill the goals of pleasure and excitement. As such, hedonic product benefits may have a stronger effect on the generation of arousal and positive emotions. Furthermore, Kaltcheva and Weitz (2006) provide evidence that consumer motivations affect the nature of the relationship between arousal and pleasant feelings. Their results indicate that when consumers have a hedonic orientation, the relationship between pleasant feelings and arousal increases. On the other hand,
when consumers have a utilitarian orientation, the relationship between pleasant feelings and arousal decreases.

Similarly, we expect that when consumers read a hedonic product description, the description increases the positive effect of arousal on positive feelings such as optimism. Conversely, when consumers read a new product description which has a utilitarian orientation, we predict the description decreases the effect of arousal on optimism and other positive feelings. These differences may be attributed to differences in sensory enjoyment produced by hedonic and utilitarian product descriptions. Hedonic descriptions based on concrete, sensory cues may produce greater sensory enjoyment than utilitarian descriptions. This enjoyment will lead to a stronger linkage between arousal and a positive emotion like optimism.

**H2: (a)** Change in self-reported arousal will be positively related to optimism. **(b)** This effect will be greater for a hedonic product description.

Positive feelings may also reduce the extent of negative feelings for hedonic product descriptions over utilitarian descriptions. Positive and negative emotions exhibit bipolarity and mutual exclusiveness rather than independence at intense levels (Diener and Iran-Nejad 1986). Diener and Emmons (1984) report a strong inverse correlation between positive and negative emotion when the affective experience was reported at specific points in time. Hence, as positive emotion that results from the positive disconfirmation upon exposure to a radical innovation increases, negative emotions are expected to decrease. Further, as discussed earlier, the decrease in negative emotions will be routed through arousal, which is considered to represent the magnitude or intensity of emotional response. There is evidence that arousal is increased by hedonic values and decreased by utilitarian values (Mano and Oliver 1993). Thus, we expect hedonic product descriptions to create greater arousal and produce both higher positive emotions (optimism, see H2), and lower negative emotions (anxiety).
**H3:** (a) Change in self-reported arousal will be negatively related to anxiety. (b) This effect will be greater for a hedonic product description.

As previously described, perceived risk is commonly identified as a key determinant in the successful introduction of radical innovations (Herzenstein, Posavac and Brakus 2007; Hoeffler 2003; Meuter et al. 2005; Ram and Sheth 1989; Rogers 2003). Radical innovations have a high potential benefit for the consumer, but they also involve a potential high cost (in terms of price, safety, social standing, changes in behavior, etc.). This potential for loss is perceived risk and it may create an unwillingness to adopt a radical innovation, particularly when the level of perceived incongruity with the existing technology is high. Thus, incongruity leads to perceived risk. Although we are more concerned in our model with the intervening process by which incongruity in a new product leads to perceptions of risk, we must also account for and include the direct effect of incongruity on perceptions of risk in our model.

**H4:** Perceived incongruity of the innovation will be positively related to perceived risk.

Emotion and perceived risk are related because emotion is knowledge and knowledge affects risk (Bauer 1960). Traditionally, we think of knowledge as “cold cognition” or rational information that is processed analytically, to reduce risk and uncertainty. However, in keeping with the literature on affect as information (Buck 1988; Pham et al. 2001), emotion may also be conceived of as a type of knowledge that is known only by direct acquaintance with phenomena. As such, emotion may serve to provide holistic experiential information. This experiential information provides knowledge that may serve to reduce the potential for loss (or perceived risk) if the consumption experience generates positive feelings. However, negative feelings are likely to increase perceptions of risk and potential loss. Given that consumers’ exposure to a radical innovation via a news report is considered a part of the consumption experience, we should then expect that emotions generated as a results of such exposure to influence consumers’
perceived risk of such innovation. Previous research on the relationship between positive and negative emotions and perceived risk corroborates the effects illustrated in Figure 1 (Chaudhuri 2002).

**H5:** The level of optimism towards the innovation will be negatively related to perceived risk.

**H6:** The level of anxiety towards the innovation will be positively related to perceived risk.

WTT is defined as an intention by the consumer to engage in experiential behaviors that create greater knowledge of the innovation. Since perceived risk is the perception of potential loss accruing from the innovation, any sense of such loss is expected to reduce consumers’ willingness to engage further with the innovation. At the same time, a lack of willingness to try the innovation may be offset by countervailing forces such as optimism resulting from a description of the innovation. There is substantial evidence that consumers experience at least some degree of ambivalence in dealing with complicated decisions (Fitzsimons, Nunes and Williams 2007; Priester, Petty and Park 2007; Zemborain and Johar 2007).

**H7:** The level of perceived risk towards the innovation will be negatively related to WTT.

In addition to its indirect effect on WTT via perceived risk, optimism is expected to be directly related to WTT. Thus, positive emotions such as optimism are proposed to act as a countervailing force on WTT over perceived risk. Optimism or confidence that the innovation will result in favorable future outcomes is expected to generate greater willingness to engage in behaviors that lead to more knowledge and understanding of the innovation. However, we do not include a direct path from anxiety to WTT since Wood and Moreau (2006) do not find evidence that negative emotions affect the pretrial state.

**H8:** The level of optimism towards the innovation will be positively related to WTT.
Control Variable

We control for the effect of familiarity with the innovation in our model. The mere exposure effect (Zajonc 1968) suggests that familiarity with the innovation could increase or decrease responses to the innovation. Hence, we include familiarity in the model to control for its effect on WTT. It is uncertain if familiarity will increase or decrease the level of WTT and so we present no hypotheses on the effects of this control path.

METHOD

Stimuli

Two criteria guided the selection of the radical innovation to be used in this study. The chosen product: (1) had to be a fairly recent innovation and (2) had to be capable of encompassing both hedonic and utilitarian dimensions. The innovation we chose was the automated highway. The automated highway is a hands-free technology that allows drivers to read, eat and chat while they drive their vehicles. It is a relatively recent innovation and was thought to comprise both utilitarian and hedonic values. We used an actual news report (verbal elements only) on the automated highway. We altered the article to produce the two types of descriptions, hedonic (Appendix A) and utilitarian (Appendix B). We changed the headline and the blurb in the description to reflect our hedonic and utilitarian definitions of pleasure and functionality, respectively. Similarly, we changed the beginning and the end of each description.

Pretest

Previous research claims that younger people are more receptive to new products (Im, Bayus and Mason 2003; Manning, Bearden and Madden 1995). While this may make younger, undergraduate students an agreeable universe to survey in our study, it may also lead to a bias in terms of its representativeness to a larger population. At the same time, student samples may be
more desirable to study because of greater homogeneity leading to greater control over extraneous variables (Peterson 2001). To determine if there would be adequate generalizability in the use of undergraduate student subjects, we conducted a pretest among students and non-students on the campus of a small northeastern university. A trained research assistant entered various university buildings, some with classrooms and some that only house administrative offices, with instructions to approach an individual, determine whether he/she had a few free minutes and to ask him/her about participating in an academic study on new products. Further, there was an expectation for the assistant to identify and approach approximately equal numbers of students and non-students. Those who agreed received a self-administered questionnaire, which contained instructions, a description of the automated highway (in an article format), and the measures of the constructs of interest. The questionnaire also had several demographic/statistical questions at the end. 113 subjects participated in the pretest: 50% were undergraduate students; of the non-students, 23% identified themselves as white collar workers (secretaries, librarians, etc.), with the remainder being blue collar (maintenance staff, etc.), professionals (IT, etc.) or faculty. The mean age of the subjects was 31, and 60% of the subjects were female.

An independent samples t-test revealed no significant differences between students and non-student subjects on the constructs of interest, except for perceived risk: t (1,108) = -2.07, p ≤ .05. Interestingly, non-students’ perceptions of risk for the automated highway were lower (M_{non-students} = 4.24) than students’ perceptions (M_{students} = 4.75). While this finding may influence the magnitude of effects in the two populations, we do not expect it to affect the direction of any of the hypothesized relationships. Therefore, we decided to use a student sample.

**Participants, Design and Procedure**
340 undergraduate students were recruited to participate in the study. Student respondents attended one of two universities (a small, private institution in the Northeast, a larger, public institution in the Southeast) and were asked to participate while in one of their marketing classes. As an incentive to complete the survey, each student received extra course credit that was applied to the end-of-the-semester grade. Although they were approached in marketing courses, the respondents comprised a variety of majors (marketing, other business disciplines, communication, psychology to name a few). 177 respondents received the utilitarian version of the automated highway questionnaire and 163 respondents received the hedonic version of the questionnaire. The mean age of the respondents was 21 (age range 17-56), and 57% of the respondents were female. The study used a quasi-experimental design. Product description (utilitarian/hedonic) was manipulated as the single between subjects factor. In both conditions, subjects were given a self-administered questionnaire. The questionnaire contained instructions, the innovation description manipulation, and the measures for the latent constructs. After reading through the instructions on the first page, participants were asked to indicate their current arousal levels. Next, depending on the experimental condition, participants read an excerpt from a news article that offered either a hedonic or utilitarian description of the automated highway (see Appendices A and B). Immediately after participants read this description, they were asked to once again indicate their level of arousal, followed by the manipulation test and a series of measures for the other latent constructs.

**Measures**

We measured all the items for each construct on 7-point scales. The anchors for the perceived incongruity, optimism, anxiety, perceived risk, WTT and familiarity items were “strongly disagree” and “strongly agree.” For the arousal items, the anchors were “not at all” and
“very much.” Note that in spite of our expectation that positive and negative emotions are related in a bi-polar manner, we maintained independence in the measurement of these emotions. This was considered to be a more rigorous way of testing that bipolarity had actually taken place and was not simply an artifice of using scales with built in bipolarity (Russell and Barrett 1999).

**Perceived incongruity.** Our measures for perceived incongruity of the innovation were based on our definition of this construct as the degree of perceived difference between the innovation and the current idea that the innovation replaces. We also tried to conform to the disconfirmation of expectations construct used by Wood and Moreau (2006). Accordingly, we explicitly included the notion of expectations in two of the items in our measures of incongruity. The items used to measure perceived incongruity were as follows: *The automated highway challenges my existing ideas about highways, The automated highway is different from my expectations about highways, The automated highway is a unique type of highway, and The automated highway is a novel type of highway.* Table 1 shows the composite reliability and Cronbach’s alpha for all constructs.

**Arousal.** Two critical dimensions of arousal have been previously identified – energetic arousal and tense arousal (Thayer 1989). Raju and Unnava (2006) suggest that tense arousal is a preparatory type of arousal that is evoked during emergencies. Since our study did not involve an emergency situation but a reading task in which the stimulus was not of an aversive nature, we did not include measures of tense arousal. Further, because we were asking respondents to consider a new, novel innovation that would hopefully excite and interest them, we utilized a subset of Thayer’s 20-item (1989) energetic arousal scale (items such as calm, placid, still and the like did not fit our purposes) to measure the arousal level of participants before and right after they read the description article about the automated highway. Arousal items measured the
degree to which participants felt energetic, lively, full-of-pep, vigorous and active. Change in arousal was measured as the difference on each item between the before and after arousal scores (see Irmak, Block & Fitzsimons 2005).

**Optimism.** Optimism was measured using the following three items: *The automated highway makes me feel optimistic*, *The automated highway makes me feel hopeful*, and *The automated highway makes me feel encouraged*. These three items identify optimism in Richins’ (1997) Consumption Emotions Set.

**Anxiety.** The following items measured anxiety: *The automated highway makes me feel anxious*, *The automated highway makes me feel worried*, and *The automated highway makes me feel tense*. We took these two items, which identify worry, from Richins’ (1997) Consumption Emotions Set.

**Perceived risk.** Consumers may perceive a combination of various types of risk (physical, financial, performance) when faced with a radical innovation for the first time. Thus, we measured perceived risk with the following three items: *The automated highway could cause me physical harm*, *The automated highway could perform poorly and let me down*, and *Overall the automated highway is risky* (Kaplan, Szybillo & Jacoby 1974).

**WTT.** We created the following three items to measure WTT: *I would be willing to spend time to know the automated highway better*, *I would be willing to spend the effort to know the automated highway better*, and *If asked, I am willing to take a test-drive on the automated highway today*. Due to the nature of the product under consideration (radical innovation), our intention was to pose questions about trial that would speak directly to the individual’s willingness to exert extra effort to learn more about something new and novel.
**Familiarity.** Familiarity was measured using the following two items: *I had knowledge of the automated highway before today and I have heard about the automated highway before today.* The purpose of the familiarity construct was to provide a measure of individuals’ prior experiences with the product in question, not to capture respondents’ attitudes about or perceptions of the product. The correlation between these items was .88 (p< .001).

**Manipulation Check**

To measure the hedonic and utilitarian manipulations of the automated highway, we used the HED/UT scale (Voss, Spangenberg & Grohmann 2003). The scale includes the following ten semantic differential response items measured on 7-point scales: *Appealing/Unappealing, Fun/Not fun, Exciting/Unexciting, Interesting/Uninteresting, Pleasurable/Not pleasurable, Helpful/Unhelpful, Necessary/Unnecessary, Effective/Ineffective, Functional/Not functional, Practical/Impractical.* The first five items measure the hedonic construct, while the second five items measure the utilitarian dimension.

To assess whether the hedonic-utilitarian manipulation of the automated highway was successful, we conducted an independent samples t-test on the participants’ evaluations of the utilitarian and hedonic dimensions of the automated highway. The t-test revealed a significant difference in terms of its utilitarian values (t (1,319)= 2.04, p≤ .05), as well as a marginally significant difference in terms of its hedonic values (t (1,319)= -1.65, p≤ .05) depending on the experimental condition. Respondents who read the utilitarian description of the automated highway rated highways (*M_*utilitarian= 4.89) higher in utilitarian value than those who read the hedonic description (*M_*hedonic= 4.62). Respondents who read the hedonic description rated the automated highway (*M_*hedonic= 4.68) higher in hedonic value than those subjects who read the utilitarian description (*M_*utilitarian= 4.44).
**RESULTS**

**Measurement Model**

The results of a confirmatory factor analysis using LISREL 8.72 showed that the measurement model for the constructs of theoretical interest was statistically significant: $\chi^2_{(209)} = 441.06$ (p= 0.0). However, the various indices suggested that the model fit the data well (RMSEA= .06, NFI= .92, NNFI= .94, CFI= .95, IFI= .95). The composite reliabilities and Cronbach alphas for all constructs were .60 or greater. All lambda loadings were also .60 or greater, except for four items: .44 for *The automated highway is a unique type of highway* (incongruity), .37 for *The automated highway is a novel type of highway* (incongruity), .47 for *Anxious* (anxiety), and .48 for *If asked, I am willing to take a test-drive on the automated highway today* (WTT). Although these items’ loadings were below .60, we decided to retain them because of their theoretical importance in helping to define their respective constructs (see Table 1). In Table 2, we provide the correlations among, as well as the means and standard deviations of the latent constructs.

In order to assess discriminant validity, we first applied the method recommended by Anderson and Gerbing (1988). For each pair of constructs, we constrained the pairing’s correlation so that it equaled one and then computed a Chi-square difference between a single-factor and a two-factor model. A significant difference signals discriminant validity between the two constructs. In the case of all the Chi-square difference tests based on pairs, we were able to discriminate between the two constructs. As a second test of discriminant validity, we calculated the average variance extracted (AVE) for each construct and compared it to the squared correlation of that construct with every other construct (Fornell and Larcker 1981). The construct
achieves discriminant validity when its AVE is greater than all the squared correlations. In all cases, the AVE for each construct was greater than the square of that construct’s correlation with every other construct. The AVE for each construct of theoretical interest can be found in Table 1.

**Common method variance (CMV).** Since we measured for both the exogenous and endogenous constructs in the same questionnaire, we next consider the issue of common method variance (CMV). To do this, we introduced an additional latent variable that was theoretically unrelated to all the constructs in our hypothesized model (Podsakoff et al. 2003). We then tested a model in which we treated this latent variable as a purely exogenous construct and related it to all the other constructs. The presence of any significant relationships between this latent construct and each of our constructs could be attributed to CMV. There were no significant relationships, signaling that we statistically controlled for CMV. Thus, any systematic variance among the indicators due to CMV was accounted for in estimating the relationships among the constructs. As is shown in Table 3, the incongruity→perceived risk path becomes non-significant as a result of adding the latent construct; all other changes are minimal, i.e., all effect sizes are the same or very similar, directionality and all other significance levels remain the same.

**Structural Model**

The structural results obtained from LISREL 8.72 suggest a well-fitting model: \( \chi^2_{(219)} = 470.02 \) (\( p = 0.0 \)), RMSEA = .06, NFI = .91, NNFI = .94, CFI = .95, IFI = .95. In Table 3, we present the completely standardized path coefficients. Concerning each of the structural hypotheses, the results support **H1**, namely that incongruity with the innovation leads to a greater change in arousal (\( \gamma = .14, p < .05 \)). Further, in support of **H2a** and **H3a**, change in arousal increases optimism (**H2a; \( \beta = .37, p < .05 \)) while also decreasing anxiety (**H3a; \( \beta = -.18, p < .05 \)). The results also support the direct, positive effect of incongruity increasing perceived risk (**H4; \( \gamma = .12, p < .05 \))
.05). Turning to the emotions, increased optimism leads to a decrease in perceived risk (H5 supported; \( \beta = -0.45, p \leq 0.05 \)); on the other hand, increased anxiety leads to an increased perception of risk (H6 supported; \( \beta = 0.41, p \leq 0.05 \)). With regard to H7, although an increase in perceived risk decreases WTT, this path is not significant in our data (H7 not supported; \( \beta = -0.10, p > 0.05 \)- this path becomes significant if the path from optimism to perceived risk is omitted, which suggests that optimism not only increases WTT directly, but also indirectly by reducing the effect of perceived risk on WTT). Finally, in this dataset, as optimism increases one’s willingness to try the innovation also increases (H8 supported; \( \beta = 0.47, p \leq 0.05 \)).

Place Table 3 about here

**Description Type as a Moderator**

We tested for the moderating role of type of description (utilitarian versus hedonic) on those paths identified in the hypothesis section (H2b and H3b). We created a two-group model based on the two versions of the automated highway description (utilitarian description, N= 177; hedonic description, N= 163) and conducted a multigroup analysis using LISREL 8.72. The first step was to identify all the path coefficients of interest for both the hedonic and utilitarian groups: change in arousal \( \rightarrow \) optimism: \( \beta_{\text{utilitarian}} = 0.29, \beta_{\text{hedonic}} = 0.48 \); change in arousal \( \rightarrow \) anxiety: \( \beta_{\text{utilitarian}} = 0.003, \beta_{\text{hedonic}} = -0.39 \). Next, we computed a Chi-square difference between a model that accounts for equal paths across both groups and one that assumes all paths differ across both groups. The resultant difference is statistically significant (\( \Delta \chi^2_{10} = 23.36, p \leq 0.01 \)). Thus, the model differs with regard to description type (utilitarian versus hedonic).

In order to determine whether description type moderates the specific paths of interest, we next constrained (one at a time) each path of interest for both groups and calculated Chi-square difference tests. Significant differences, resulting from the difference between the
baseline model and each of these “modified” constrained models indicates whether description type moderates the specific path. The path from change in arousal \( \rightarrow \) optimism (H2b) differed significantly (\( \Delta \chi^2_{(1)} = 5.03, p \leq .05 \)) between description type, such that a change in arousal increased optimism, and this occurred more for the hedonic description. Likewise, we also find a significant difference (\( \Delta \chi^2_{(1)} = 10.57, p < .01 \)) for the path from change in arousal \( \rightarrow \) anxiety (H3b), such that a change in arousal decreased anxiety, and this occurred more for the hedonic description.

**Model Replication**

As stated earlier, the stimuli for our study involved altering a news report about a recent innovation (the automated highway) to produce hedonic and utilitarian descriptions for the product. To test the robustness of these results with “real world” information, we utilized the unaltered version of the automated highway news report for the utilitarian stimuli. For the hedonic stimuli, we chose a recent article about the AIBO pet dog. The AIBO is an electronic dog that is capable of simulating a wide range of doglike behaviors. The AIBO article stressed that the product was a “substitute pet.” We considered this article to be more hedonic because of its focus on the potential relational/companion aspects associated with owning an electronic pet dog, while the automated highway article (in its unaltered form) stressed functional uses and utilitarian values (e.g., saving time, etc.).

To ensure that both articles represented radical innovations, we conducted a pretest with 25 graduate students from a northeastern university. All students read the articles about both products and answered several questions about them. The order of the newspaper articles was varied (13 students read the highway information first and 12 students read the AIBO information first). Participants were first given a definition of a radical innovation and then were
asked to answer several questions. The extent to which the products were considered to be a radical innovation was assessed by asking subjects whether “The product involves a new technology” and “The product requires consumers to change their consumption/ usage behavior” on a 7-point scale with 1 = “Strongly disagree” and 7 = “Strongly agree.” The two items were combined to give one radical innovation score for the automated highway and one score for the AIBO. A MANOVA with the order in which participants read the articles (automated highway first versus AIBO first) as the independent variable and the two radical innovation scores as the dependent variables indicated no main effect of the article order (Wilk’s Lambda = .96, F(2, 22) = .43, p = .66). Therefore the data were combined in further analyses. A t-test indicated that both products were above the midpoint (M = 4.00) of the radical innovation scale [automated highways: M = 5.78, t(24) = 8.63, p < .001; AIBO: M = 5.08, t(24) = 5.42, p < .001]. Thus, both products were considered to be radical innovations.

We analyzed the model (Figure 1) with a dataset comprised of 315 graduate and undergraduate student responses about the AIBO (N= 147) and the automated highway (N=168). The procedures for collecting data and the methods of analysis remained the same as in the original study. The only difference was with regard to construct measures. The replication dataset contained a sub-set of measures from the original study. However, all constructs were still measured using at least two measures from the data in the original study.

The structural model results replicated our model in the original study very well, thus supporting H1-H6, and H8 (the replication study did not support H7 either). With regard to the moderating role of product type, recall that the paths from arousal to optimism and anxiety were significant in our study. Although these paths were not significant (p> .05) in the replication study, the path coefficients for these two paths were, importantly, in the same direction as we
hypothesized (change in arousal $\rightarrow$ optimism: $\beta_{\text{utilitarian}} = .05$, $\beta_{\text{hedonic}} = .23$; change in arousal $\rightarrow$ anxiety: $\beta_{\text{utilitarian}} = -.04$, $\beta_{\text{hedonic}} = -.14$). Thus, we were able to adequately replicate our findings using a different dataset with “real world” descriptions as the stimuli.

**DISCUSSION**

The model presented in this study reinforces the importance of emotions in the process of innovation, diffusion and evaluation. Our findings substantiate the potency of emotions in determining consumers’ responses to radically innovative products beyond the conventional cognitive frameworks in which innovations have been previously studied. This research reveals that consumers’ exposure to a radical innovation in news reports not only provides objective information upon which consumers make judgments but also generates information in the form of affective reactions. Such affect may then predict consumers’ cognitive product evaluations in the form of perceived risk and willingness to try the innovation.

While prior research has explored the different aspects of product and consumer characteristics as predictors of the adoption of new products (Rogers 2003), the emotional connection between exposure and initial evaluations of radical innovations is an important link that has been overlooked in most prior studies. Hence, our findings add an important dimension to previous diffusion models. Our model contributes to the theoretical basin on the diffusion of innovation by highlighting the critical nature of emotion in predicting consumers’ initial evaluation of a radical innovation. The results of this study build upon and extend Wood and Moreau’s (2006) E$^3$ model of emotional influence. In the context of product trial, the E$^3$ model suggests a five step process in which consumers’ complex expectations and the disconfirmation of these expectations lead to the generation of emotions which then influence evaluation and usage decisions.
We extended the E³ model in several ways. First, we demonstrated the role of arousal as an important intervening variable between incongruity perceptions, generated emotions and subsequent evaluations. Mandler (1982) and others have theorized that incongruity creates arousal. Consistent with this, our results support the argument that the discovery of a radical innovation creates arousal because it is incongruous with consumers’ existing ideas about the product. Previous work (e.g. Myers-Levy Tybout 1989) suggests that extremely incongruous stimuli are not positively evaluated by consumers. However, our results suggest that, in the case of a radical innovation, greater incongruity leads to greater arousal.

Second, we examined the effect of arousal in the generation of two specific emotions; optimism and anxiety. These two emotions are relevant in the context of radical innovations as these products promise consumers greater benefits but at the same time are associated with greater levels of risk compared to other product types. Arousal was found to lead to greater positive emotion (optimism) and lower negative emotion (anxiety). Third, we studied specific outcomes of the exposure to radical innovations in terms of evaluation (perceived risk) and behavioral intent (WTT). We found that arousal did not influence perceived risk or WTT directly but indirectly, via positive emotional responses like optimism. According to our results, such an emotional response can reduce negative evaluations like perceived risk and encourage WTT. Fourth, we examined the moderating effect of product type. We found that our model is significantly different for hedonic and utilitarian types of descriptions. Consistent with previous research on the genesis of product emotions (Mano and Oliver 1993; Oliver 1997), we find that product descriptions which emphasize hedonic values (as contrasted to utilitarian values) in an innovation increase the effect of arousal on positive emotion. We also find that these same descriptions decrease the level of negative emotions like anxiety. Our findings on arousal may
appear to conflict with those of Gorn, Pham and Sin (2001). In an advertising context, these authors (in their second study) found that arousal and not the valence dimension of the affective state, was predictive of the evaluation of the ad. Our results show that valence and not arousal is indicative of the evaluation. However, in their study, the valence and arousal dimensions were manipulated to induce a certain mood. Our study, on the other hand, measured these dimensions as a result of the target stimuli. Also, their results were contingent on ads which had either a positive or negative tone. Our moderating variables were hedonic and utilitarian types of descriptions, both of which could be regarded as positive in tone. Further, their results were more pronounced for self-referent evaluations (“I like the ad”) while our study used object-referent evaluations (“the automated highway is risky”). Overall, there are critical differences between the two studies which may explain the differences in the results. Most importantly, we make a separate and distinct contribution by measuring both dimensions of affect towards the target stimulus and showing that arousal influences affect valence.

Overall, we find some interesting results about the relationships between our constructs as discussed above. In keeping with Rogers (1983), we suggest that communication may be a vital element in the diffusion of innovations and, specifically, emotional communication using different verbal modes of processing. For instance, we find that the manner in which a radical innovation is described in a newspaper report can produce favorable or unfavorable consequences in terms of emotional responses towards the innovation and, eventually, perceived risk and willingness to try the innovation. Note that the results may have been different if we had studied advertisements instead of newspaper reports. In fact, there is reason to believe that there will be differences between studying advertisements and descriptions of innovations using news reports. Descriptions of innovations may point out the perceived risk in the product for
consumers while, with the exception of special types of advertisements (e.g., for pharmaceutical products), advertisements tend to avoid information about the perceived risks associated with the product.

**Managerial Implications**

Introducing radical innovations represents a special challenge for many firms. While they may bring substantial financial returns, radical innovations also suffer from the liability of newness and the risks associated with their inherent discontinuous nature. Given these risks, marketing managers often face the challenge of getting consumers to try radical innovations. For instance, radical innovations involve some element of behavioral change for consumers. Such change may not always be appealing since it may involve considerable expenditures not only in terms of money, but also in time, effort and psychological costs (Zachary 2008). In fact, the prospect of such change may cause consumers to lend more attention to the perceived risk of the innovation in order to avoid any change in consumption behavior; a decision which may ultimately lower willingness to try the innovation.

Whether consumers adopt or reject an innovation has been described in recent media reports as the “billion-dollar question” (*New York Times* 2008). Given the substantial costs incurred by firms introducing radically innovative products coupled with the greater level of perceived risk associated with these products, marketing managers have a vested interest in carefully planning for and forecasting consumers’ response to such product introductions.

In this connection, results from this research suggests to marketing managers introducing radical innovations a need for a greater appreciation and a more careful anticipation of consumers’ emotions in response to such products. Given the uncertain nature of radical
innovations, these initial emotions may represent an important source of information for consumers, upon which they may make evaluative judgment.

Our results draw greater attention to the importance of emotions in adding to the predictive accuracy of innovation adoption models. Managers should be alert to the powerful role of consumers’ emotional response in shaping variables considered critical to the diffusion of radical innovations such as perceived risk and willingness to try. While traditionally, newness has always represented a liability for new products; our results suggest that if radical innovations were presented to consumers in a manner that stressed the hedonic benefits associated with their newness, such exposure may positively disconfirm consumers’ expectations and lead to the generation of emotions that facilitate adoption.

As such, managers are advised to give greater attention to the process of managing consumers’ incongruency perceptions. According to our findings, marketers of radical innovations are well advised to emphasize the hedonic benefits of their products in the form of news releases. To the extent that managers can influence the way in which product descriptions are presented in the media through new product news releases, then consumers’ anxiety about radical innovations may be reduced and their optimism increased. We found, that, indeed, there is anxiety among consumers about radical innovations and that such anxiety does increase perceived risk. We also found that arousal leads to optimism and, at the same time, lowers consumers’ anxiety. Additionally, this effect was shown to be stronger for hedonic product descriptions. Thus, firms introducing radical innovations may benefit from newspaper reports and advertising that depicts the product in not only utilitarian terms but also hedonic ones. In fact, our results suggest that more emphasis on hedonic outcomes in marketing communications may result in more optimism, greater willingness to try and less perceived risk of the innovation.
among consumers. Hence, in the context of radical innovations, our findings provide marketing managers a better conceptual understanding of the different product benefit dimensions (utilitarian vs. hedonic) and their influence on post exposure emotional, perceptual and behavioral consequences.

Furthermore, managers could experiment with other sources of arousal and positive emotion such as better service or advertising and consider the effect of these variables as an alternative to discounting the price of a new product. For instance, if arousal leads indirectly via optimism to a lowering of perceived risk and an increase in willingness to try the innovation, then managers will be well advised to increase the factors in the initial exposure experience that lead to stronger arousal and positive emotional response while attempting to avoid negative emotions. For example, both advertising and news releases can accentuate the positive emotional values that may emanate from the use of the innovation. These findings may also have important implications for sales managers. Sales representatives are responsible for communicating and presenting a company’s new products to potential customers and they may be the source of consumers’ initial exposure to an innovation. Hence, salespeople should be trained not only on the utilitarian or functional product attributes but also the hedonic ones. In sum, if managers are able to solicit positive affective reactions (optimism) and limit negative emotions (anxiety) from consumers in response to information about a radical innovation, this may facilitate consumers’ acceptance of this product through lower risk perceptions and greater willingness to try. This process may then translate into significant financial rewards for manufacturers of radically innovative products.

Limitations and Future Research
Future research could consider individual difference variables that we did not consider in our study. An interesting study would be to look at feelings among promotion-focused as opposed to prevention-focused people (regulatory focus) in the context of hedonic and utilitarian descriptions. Promotion-focus in subjects should produce greater hope and prevention-focus should produce greater anxiety. A possible hypothesis would be that for promotion-focused (prevention) subjects but not for prevention-focused (promotion) subjects, hedonic (utilitarian) product descriptions will produce more hope (anxiety).

Similarly, we suggest looking at differences between discontinuous (radical) innovations and continuous innovations. Our findings suggest that discontinuous innovations entail both arousal and perceived risk. Using both appraisal theory and affect as information perspectives, subjects exposed to a discontinuous innovation (that addresses important goals but entails potentially risky changes in consumer behavior) will perceive both greater perceived risk and greater arousal than those exposed to a continuous innovation. How will they cope with their feelings? Pham’s work (1996; 1998; Gorn, Pham and Sin 2001) suggests that people generate more positive and negative feelings by focusing on diagnostic (high information) cues than non-diagnostic cues in high arousal situations. In addition, they have greater reliance on these feelings when they make judgments about hedonic situations than about utilitarian ones. Consequently, it is suggested that researchers investigate whether for discontinuous innovations, but not for continuous innovations, hedonic product descriptions are likely to produce more polarized judgments (based on positive and negative feelings) than utilitarian product descriptions, when a diagnostic picture (for instance) is provided rather than when there is a non-diagnostic picture.
Our methods have some limitations. First, although we tested and found only one difference between student and adult samples, our studies involved student samples, which may not be appropriate for all types of products. Second, we tested both feelings and evaluations after subjects read a product description. Hence, and in spite of testing various models, we cannot provide conclusive temporal proof about whether one precedes the other. Manipulations of emotional states are needed to replicate our results in this respect. Furthermore, in the present study we tested the difference between hedonic and utilitarian descriptions of radical innovations. While both products in this study may have contained a minimum level of hedonic characteristics, our focus was on how the product was described to consumers. However, there are radical innovations that tend to be strictly utilitarian and only offer functional benefits and others that are strictly hedonic and only offer pleasurable benefits. We have not examined the difference between such products, which may represent a promising avenue for future research.

Overall, our results shed light on a crucial but often overlooked aspect of the new product diffusion process; the intervening role of consumers’ emotions. This role is especially pertinent for radical innovations whose characteristics vary significantly from existing products. According to our work, if channeled through positive emotions such as optimism, marketing managers may be able to encourage willingness to try and overcome the inherent risk of newness associated with radical innovations. Our work highlights the importance managers should lend to consumers’ arousal, optimism and anxiety in understanding and influencing both willingness to try and consumers’ risk perceptions of radical innovations. Given high development costs for radical innovations, shorter product life cycles and more intense competition, a decrease in consumers’ perceived risk combined with an increase in consumers’ willingness to try such products may have significant financial implications.
REFERENCES


Figure 1
Hypothesized Model
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<th>Composite Reliability</th>
<th>Cronbach Alpha</th>
<th>Average Variance Extracted</th>
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<td></td>
</tr>
<tr>
<td></td>
<td>Overall, the automated highway is risky.</td>
<td>.86</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willingness to Try</td>
<td>I would be willing to spend time to know the automated highway better.</td>
<td>.90</td>
<td></td>
<td>.84</td>
<td>.62</td>
</tr>
<tr>
<td></td>
<td>I would be willing to spend the effort to know the automated highway better.</td>
<td>.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>If asked, I am willing to take a test-drive on the automated highway today.</td>
<td>.48</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** All items measured on 7-point scales.
Table 2
Correlation Matrix of Latent Constructs

<table>
<thead>
<tr>
<th></th>
<th>Incongruity</th>
<th>Arousal</th>
<th>Optimism</th>
<th>Anxiety</th>
<th>Perceived Risk</th>
<th>Willingness to Try</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incongruity</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in Arousal</td>
<td>.12*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimism</td>
<td>.20**</td>
<td>.31**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>.06</td>
<td>-.13*</td>
<td>-.16*</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived Risk</td>
<td>-.01</td>
<td>-.18**</td>
<td>-.47**</td>
<td>.42**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Willingness to Try</td>
<td>.21**</td>
<td>.22**</td>
<td>.50**</td>
<td>-.17**</td>
<td>-.36**</td>
<td>1</td>
</tr>
</tbody>
</table>

Mean          5.30  - .01  4.45  3.94  4.28  5.14  
St. Dev.      .99  .78   1.21  1.26  1.18  1.39  

*correlation is significant at p ≤ .05  
**correlation is significant at p ≤ .01
### Table 3
**Structural Results**

<table>
<thead>
<tr>
<th>Paths</th>
<th>Coefficients</th>
<th>with/CMV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H1</strong>: Incongruity→Change in Arousal</td>
<td>.14</td>
<td>.13</td>
</tr>
<tr>
<td><strong>H2a</strong>: Change in Arousal→Optimism</td>
<td>.37</td>
<td>.37</td>
</tr>
<tr>
<td><strong>H3a</strong>: Change in Arousal→Anxiety</td>
<td>-.18</td>
<td>-.18</td>
</tr>
<tr>
<td><strong>H4</strong>: Incongruity→Perceived Risk</td>
<td>.12</td>
<td>.11 (ns)</td>
</tr>
<tr>
<td><strong>H5</strong>: Optimism→Perceived Risk</td>
<td>-.45</td>
<td>-.45</td>
</tr>
<tr>
<td><strong>H6</strong>: Anxiety→Perceived Risk</td>
<td>.41</td>
<td>.41</td>
</tr>
<tr>
<td><strong>H7</strong>: Perceived Risk→Willingness to Try</td>
<td>-.10 (ns)</td>
<td>-.10 (ns)</td>
</tr>
<tr>
<td><strong>H8</strong>: Optimism→Willingness to Try</td>
<td>.47</td>
<td>.52</td>
</tr>
<tr>
<td><strong>Control</strong>: Familiarity→Willingness to Try</td>
<td>-.03 (ns)</td>
<td>-.02 (ns)</td>
</tr>
</tbody>
</table>

**Notes:** Completely standardized coefficients reported in all samples. (ns) indicates a non-significant (p> .05) coefficient.
SAN DIEGO, Aug. 6- “It is an intense feeling, it’s fun, it’s exciting and it’s refreshing” that’s how H.E Edmonton described his experience driving his vehicle in the biggest public test yet of a prototype automated highway system (AHS).

He was relaxed comfortably in the driver’s seat as his vehicle cruised down a stretch of interstate 15 at 45 miles an hour. He changed lanes to pass, swerved to avoid an orange construction barrel and then slowed to a gentle stop. No big deal, except for this: Mr. Edmondson’s feet never touched the pedals, and his hands never brushed the wheel.

He sat in the driver’s seat but left all the work to a matchbook-size video camera mounted on the front windshield, radar sensors on the front and sides and a desktop-sized computer stored behind him and so did the drivers in the other four vehicles on the road around him. Yet, the system lets him resume control at the tap of the brake or a touch of the steering wheel.

The magnetic-based system is intended to double or triple lane capacity by allowing cars to travel at high speeds in radio-linked, magnet guided convoys as little as 12 feet apart. In this system, digital radio signals transmitted 50 times a second from the car at the head of the line and each one behind it can guide braking, steering and other functions, all in rapid sequence without the intervention of drivers.

Giving motorists a fun, exciting and relaxing way to travel.

The Government estimates that human error is a contributing factor in 90% of the 10.7 million annual automobile accidents and one-third of the 40,000 fatalities. “If we can take even part of those crashes away, we can save a tremendous number of lives,” Dr. Rillings said.

The system has its skeptics. While the public now trusts computers in transportation like jet planes and light-rail trams, passengers do not see the hands-free operation close up, and accepting it day-to-day will take some getting used to.

The advantage of the magnetic system is that it can work in all weather and road conditions, and it would cost only about $10,000 per lane-mile to fit existing roads with magnet spaced every four feet, as opposed to $1 million to $100 million to build a new lane-mile of road.

If the AHS becomes a reality, drivers can look forward to a fun, relaxing and comfortable way to drive while indulging on a burger, chatting on cell phones or even having the pleasure of reading their favorite books.
The Automated Highway is Practical, Convenient & Safe

By TODD S. PURDUM

SAN DIEGO, Aug. 6- “It is a very practical way to drive, it’s safe, it’s comfortable and it’s convenient too” that’s how H.E Edmonton described his experience driving his vehicle in the biggest public test yet of a prototype automated highway system (AHS).

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If the AHS becomes a reality, multitasking will become a whole lot easier. The AHS will be a practical, efficient and safe way to drive your car while eating a sandwich, chatting on your cell or even reading a book.