
Impact of 3-D Advertising on Product Knowledge, Brand Attitude, and Purchase Intention: The Mediating Role of Presence

Hairong Li, Terry Daugherty, and Frank Biocca

The conceptualization of a virtual experience has emerged because advancements in computer technology have led to a movement toward more multisensory online experiences. Two studies designed to explore the concepts of virtual experience and presence are presented, with the results largely supporting the proposition that 3-D advertising is capable of enhancing presence and, to varying degrees, ultimately influencing the product knowledge, brand attitude, and purchase intention of consumers. The marketing implications are immediate because the ability to create a compelling virtual product experience is not beyond the current capability of interactive advertising. By creating compelling on-line virtual experiences, advertisers can potentially enhance the value of product information presented and engage consumers in an active user-controlled product experience.

Hairong Li (Ph.D., Michigan State University) is Associate Professor of Advertising, Michigan State University.

Terry Daugherty (Ph.D., Michigan State University) is a Post Doctoral Fellow at eLab, Vanderbilt University.

Frank Biocca (Ph.D., University of Wisconsin-Madison) is SBC Ameritech Professor of Telecommunication, Michigan State University.

The authors thank Michigan State University for a grant to initiate this research, Matt Eastin and Zoo-Hyun Chae for assistance with the data collection, and editor Marla Stafford and three anonymous reviewers for their helpful comments.

Internet advertising has evolved dramatically since its inception in 1994 when the first banner ads appeared on the Hotwired site (Adams 1995). Although banner ads are still a dominant type of Internet advertising, their share decreased from 56% of the total \$4.6 billion Internet advertising revenue in 1999 to 48% of the \$8.2 billion in 2000. Furthermore, 2000 marked the first year in the United States that revenue from rich media advertising was listed separately, accounting for 2% of the total ad revenue (Interactive Advertising Bureau 2001). Rich media advertising is different from conventional banner ads, in that it generally incorporates high impact sound with video and is often more interactive (Rewick 2001). More recently, three-dimensional (3-D) advertising has emerged as a new form of rich media advertising (Mirapaul 2000) that enables consumers to inspect products on the Web, much like they can in a retail store, for certain types of products. More important, 3-D advertising can simulate a new consumption experience—virtual experience.

Although the concept of virtual experience had been used in previous research (Klein 1998), Li, Daugherty, and Biocca (2001) defined it as psychological states that consumers undergo while interacting with 3-D products in a computer-mediated environment. McLuhan and McLuhan (1988) suggest that, within any medium, there is a connection among the human mind, the technology, and the environment that serves to immerse users. On the Internet, consumers are able to experience psychological states because the medium creates a sense of presence that results in augmented learning, altered behaviors, and a perceived sense of control (Hoffman and Novak 1996).

A sense of presence is an important mediator in the formation of virtual experience from 3-D advertising (Biocca, Li, and Daugherty 2001). Presence is defined as the illusion of "being there" (Lombard and Ditton 1997; Steuer 1992) or an experience of being in an environment while physically situated in another location (Witmer and Singer 1998). Researchers (Coyle and Thorson 2001; Klein 2001) have recognized the relationship between presence and virtual experience and attempted to test it empirically. However, the role of presence in generating virtual product experiences from 3-D advertising remains unclear. Therefore, the purpose of this study is three-

fold. First, we explore the properties of 3-D advertising and its impact on consumers through an elevated sense of presence. Second, we explain how presence mediates the formation of virtual experience. Third, we test a set of hypotheses derived from the conceptualization to advance the knowledge of 3-D advertising in the area of electronic commerce.

Literature Review

Three-dimensional advertising is a new and innovative form of interactive advertising that provides prepurchase product inspection on the Internet using 3-D visualization technology to simulate real products. A simulated 3-D product may have many interface properties. For example, shoppers may rotate it, zoom in and out for inspection, animate features and functions of the product, and even change the color or contextualization with other products in different settings (for a review of interface properties of 3-D products, see Li, Daugherty, and Biocca 2001). Furthermore, marketers have the ability to utilize these properties within banner ads, pop-ups, and product Web sites to influence how consumers think and feel about a product when interacting with it on the Internet. The potential psychological impact of 3-D advertising can be better understood with the theories of presence and virtual experience.

Presence

Although presence is often explored in the literature of virtual reality, few media theorists would argue that the sense of presence suddenly emerged with the debut of virtual reality. The illusion of presence is a product of all media (Reeves and Nass 1996), and virtual reality is a medium that can generate the most compelling sense of presence (Biocca 1997). Presence, also known as telepresence, is an illusion of "being there" in a mediated environment. Biocca (1997, 5.3) wrote,

When we experience our everyday sense of presence in the physical world, we automatically generate a mental model of an external space from patterns of energy on the sensory organs. In virtual environments, patterns of energy that stimulate the structure to those experienced in the physical environment are used to stimulate the same automatic perceptual processes that generate our stable perception of the physical world.

Previous research indicates that consumers feel a sense of presence while interacting with 3-D products in a non-immersive, mediated environment (Biocca et al. 2001; Li, Daugherty, and Biocca 2001). Pres-

ence can be established for consumers when they are interacting with either a virtual product or a virtual environment. For example, when consumers surf through the aisles of a virtual store, they may feel as if they are walking in a conventional store and can pick up a brand from a virtual shelf to take a closer look by zooming in or rotating it as if they were examining the brand in a real store. Shoppers are likely to gain a unique experience when they feel physically present, because a virtual e-commerce environment is able to simulate many of the same experiences as a real store, with presence mediating the persuasive impact.

In a study designed to manipulate the sensory saturation of a consumer's visual perception, Kim and Biocca (1997) were able to detect significant differences in confidence levels regarding brand preferences when viewers were watching television. More specifically, the sense of presence resulted in a stronger experience; viewers became more confident in their attitudes toward the product information presented. Kim and Biocca (1997) concluded that the virtual experience created by presence simulated a direct experience, which resulted in increased persuasion. Li, Daugherty, and Biocca (2001) reported from an exploratory study that participants expressed a natural and physical sense of presence when they examined virtual product representations in e-commerce settings.

Interactivity and Richness

Two media characteristics that have been identified as antecedents of presence are interactivity and richness (Steuer 1992), which are core characteristics of 3-D advertising. The concept of interactivity has been explored in studies of computer-mediated communications (Heeter 1986; Rafaeli 1985, 1988; Rice 1984, 1987; Rogers and Rafaeli 1985), the Internet and virtual reality (Biocca 1992; Ku 1992; Newhagen and Rafaeli 1996; Steuer 1992), and Internet marketing and advertising (Alba et al. 1997; Deighton 1996; Ghose and Dou 1998; Hoffman and Novak 1996; Peterson, Balasubramanian, and Bronnenberg 1997). The construct of interactivity is considered a multidimensional concept (Heeter 1986). Rafaeli (1985, 1988) defined interactivity in terms of the responsiveness of participants and the degree to which a communication process resembles human discourse. The high relevance of later messages to earlier messages is referred to as "response contingency" (Alba et al. 1997), "message tailoring" (Rimal and Flora 1997), and "mapping" (Steuer 1992). Immediacy of response is considered another dimension of interactivity (Ku 1992; Rice 1987), though it is an intrinsic attribute of responsiveness

itself. A communication process is perceived to be interactive when responses are exchanged in real time (Newhagen and Rafaeli 1996). Interactivity is also defined by the ability to select the timing, content, and sequence of a communication act within a mediated environment, which is a form of user control. Steuer (1992, p. 84) simply defines interactivity as "the extent to which users can participate in modifying the form and content of a mediated environment in real time." Three-dimensional advertising is able to provide non-immersive user control over many aspects of a simulated product.

Another intrinsic property of 3-D advertising is media richness, which tends to enhance a sense of presence. Media richness also is referred to as media vividness (Steuer 1992). It means the intensity with which a mediated environment is able to present information to the senses. Two aspects of media richness are sensory breadth, which is the number of sensory dimensions simultaneously presented, and sensory depth, which is the resolution of each perceptual channel (Steuer 1992). Breadth is a function of the ability of a communication medium to present information across the senses. For example, television addresses both the audio and visual systems, whereas radio addresses only the audio system. Thus, television has greater sensory breadth. Depth refers to the quality of information; an image with greater depth is generally perceived as being of higher quality than one with less depth for both auditory and visual representation. The premise of media richness lies in the assumption that messages appealing to multiple perceptual systems are better perceived than are those that call on single perceptual systems and that high quality messages are more effective than low quality messages. Although this assumption should be true in most cases, we cannot always assume that a richer mediated environment is better. Therefore, it is reasonable to speculate that adequate richness for a given cognitive task is more important than excessively low or high richness in 3-D advertising.

Virtual Experience

Three-dimensional advertising is able to generate a virtual experience. Traditionally, product experiences have been dichotomized as direct or indirect. Direct product experience is the unmediated interaction between consumers and products in full sensory capacity, including visual, auditory, taste and smell, haptic, and orienting (Gibson 1966). Indirect experience can occur from various sources (i.e., word of mouth, *Consumer Reports*), yet the most prevalent form explored in consumer psychology is advertising. Indirect experience

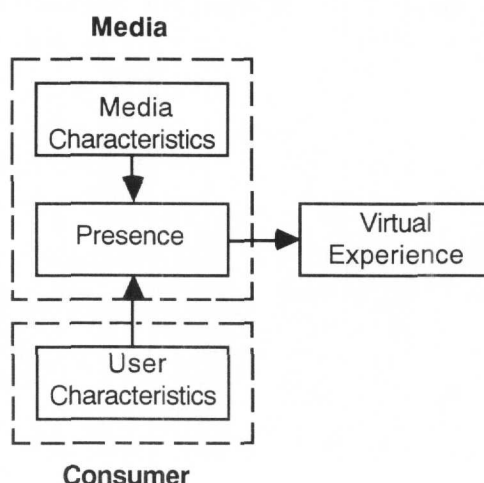
offers a limited amount of sensory stimuli, and consumers generally have very little control over the content of any type of indirect experience from marketers, other than to change the channel, flip the page, or visit another Web site.

A virtual experience is a form of indirect experience, because both are mediated experiences (Heeter 2000). However, virtual experience tends to be richer than indirect experience rendered by print ads, television commercials, or even two-dimensional (2-D) images on the Web. Li, Daugherty, and Biocca's research (2001, in press) indicates that virtual experience, as simulated in 3-D advertising, consists of more active cognitive and affective activities than 2-D marketing messages. They attribute these psychological and emotional effects to the interface properties of 3-D advertising, as well as to the psychological sensation of presence. The relationship between presence and virtual experience is presented in Figure 1. Two antecedents of presence are media characteristics and user characteristics, and presence has one consequence, virtual experience. These relationships are reviewed in the next section (user characteristics are not addressed in this study).

Impact of 3-D Advertising

The impact of 3-D advertising can be ascertained from cognitive, affective, and conative dimensions (Hutchinson and Alba 1991; Lutz 1975; Wright 1980). As with traditional advertising, it is logical to assume that the effectiveness of 3-D advertising should be measured along these elements. Cognitive measures are used to determine the ability of an advertisement, physical product, or other marketing stimulus to attract attention and ultimately generate product knowledge. This element is fundamental in determining the amount of knowledge a consumer has for a product and can be measured from actual knowledge (recall) or perceived knowledge (self-reported) (Bettman and Park 1980). Affective measures are used to identify either established or created attitudes from marketing or advertising stimuli, and attitude toward the brand serves as a commonly used effectiveness measure (Fazio, Powell, and Williams 1989; MacKenzie and Lutz 1989). Conative measures are used to anticipate a response behavior resulting from a marketing or advertising stimulus. They generally involve some type of behavior intention, such as searching for additional information or purchase (Brucks 1985; Hoch and Ha 1986). The most widely used conative measure in advertising effectiveness research is intention to purchase (Andrews et al. 1992; Beerli and Santana 1999).

Figure 1
A Basic Model of Virtual Experience



Hypotheses

Assuming personal preferences are held constant, the research proposition is that consumers interacting with products in 3-D advertising are more likely to perceive a sense of presence, which results in a positive consumer response as measured by increases in product knowledge, brand attitude, and purchase intention. Therefore, we propose the following hypotheses:

- H1: Three-dimensional advertising will result in a greater sense of presence than will 2-D advertising.
- H2: Three-dimensional advertising will result in (a) greater product knowledge, (b) more favorable brand attitude, and (c) increased purchase intent than will 2-D advertising.

Study 1

Research Design

To test the hypotheses, an experiment was conducted in a laboratory setting in which each participant accessed a product Web site via the computer. Each Web site represents an experience type: 3-D advertising for virtual experience and 2-D advertising for indirect experience. Three-dimensional advertising was operationally defined as a user-controlled product Web site in which consumers may rotate, zoom in or zoom out, and move the product for detailed inspection. In contrast, 2-D advertising was operationally defined as a non-interactive, static product Web site in which a photograph of a product is presented

for inspection, thus representing a standard indirect experience portrayed on countless e-commerce sites.

Participants

A total of 60 undergraduate students enrolled at a major Midwestern U.S. university participated in the experiment and were randomly assigned to the experimental conditions. The use of a student sample was deemed acceptable because of the nature of the study and students' literacy for the computer and Internet. The sample consisted of 34 women (56.7%) and 26 men (43.3%) with an average age of 21.6 years ($SD=1.84$).

Stimulus

To investigate the relative impact of both virtual and indirect experience, the test product needed to (1) be effectively represented in each type of experience, (2) require participants to engage in information processing, and (3) stand for a brand of moderate interest. The first parameter stems from the need to minimize the differences between the stimulus materials to isolate the type of experience properly as the influencing variable. The second parameter was necessary to engage the participants in active processing for evaluation of the test product. This is commonly achieved in consumer behavior research by informing participants that they will be asked to report their opinions and thoughts upon completion of the study (Kempf and Smith 1998). The final requirement was important to minimize any preconceived response bias.

Several products were evaluated and considered (i.e., ring, watch, bedding material, computer, cellular telephone, headphones) prior to the selection of a digital video camera as the test product. A digital video camera was judged appropriate because it represents a high involvement purchase item that can be evaluated using both experience attributes (e.g., weight, size, visual clarity) and search attributes (e.g., price, warranty, special effect features). In addition, to increase the legitimacy of the study, a reputable digital video camcorder company (Panasonic) was identified in a pretest ($n=76$) as a neutral brand against four major manufacturers (Sony, JVC, Canon, and Sharp). Participants were asked to rate the perceived quality of each of the digital video camcorder brands using a seven-point scale (low quality/high quality). Results showed that Sony ($M=6.04$, $SD=1.03$) and Canon ($M=5.16$, $SD=1.06$) were perceived as the two highest quality brands and Sharp ($M=4.59$, $SD=1.40$) and JVC ($M=4.33$, $SD=1.41$) as the two lowest quality brands, with Panasonic ($M=4.88$, $SD=1.18$) between these two sets of brands.

Another step in developing the stimulus material was to identify salient product attributes using a free elicitation technique recommended by Fishbein and Ajzen (1975) and commonly used in consumer research (Kempf and Smith 1998; Smith 1993). During a pretest, participants from the student population at the same university were asked to write down the most important product attributes they would consider when buying a digital video camcorder. A total of 27 different attributes were identified, and the 5 most salient were selected (price, size/weight, special effects, quality, and ease of use) and combined with the company logo and slogan to construct the product Web site.

Two versions of the product Web site were created: one representing 3-D advertising followed by an identical version that substituted 2-D advertising. The 3-D advertisement contained specific interactive features (move, rotate, and zoom in or out) previously identified by research as creating an effective virtual experience (Li, Daugherty, and Biocca 2001). Finally, the message appeal was held constant across each condition using an informative approach that framed the identified salient attributes positively, such as "crystal-clear detail" and "easy-to-use functionality."

Procedures

The experiment began with a short survey designed to collect background information on each participant. Once the survey was completed, participants were escorted into a large laboratory and seated at a computer

station corresponding to the assigned experimental condition. Participants were instructed that the purpose of the study was to collect their evaluation of the product, so they should thoroughly examine the Web site to determine how they think and feel about the product. For the virtual experience condition, brief navigation instructions were given to explain how to rotate and zoom in or out to examine the product. In addition, evaluation times were held constant at five minutes for each condition to prevent overexposure. Finally, participants were told that, on conclusion of their evaluation, they would be asked to complete a survey. This served to prime participants to engage in cognitive processing and is consistent with previous consumer experience studies (Kempf and Smith 1998).

Dependent Measures

The dependent variables of the study (presence, product knowledge, brand attitude, and purchase intention) were measured using semantic differential and Likert-type items. Presence was measured using a shortened version of the Independent Television Commission-Sense of Presence Inventory (ITC-SOPI; Lessiter et al. 2000). The ITC-SOPI is a self-reported, 44-item Likert scale (strongly disagree/strongly agree) designed to measure four dimensions of presence (physical, engagement, naturalness, and negative effects). The scale is used to measure presence across multiple types of media and focuses on participant experiences within the mediated environment. The first dimension, experiencing a sense of physical space, corresponds with the traditional definition of "being there" in the mediated environment. Usually, this dimension is measured using 20 items, but only 14 were considered relevant for this study. The 6 excluded items dealt with either social interaction or olfactory sensory experiences. The second dimension, engagement, measures the intensity and enjoyment experienced in the mediated environment (13 items). The third dimension, naturalness, taps into the sense that characters or objects are perceived as life-like and real (5 items). Finally, the fourth dimension, negative effects, explores the adverse physiological reactions sometimes associated with the feeling of presence, such as dizziness and nausea (6 items). However, due to the absence of high-speed motion and the limited range of sensory immersion when examining a standard computer display, it was determined from previous research (Biocca et al. 2001) that no negative effects are experienced in these experimental conditions, so these items were excluded.

An established three-item scale was used to assess self-reported product knowledge (Smith and Park 1992).

Participants were asked to indicate their agreement (strongly disagree/strongly agree) with statements regarding how knowledgeable they felt about the product and the amount of additional information they would need to make a purchase decision or a quality judgment of the product. Although Smith and Park's (1992) original scale included a fourth item, previous research has indicated low reliability, resulting in the exclusion of the item in this study (Biocca et al. 2001).

Overall brand attitude was assessed using a published scale (Bruner 1998) that asks participants to indicate how they feel about the product using seven-point semantic differential items (bad/good, unappealing/appealing, unpleasant/pleasant, unattractive/attractive, boring/interesting, and dislike/like).

Purchase intention is a common effectiveness measure and often used to anticipate a response behavior. The method of asking participants to evaluate an advertisement or product and then indicate an intention is prevalent throughout the literature (Andrews et al. 1992; Beerli and Santana 1999). Thus, an established four-item, seven-point semantic differential scale (unlikely/likely, improbable/probable, uncertain/certain, and definitely not/definitely) was used to measure the likelihood that participants would purchase the evaluated product (Bearden, Lichtenstein, and Teel 1984).

Results

Data Analysis

All the scales were tested for internal consistency and a specified factor structure based on theory-driven indicators using confirmatory factor analysis and found to be unidimensional (Hunter and Gerbing 1982). Furthermore, reliability assessment was conducted using Cronbach's alpha for each scale (presence-physical $M=2.52$, $SD=.82$, $\alpha=.90$; presence-engagement $M=2.59$, $SD=.62$, $\alpha=.87$; presence-naturalness $M=3.33$, $SD=.64$, $\alpha=.71$; product knowledge $M=4.10$, $SD=1.23$, $\alpha=.78$; brand attitude $M=5.13$, $SD=1.01$, $\alpha=.91$; purchase intention $M=3.11$, $SD=1.33$, $\alpha=.90$), and all exceeded the generally accepted guideline of .70 (Hair et al. 1998). Composite measures for each of the scales were then constructed to represent the multiple items and used in the subsequent analysis to reduce measurement error.

Hypotheses Testing

To test the hypotheses, independent sample *t*-tests were conducted that compared the mean differences between the 3-D and 2-D conditions for each of the dependent variables (see Table 1). Hypothesis 1 pre-

dicted that participants evaluating the 3-D interactive product would experience a greater sense of presence than would those evaluating the 2-D static product. The effects of user-controlled interactivity and media richness from 3-D advertising showed significant differences across all three dimensions of presence, in support of the hypothesis. Specifically, physical presence ($M=2.92$), engagement ($M=2.81$), and naturalness ($M=3.51$) were consistently higher for participants evaluating the product in 3-D advertising compared with the reported levels of physical presence ($M=2.12$, $t(59)=4.31$, $p<.01$), engagement ($M=2.37$, $t(59)=2.87$, $p<.01$), and naturalness ($M=3.15$, $t(59)=2.20$, $p<.05$) in 2-D advertising.

The second hypothesis predicted that an increase in presence would result in greater product knowledge, brand attitude, and purchase intent. The results largely support this assertion; participants report significantly higher values for product knowledge ($M=4.57$) in the 3-D advertising condition compared with in the 2-D advertising condition ($M=3.63$, $t(59)=3.15$, $p<.01$). Likewise, participants indicated more favorable brand attitudes for 3-D advertising ($M=5.40$) than for 2-D advertising ($M=4.85$, $t(59)=2.18$, $p<.05$). However, purchase intention was not significantly greater for the 3-D ($M=3.39$) than the 2-D condition ($M=2.83$, $t(59)=1.66$, $p>.05$).

Mediation Analysis

To determine whether presence mediates the relationship between the type of Internet advertising experience and reported product knowledge, brand attitude, and purchase intention, a mediation analysis was conducted as specified by Baron and Kenny (1986). To establish mediation, the following must hold: (1) the type of experience (3-D versus 2-D) must positively affect the mediator (physical, engagement, and naturalness), (2) the type of experience must positively affect the dependent variable (product knowledge, brand attitude, and purchase intention), and (3) the mediator must positively affect the dependent variable when regressed in conjunction with the independent variable. Providing these conditions are met, the effect of the independent variable on the dependent variable must be less in the third step than in the second step (Baron and Kenny 1986).

The first set of analyses indicated that the type of experience positively influenced perceived physical ($\beta=.49$, $t(58)=4.31$, $p<.01$, $R^2=.24$), engagement ($\beta=.35$, $t(58)=2.87$, $p<.01$, $R^2=.12$), and naturalness ($\beta=.28$, $t(58)=2.20$, $p<.05$, $R^2=.08$) dimensions of presence. Furthermore, the second set of analyses demonstrated

Table 1
Dependent Measures across Experimental Conditions

| <i>Measure</i> | <i>3-D</i> | <i>2-D</i> | <i>t</i> | <i>Degrees of Freedom</i> | <i>p <</i> |
|--------------------|------------|------------|----------|---------------------------|---------------|
| Presence | | | | | |
| Physical | 2.92 | 2.12 | 4.31 | 59 | .01 |
| Engagement | 2.81 | 2.37 | 2.87 | 59 | .01 |
| Naturalness | 3.51 | 3.15 | 2.20 | 59 | .05 |
| Product knowledge | 4.57 | 3.63 | 3.15 | 59 | .01 |
| Brand attitude | 5.40 | 4.85 | 2.18 | 59 | .05 |
| Purchase intention | 3.39 | 2.83 | 1.66 | 59 | .10 |

that the type of experience positively influenced product knowledge ($\beta = .38$, $t(58) = 3.15$, $p < .01$, $R^2 = .13$) and brand attitude ($\beta = .28$, $t(58) = 2.18$, $p < .05$, $R^2 = .08$) but did not yield significant results for purchase intention ($\beta = .21$, $t(58) = 1.65$, $p > .05$). This lack of significance excluded purchase intention from the mediation analysis. Finally, the third set of analyses supported presence as a mediating variable along the physical and engagement dimensions for product knowledge ($\beta = .30$, $t(2,57) = 2.19$, $p < .05$, $R^2 = .21$; $\beta = .34$, $t(2,57) = 2.77$, $p < .01$, $R^2 = .25$, respectively) and brand attitude ($\beta = .53$, $t(2,57) = 4.15$, $p < .01$, $R^2 = .29$; $\beta = .43$, $t = 3.44$, $p < .01$, $R^2 = .23$, respectively). Accordingly, the effect of advertising experience on product knowledge diminished when included in the analysis with the physical ($\beta = .24$, $t(2,57) = 1.75$, $p > .05$) or engagement ($\beta = .26$, $t(2,57) = 2.14$, $p < .05$) dimensions, and the effect on brand attitude was also reduced when regressed along with the physical ($\beta = .01$, $t(2,57) = .10$, $p > .05$) or engagement ($\beta = .13$, $t = 1.02$, $p > .05$) dimensions. However, the naturalness dimension was not supported as a mediating variable for either product knowledge ($\beta = .15$, $t(2,57) = 1.17$, $p > .05$) or brand attitude ($\beta = .16$, $t(2,57) = 1.26$, $p > .21$). Thus, the results indicate that the physical and engagement dimensions of presence served as mediators in the relationship between the type of advertising experience and product knowledge, as well as brand attitude, for this study.

Discussion

Results of this study support the proposition that consumers interacting with 3-D advertising rather than 2-D advertising are more likely to experience an elevated sense of presence. The mediation analysis confirms the role of presence in affecting on-line consumers. These findings establish an important relationship among virtual experience, presence, and marketing effectiveness measures that several scholars have suggested exists (Hoffman and Novak 1996;

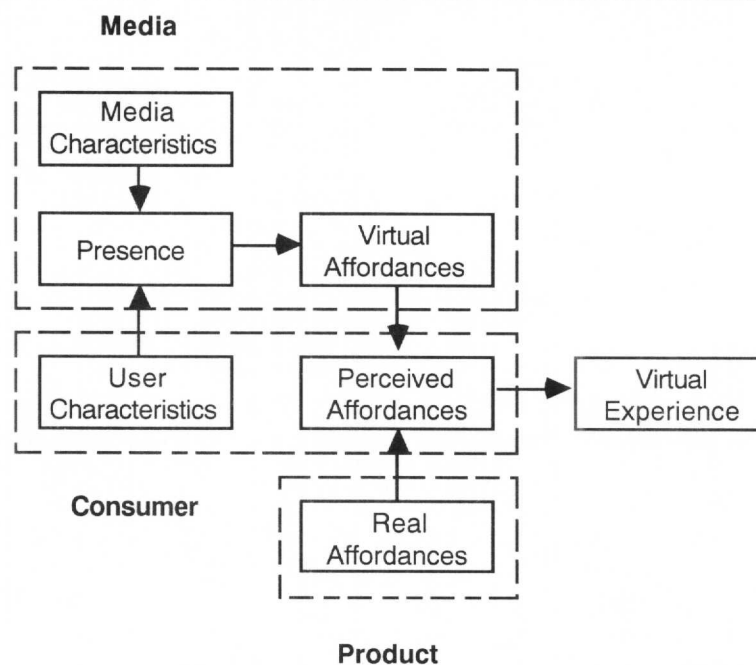
Kim and Biocca 1997; Klein 1998; Li, Daugherty, and Biocca 2001). However, after testing only a single product, it remains uncertain if a sensation of presence can be created across different products by utilizing 3-D advertising to enhance a virtual experience. To extend the external validity of this causality, it is necessary to confirm it with different types of products, because previous research has indicated that different types of products often affect how consumers evaluate these products (Klatzky, Lederman, and Matula 1991; Norman 1998).

Study 2

Product Types

Product attributes play a significant role in determining how consumers evaluate products (Deighton 1997; Klein 1998; Smith 1993; Smith and Swinyard 1982; Wright and Lynch 1995), and different product classifications have been conceptualized on the basis of product attributes. Nelson (1976, 1981) made distinctions between search and experience products, which he subsequently refined as search and experience attributes because a product can have both types of attributes. Search attributes are those features of a product that consumers can assess without actual use of the product, such as size, color, and price. Experience attributes are those that consumers can assess only through actual use or direct contact, such as taste, softness, or fit. McCabe and Nowlis (2001) examined the influence of different product attributes on the consumer's information search and purchases in e-commerce. They adopted the definition of geometric and material attributes from Klatzky, Lederman, and Matula (1991), who observed that people explore everyday objects through two sensory dimensions: vision and touch. Objects with attributes that can be fully understood through vision are called geometric objects. Objects with attributes that re-

Figure 2
Expanded Model of Virtual Experience



quire touching for understanding are called material products. According to McCabe and Nowlis (2001), examples of material products would be a sweater and a towel. A candy bar, a compact disc, or a bag of potato chips would be examples of geometric products, because it is possible for consumers to get sufficient information about them without touching them. McCabe and Nowlis (2001) found that the consumer's preference for either on-line or off-line information search largely depends on different product attributes. Li, Daugherty, and Biocca (in press) extended McCabe and Nowlis's (2001) classification by adding a third product type: mechanical products. This new type of product includes those products that consumers prefer to interact with in prepurchase inspection, such as a laptop computer, camcorder, or personal digital assistant (PDA).

Product Affordances

With these different product classifications, the issue becomes what type of dominant product attribute is more likely influenced by virtual experience and presence. It is helpful to review the concept of product affordances for this exploration. In consumer psychology, product affordances are perceptual cues that guide consumers interacting with products during prepurchase inspection. Li, Daugherty, and Biocca

(in press) expand Norman's (1998) concept of affordances to include virtual affordances in addition to real and perceived affordances. Real affordances are physical attributes of a product, perceived affordances are perceptual cues a consumer possesses and uses in assessing a product prior to purchase, and virtual affordances are product properties that are simulated in 3-D products, which could differ from perceived affordances. An important point is that perceived affordances vary by consumers, because two people examining the same product can formulate completely different perceptions of what a product can offer. For example, perceived affordances of the same camera are quite different for a professional photographer and an amateur. In turn, virtual affordances can be restricted, equal, or exceed real and perceived affordances (Li, Daugherty, and Biocca in press). The relationships among real, perceived, and virtual affordances, presence, and virtual experience are presented in a model of virtual experience (Figure 2).

Hypotheses

The sensation of presence is stimulated in a mediated environment from the intensity of sensory information presented and the degree of interactivity with the content (Steuer 1992). Because 3-D advertising provides enhanced visual sensory information and

user control over how to inspect a product, elevated levels of presence are expected compared with 2-D advertising, regardless of product types. Thus, the following hypothesis is proposed to extend the findings from Study 1 to geometric and material products:

- H3: Three-dimensional advertising will result in a greater sense of presence than will 2-D advertising for both geometric and material products.

When consumers inspect a geometric product, visual inspection is usually sufficient for them to make a confident purchase decision. However, when consumers examine a material product prior to purchase, they normally prefer to touch and feel the product to gain further information that is not available by merely viewing the product. Therefore, it is reasonable to assume that 3-D advertising is limited in its capacity of simulating tactile affordances to meet such a need in consumers. On the basis of the concepts of product types and affordances, the following hypotheses are proposed:

- H4: Three-dimensional advertising will result in (a) greater product knowledge, (b) more favorable brand attitude, and (c) increased purchase intent than will 2-D advertising when evaluating a geometric product.
- H5: Three-dimensional advertising will result in no differences for (a) product knowledge, (b) brand attitude, or (c) purchase intent compared with 2-D advertising when evaluating a material product.

Method

Experiment Design

The experiment was conducted in a laboratory setting in which each participant accessed a Web site for one of two products through the computer. A between-subjects 2×2 design was used with ad type (3-D versus 2-D) and product type (geometric versus material) serving as the two factors. Cell sizes ranged from 20 to 26 subjects each. The construction of the stimulus materials, dependent variables, and experimental procedures followed Study 1, with the only difference stemming from the additional factor of product type.

Participants

A total of 93 undergraduate students enrolled at a major Midwestern U.S. university participated in the experiment and were randomly assigned to the experimental conditions. Of those who participated, 76.3% were women with a mean age of 20.9 years ($SD=1.76$).

Stimulus

Several products were evaluated, and the goal was to select alternatives on the basis of different product affordances. Therefore, using the classifications from previous research (Klatzky, Lederman, and Matula 1991, 1993; Li, Daugherty, and Biocca 2001; McCabe and Nowlis 2001), a watch and jacket were identified as suitable alternative test products. The watch was judged as appropriate because it represents a product that is primarily evaluated using the visual senses (i.e., a geometric classification). In turn, a jacket is examined, for the most part, using tactile feedback to evaluate the feel and texture or the comfort and fit against the body (i.e., a material classification).

Results

Data Analysis

As in Study 1, all scales were tested for internal consistency using confirmatory factor analysis and found to be unidimensional. The Cronbach's alpha for each scale (presence-physical $M=2.28$, $SD=.85$, $\alpha=.93$; presence-engagement $M=2.39$, $SD=.78$, $\alpha=.90$; presence-naturalness $M=2.92$, $SD=.79$, $\alpha=.74$; product knowledge $M=4.08$, $SD=1.61$, $\alpha=.90$; brand attitude $M=4.86$, $SD=1.25$, $\alpha=.89$; purchase intention $M=2.97$, $SD=1.70$, $\alpha=.79$) was again acceptable, with composite measures constructed and used in the subsequent analyses.

Hypotheses Testing

Study 1 established empirically that 3-D advertising evokes higher levels of reported presence. Hypothesis 3 stated this relationship with both geometric and material products. The results of Study 2 support H3, in that participants again reported experiencing higher levels of physical presence ($M=2.79$), engagement ($M=2.75$), and naturalness ($M=3.27$) when evaluating 3-D advertising compared with the reported levels of physical presence ($M=1.82$, $F(89)=45.62$, $p<.01$), engagement ($M=2.08$, $F(89)=20.80$, $p<.01$), and naturalness ($M=2.56$, $F(89)=22.84$, $p<.01$) for 2-D advertising. A significant main effect was also discovered for product type, with participants indicating higher levels of physical presence ($M=2.15$) and engagement ($M=2.60$) after examining the material product compared with reported levels of physical presence ($M=2.45$, $F(89)=4.48$, $p<.05$) and engagement ($M=2.24$, $F(89)=6.13$, $p<.01$) for the geometric product. However, no significant effect was detected for naturalness between the material ($M=2.85$) and the geometric

product ($M=2.98$, $F(89)=.79$, $p>.05$). As was expected, there were no significant interactions between ad type and product type for physical presence ($F(89)=.79$, $p>.05$), engagement ($F(89)=.02$, $p>.05$), or naturalness ($F(89)=.24$, $p>.05$).

The significant main effects for product type on two dimensions of presence (physical and engagement) are unexpected because presence is a mediated experience rather than a product classification phenomenon. Therefore, contrast comparisons were tested to ensure the hypothesized effect for 3-D advertising was not a consequence of product type. The results again support H3, in that participants reported experiencing higher levels of physical presence ($M=2.58$), engagement ($M=2.56$), and naturalness ($M=3.30$) when evaluating the watch in the 3-D advertising compared with the reported levels of physical presence ($M=1.75$, $F(89)=4.58$, $p<.01$), engagement ($M=1.91$, $F(89)=3.73$, $p<.01$), and naturalness ($M=2.66$, $F(89)=3.21$, $p<.01$) for the 2-D version. Similarly, physical presence ($M=3.00$), engagement ($M=2.94$), and naturalness ($M=3.24$) were elevated when evaluating the jacket in 3-D compared with the reported levels of physical presence ($M=1.90$, $t(40)=4.89$, $p<.01$), engagement ($M=2.25$, $t(40)=2.80$, $p<.01$), and naturalness ($M=2.46$, $t(40)=3.55$, $p<.01$) for the same product in 2-D. These findings clearly indicate that the user-controlled 3-D advertising in this study induced a significantly higher level of perceived presence than 2-D advertising.

To test H4 and H5, an examination of the interaction between the ad type and product type was first conducted. The results show significant main effects in support of ad type, with participants indicating higher levels of product knowledge ($M=4.67$), brand attitude ($M=5.34$), and purchase intention ($M=3.46$) after evaluating 3-D advertising compared with reported product knowledge ($M=3.43$, $F(89)=16.23$, $p<.01$), brand attitude ($M=4.41$, $F(89)=14.19$, $p<.01$), and purchase intention ($M=2.54$, $F(89)=7.19$, $p<.01$) for 2-D advertising. As was expected, there were no main effects across product type for product knowledge ($M=4.31$), brand attitude ($M=4.76$), or purchase intention ($M=2.79$) when examining the geometric product versus the product knowledge ($M=3.80$, $F(89)=2.72$, $p>.05$), brand attitude ($M=4.99$, $F(89)=.84$, $p>.05$), or purchase intention ($M=3.19$, $F(89)=1.46$, $p>.05$) for the material product. In addition, no significant interaction was detected between ad type and product type for product knowledge ($F(89)=1.63$, $p>.05$), brand attitude ($F(89)=.06$, $p>.05$), or purchase intention ($F(89)=.01$, $p>.05$). The lack of an interaction obviously indicates that any further analyses should proceed with caution. However, because the

planned contrasts correspond with the significant main effect of ad type, H4 and H5 can be confidently tested (Iacobucci 2001; Winer, Brown, and Michels 1991, p. 141).

In testing the hypotheses, planned comparisons were conducted to examine the mean differences between 3-D and 2-D advertising for each of the dependent variables (see Table 2). Hypothesis 4 predicted that 3-D advertising would be more effective than 2-D advertising for the geometric product (watch). The results support the hypothesis. Participants reported a significantly higher level of product knowledge ($M=4.73$) after examining the 3-D interactive watch than the 2-D static representation ($M=3.88$, $t(51)=2.10$, $p<.05$). Likewise, brand attitude ($M=5.25$) was significantly greater for the 3-D interactive version compared with the 2-D static product ($M=4.26$, $t(51)=2.92$, $p<.01$). Finally, purchase intention ($M=3.27$) was significantly higher for the watch in 3-D advertising than in the 2-D advertising counterpart ($M=2.31$, $t(51)=2.05$, $p<.05$).

Hypothesis 5 anticipated that 3-D advertising would result in no significant differences from 2-D advertising when evaluating a tactile product (jacket). However, significant differences were detected in favor of the 3-D condition over the 2-D condition for reported product knowledge and brand attitude when evaluating the jacket, resulting in the rejection of H5. Surprisingly, participants reported a significantly higher level of product knowledge ($M=4.62$) after examining the jacket in 3-D than in 2-D ($M=2.98$, $t(40)=3.48$, $p<.01$). In addition, brand attitude ($M=5.42$) was significantly greater for 3-D advertising compared with 2-D advertising ($M=4.55$, $t(40)=2.46$, $p<.05$). The mean scores for purchase intention ($M=3.65$) in the 3-D condition followed the same pattern but were not significantly different than in the 2-D condition ($M=2.76$, $t(40)=1.77$, $p>.05$). One possible explanation for these findings is that consumers in the 3-D advertising condition were able to experience a limited haptic sensation by zooming, rotating, and moving the product. This enhanced virtual experience when evaluating a material product is unexpected yet interesting and warrants further discussion.

Mediation Analysis

A mediation analysis was again conducted to determine whether presence mediates the relationship between the type of Internet advertising and reported product knowledge, brand attitude, and purchase intention for each test product. The first set of analyses for the geometric product indicated that the type of advertising positively influenced the perceived physical ($\beta=.55$, $t(50)=4.58$, $p<.01$, $R^2=.30$), engagement

Table 2
Dependent Measures across Experience and Product Category

| <i>Product</i> | <i>Measure</i> | <i>3-D</i> | <i>2-D</i> | <i>t</i> | <i>Degrees of Freedom</i> | <i>p <</i> |
|----------------|--------------------|------------|------------|----------|---------------------------|---------------|
| Watch | Presence | | | | | |
| | Physical | 2.58 | 1.75 | 4.58 | 51 | .01 |
| | Engagement | 2.56 | 1.91 | 3.73 | 51 | .01 |
| | Naturalness | 3.30 | 2.66 | 3.21 | 51 | .01 |
| | Product knowledge | 4.73 | 3.88 | 2.10 | 51 | .05 |
| | Brand attitude | 5.25 | 4.26 | 2.92 | 51 | .01 |
| | Purchase intention | 3.27 | 2.31 | 2.05 | 51 | .05 |
| Jacket | Presence | | | | | |
| | Physical | 3.00 | 1.90 | 4.89 | 40 | .01 |
| | Engagement | 2.94 | 2.25 | 2.80 | 40 | .01 |
| | Naturalness | 3.24 | 2.46 | 3.55 | 40 | .01 |
| | Product knowledge | 4.62 | 2.98 | 3.48 | 40 | .01 |
| | Brand attitude | 5.42 | 4.55 | 2.46 | 40 | .05 |
| | Purchase intention | 3.65 | 2.76 | 1.77 | 40 | .08 |

($\beta=.47$, $t(50)=3.73$, $p<.01$, $R^2=.22$), and naturalness ($\beta=.41$, $t(50)=3.21$, $p<.01$, $R^2=.17$) dimensions of presence. Similarly, the second set of analyses for the watch demonstrated that the type of experience positively influenced product knowledge ($\beta=.29$, $t(50)=2.10$, $p<.05$, $R^2=.08$), brand attitude ($\beta=.38$, $t(50)=2.92$, $p<.01$, $R^2=.15$), and purchase intention ($\beta=.28$, $t(50)=2.05$, $p<.05$, $R^2=.08$). However, the third set of analyses rejected presence as a mediating variable for the geometric product along the physical, engagement, and naturalness dimensions for product knowledge ($\beta=.19$, $t(2,49)=1.19$, $p>.05$; $\beta=.03$, $t(2,49)=.21$, $p>.05$; $\beta=.02$, $t(2,49)=.10$, $p>.05$, respectively) and brand attitude ($\beta=.03$, $t(2,49)=.20$, $p>.05$; $\beta=.17$, $t(2,49)=1.17$, $p>.05$; $\beta=-.22$, $t(2,49)=1.58$, $p>.05$, respectively). Nevertheless, presence was supported as a mediating variable for purchase intention along the physical ($\beta=.48$, $t(2,49)=3.19$, $p<.01$, $R^2=.24$) and engagement ($\beta=.49$, $t(2,49)=3.55$, $p<.01$, $R^2=.2$) dimensions, with naturalness resulting in no effect ($\beta=.12$, $t(2,49)=.77$, $p>.05$). The effect of advertising on purchase intention for the watch diminished when included in the analysis with the physical ($\beta=.02$, $t(2,49)=.14$, $p>.05$) or engagement ($\beta=.05$, $t(2,49)=.36$, $p>.05$) dimensions.

For the material product, the first set of analyses indicated that the type of advertising positively influenced the perceived physical ($\beta=.62$, $t(39)=4.89$, $p<.01$, $R^2=.38$), engagement ($\beta=.41$, $t(39)=2.80$, $p<.01$, $R^2=.18$), and naturalness ($\beta=.49$, $t(39)=3.55$, $p<.01$, $R^2=.24$) dimensions of presence. In addition, the second set of analyses for the jacket demonstrated that the type of advertising positively influenced product knowledge

($\beta=.49$, $t(39)=3.48$, $p<.05$, $R^2=.24$) and brand attitude ($\beta=.37$, $t(39)=2.46$, $p<.01$, $R^2=.14$) but did not result in a significant effect for purchase intention ($\beta=.27$, $t(39)=1.77$, $p>.05$), which caused the variable to be excluded from the remaining analyses. Finally, the third set of analyses for the material product supported presence as a mediating variable along the physical, engagement, and naturalness dimensions for product knowledge ($\beta=.44$, $t(2,38)=2.69$, $p<.01$, $R^2=.36$; $\beta=.29$, $t(2,38)=1.97$, $p<.05$, $R^2=.31$; $\beta=.30$, $t(2,38)=1.96$, $p<.05$, $R^2=.31$, respectively) and brand attitude ($\beta=.73$, $t(2,38)=4.83$, $p<.01$, $R^2=.47$; $\beta=.58$, $t(2,38)=4.26$, $p<.01$, $R^2=.41$; $\beta=.51$, $t(2,38)=3.36$, $p<.01$, $R^2=.33$, respectively). Appropriately, the effect of advertising on product knowledge diminished when included in the analysis with physical ($\beta=.21$, $t(2,38)=1.29$, $p>.05$), engagement ($\beta=.37$, $t(2,38)=2.49$, $p<.01$), or naturalness ($\beta=.34$, $t(2,38)=2.17$, $p<.05$) dimensions. Likewise, the effect of experience on brand attitude for the jacket was also weakened when regressed along with the physical ($\beta=-.08$, $t(2,38)=.55$, $p>.05$), engagement ($\beta=.13$, $t(2,38)=.95$, $p>.05$), or naturalness ($\beta=.11$, $t(2,38)=.75$, $p>.05$) dimensions.

In summary, the results of the mediation analysis for Study 2 indicate that the physical and engagement dimensions of presence mediated the relationship between the type of advertising and purchase intention for the geometric product. Furthermore, all three dimensions of presence served to mediate the association between product knowledge and the type of advertising for the material product. This relationship was also supported for brand attitude.

Discussion

The most interesting finding of Study 2 is that 3-D advertising results in better knowledge and more positive brand attitude than 2-D advertising for a material product (jacket). This is contradictory to the belief that perceived affordances would propel consumers to feel and touch such an item in a prepurchase inspection. Thus, we need to seek alternative explanations for these findings.

We speculate that perceived affordances may have been altered by the illusion of presence, which resulted in a new set of virtual affordances rather than the perceptual cues that normally regulate a consumer's assessment of a product. For example, when consumers interact with a product, their perceived affordances will initially guide them in terms of what to see, feel, and try. However, because they are interacting with a 3-D product, they will soon take advantage of the interface properties offered by the virtual experience. For example, a virtual experience may enable them to engrave their name on the inner band of a ring or customize the color of bed linens. Thus, they feel as if they are dealing with a real product, and a sense of presence emerges. As a result, presence may transform their perceived affordances by weighting aspects of a product differently. Shoppers may always believe the texture of a jacket is important; however, when they see bright colors or fashionable designs, combined with user-controlled interactivity, they may think these attributes are more important than the feel of the jacket for their product evaluation within the context of e-commerce. These new perceptual cues that guide a shopper's assessment of a product in a 3-D environment are what we call virtual affordances.

Presence is the bridge between perceived affordances and virtual affordances. Precisely, presence can transform perceived affordances into virtual affordances through imagery association in 3-D advertising. In a seminal review, Klein (1998) suggests that virtual experience may occur in each of three scenarios. First, information about a product's specific attributes is easily accessible on the Internet. Second, the format of information presented can alter the weight that consumers give to different attributes, especially when experience attributes are absent. For example, the history or personality of a wine product may be sufficient for a consumer in the absence of direct contact with the packaging or display information. Third, Internet advertising may provide experience from expert sources to assist consumer learning. As a result, such a virtual

experience is able to "transform" experience attributes into search attributes and thereby reduce perceived risk prior to purchase in e-commerce.

The notion of virtual experience evolves as advances in 3-D visualization technologies emerge. If Klein's (1998) concept of virtual experience is based on "semantic associations," interactive 3-D advertising is more likely to generate a virtual experience through "imagery associations." Both spontaneous and voluntary imagery can facilitate the simulation of an experience (Richardson 1984). Imagery-based virtual experience is likely to be richer than semantic-based virtual experience, though both types may be interwoven in a consumer's interaction with a product in a virtual environment. As a result of the imagery association, perceived affordances may be altered. It is our belief that the perceived product affordances (touch and feel) that normally dominate the evaluation of a material product were transformed because of presence. Subsequently, participant evaluations were based on the virtual affordances offered by 3-D advertising, such as the ability to control the content of the media, because the heightened sense of presence served to simulate consumption.

Limitations

Inherent within any study are potential limitations that affect the overall validity and reliability of the results. With regard to this research, a few limitations should be considered when interpreting the findings. One limitation is the use of a student sample in combination with a laboratory experiment. This type of experiment restricts the external validity, which should be kept in mind when interpreting the results. Although strong consideration and planning took part in the selection of appropriate test products, the selection of different product categories that incorporate more search or experience attributes could affect the results. Another limitation is that Internet access and computer performance were optimized in this study, so participants were not exposed to any effect of slow download time or poor computer performance. As a result, the findings of this study should be more pertinent to e-commerce when consumers can experience 3-D product visualization through broadband Internet connections. Finally, product evaluation times were restricted in length and held constant across both studies. Although this provides adequate control for comparison purposes, additional research should explore consumers in a browsing frame of mind by removing this restraint.

Conclusion

The purpose of this study was to expand the knowledge of consumer experience by testing the relationship between 3-D advertising and presence. These frameworks are important to both scholars and practitioners because the Internet has the ability to serve as a more powerful medium than traditional media, in the sense that consumers are able to interact with products in multimedia environments. The managerial implications are immediate, because the ability to establish a virtual experience is not beyond the current capabilities of marketers. By creating compelling on-line virtual experiences with products, advertisers potentially can enhance the value of the product information presented, engage consumers in an active shopping experience, increase the number of unique and repeat traffic visitors for a site, and ultimately establish an on-line competitive advantage. The underlying reason for this is that virtual experiences allow for vicarious consumption because consumers are actively engaged in the inspection and control of a product in 3-D advertising rather than relegated to being a passive observer, as is common in more traditional media. Furthermore, the findings of this study consistently show that 3-D advertising outperforms the 2-D advertising commonly used today to display and present product information online.

The conceptualization of a virtual experience has emerged because advancements in computer technology have led to a movement toward more multisensory on-line experiences. Similar to traditional forms of indirect experience, 3-D advertising enables consumers to form prior hypotheses by framing the information presented. However, in contrast with indirect experience, 3-D advertising is able to offer user control over the inspection of a product. This is an important advantage because high information control in e-commerce environments has been found to improve consumer decision quality and knowledge (Ariely 2000). This level of control is not a representation of an actual product but rather a simulation of the consumption experience, which has become increasingly important as society moves toward an experience economy (Pine and Gilmore 1998).

This study represents two laboratory experiments in this new and unexplored area. Therefore, replications and extensions of this work are needed to verify and validate the results and to fully understand the impact of a virtual experience in the form of 3-D advertising. Although increased sensory information enhances the sense of presence, future research should explore at

what point cognitive resources are overloaded and the effectiveness of 3-D advertising diminishes. In addition, the use of avatars and virtual shopping worlds in e-commerce warrants further investigation. Another area often neglected in research that explores presence and 3-D advertising is the impact of individual user characteristics. For example, consumer information processing style (i.e., utilitarian versus hedonic) could provide valuable insight into the design and customization of e-commerce sites to achieve maximum effectiveness. Through continued research, the key is to develop and explore fully the psychological and emotional states created in a virtual experience.

References

- Adams, Mark (1995), "Brands of Gold," *Mediaweek*, (November 13), 30-32.
- Alba, Joseph, John Lynch, Barton Weitz, Chris Janiszewski, Richard Lutz, Alan Sawyer, and Stacy Wood (1997), "Interactive Home Shopping: Consumer, Retailer, and Manufacturer Incentives to Participate in Electronic Marketplaces," *Journal of Marketing*, 61 (3), 38-53.
- Andrews, J. Craig, Syed H. Akhter, Srinivas Durvasula, and Darrel Muehling (1992), "The Effects of Advertising Distinctiveness and Message Content Involvement on Cognitive and Affective Responses to Advertising," *Journal of Current Issues and Research in Advertising*, 14 (Spring), 45-58.
- Ariely, Dan (2000), "Controlling the Information Flow: Effects on Consumers' Decision Making and Preferences," *Journal of Consumer Research*, 27 (2), 233-249.
- Baron, Reuben M. and David A. Kenny (1986), "The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations," *Journal of Personality and Social Psychology*, 51 (6), 1173-1182.
- Bearden, William O., Donald R. Lichtenstein, and Jesse E. Teel (1984), "Comparison Price, Coupon, and Brand Effects on Consumer Reactions to Retail Newspaper Advertisements," *Journal of Retailing*, 60 (2), 11-34.
- Beerli, Asuncion and Josefa D. Martin Santana (1999), "Design and Validation of an Instrument for Measuring Advertising Effectiveness in the Printed Media," *Journal of Current Issues and Research in Advertising*, 21 (2), 11-30.
- Bettman, James A. and Whan C. Park (1980), "Effects of Prior Knowledge and Experience and Phase of the Choice Process on Consumer Decision Making Processes: A Protocol Analysis," *Journal of Consumer Research*, 7 (December), 234-248.
- Biocca, Frank (1992), "Virtual Reality Technology: A Tutorial," *Journal of Communication*, 42 (4), 23-72.
- (1997), "Cyborg's Dilemma: Progressive Embodiment in Virtual Environments," *Journal of Computer Mediated-Communication*, 3 (2), [<http://www.ascusc.org/jcmc/vol3/issue2/biocca2.html>].
- , Terry M. Daugherty, Hairong Li, and Zoo-Hyun Chae (2001), "Effect of Visual Sensory Immersion on Product Knowledge, Attitude toward the Product and Purchase Intention," in *Proceedings of the Experiential E-Commerce Conference*, Frank Biocca, ed. [CD-ROM], East Lansing, MI: Michigan State University.

- , Hairong Li, and Terry M. Daugherty (2001), "Experiential E-Commerce: Relationship of Physical and Social Presence to Consumer Learning, Attitudes, and Decision-Making," paper presented at the Presence Conference, (May 21-23), Philadelphia, PA.
- Brucks, Merrie (1985), "The Effects of Product Class Knowledge on Information Search Behavior," *Journal of Consumer Research*, 12 (June), 1-16.
- Bruner, Gordon C. (1998), "Standardization and Justification: Do Aad Scales Measure Up?" *Journal of Current Issues and Research in Advertising*, 20 (1), 1-18.
- Coyle, James R. and Esther Thorson (2001), "The Effects of Progressive Levels of Interactivity and Vividness in Web Marketing Sites," *Journal of Advertising*, 30 (3), 65-77.
- Deighton, John (1996), "The Future of Interactive Marketing," *Harvard Business Review*, 76 (2), 151-160.
- (1997), "Commentary on 'Exploring the Implications of the Internet for Consumer Marketing,'" *Journal of Academy of Marketing Science*, 25 (4), 347-351.
- Fazio, Russell H., Martha C. Powell, and Carol J. Williams (1989), "The Role of Attitude Accessibility in the Attitude-to-Behavior Process," *Journal of Consumer Research*, 16 (December), 280-288.
- Fishbein, Martin and Icek Ajzen (1975), *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*, Reading, MA: Addison-Wesley.
- Ghose, Sanjoy and Wenyu Dou (1998), "Interactive Functions and Their Impacts on the Appeal of Internet Presence Sites," *Journal of Advertising Research*, 38 (2), 29-43.
- Gibson, J. J. (1966), *The Senses Considered as Perceptual Systems*, Boston: Houghton Mifflin.
- Hair, Joseph F., Rolph E. Anderson, Ronald L. Tatham, and William C. Black (1998), *Multivariate Data Analysis*, 5th ed., Upper Saddle River, NJ: Prentice Hall.
- Heeter, Carrie (1986), *Perspectives for the Development of Research on Media Systems*, unpublished doctoral dissertation, Michigan State University, East Lansing.
- (2000), "Interactivity in the Context of Designed Experience," *Journal of Interactive Advertising*, 1 (1), [http://www.jiad.org/vol1/no1/heeter/index.html].
- Hoch, Stephen J. and Young-Won Ha (1986), "Consumer Learning: Advertising and the Ambiguity of Product Experience," *Journal of Consumer Research*, 13 (September), 221-233.
- Hoffman, Donna L. and Thomas P. Novak (1996), "Marketing in Hypermedia Computer-Mediated Environments: Conceptual Foundations," *Journal of Marketing*, 60 (3), 50-68.
- Hunter, John E. and David W. Gerbing (1982), "Unidimensional Measurement, Second Order Factor Analysis, and Causal Models," *Research in Organizational Behavior*, 4, 267-320.
- Hutchinson, J. Wesley and Joseph W. Alba (1991), "Ignoring Irrelevant Information: Situational Determinants of Consumer Learning," *Journal of Consumer Research*, 18 (December), 325-345.
- Iacobucci, Dawn (2001), "Can I Test for Simple Effects in the Presence of an Insignificant Interaction?" *Journal of Consumer Psychology*, 10 (1& 2), 5-9.
- Interactive Advertising Bureau (2001), *IAB Internet Advertising Revenue Report: 2000 Fourth-Quarter Results and Full-Year Highlights*, New York: PriceWaterhouseCooper.
- Kempf, DeAnna S. and Robert E. Smith (1998), "Consumer Processing of Product Trial and the Influence of Prior Advertising: A Structural Modeling Approach," *Journal of Marketing Research*, 35 (August), 325-338.
- Kim, Taeyoung and Frank Biocca (1997), "Telepresence via Television: Two Dimensions of Telepresence May Have Different Connections to Memory and Persuasion," *Journal of Computer-Mediated Communication*, 3 (2), [http://www.ascusc.org/jcmc/vol3/issue2/kim.html].
- Klatzky, Roberta L., Susan J. Lederman, and Dana E. Matula (1991), "Imagined Haptic Exploration in Judgments of Object Properties," *Journal of Experimental Psychology: Learning, Memory and Cognition*, 17 (March), 314-322.
- Klein, Lisa R. (1998), "Evaluating the Potential of Interactive Media Through a New Lens: Search versus Experience Goods," *Journal of Business Research*, 41 (3), 195-203.
- (2001), "Creating Virtual Experiences: The Role of Telepresence," in *Proceedings of the Experiential E-commerce Conference*, Frank Biocca, ed. [CD-ROM], East Lansing, MI: Michigan State University.
- Ku, Linlin (1992), *Impacts of Interactivity from Computer-Mediated Communication in an Organizational Setting: A Study of Electronic Mail*, unpublished doctoral dissertation, Michigan State University.
- Lessiter, Jane, Jonathon Freeman, Edmund Keogh, and Jules Davidoff (2000), "Development of a New Cross-Media Presence Questionnaire: The ITC-Sense of Presence Inventory," paper presented at the 3rd International Workshop on Presence, (March 27-28), Technical University of Delft, Netherlands.
- Li, Hairong, Terry Daugherty, and Frank Biocca (2001), "Characteristics of Virtual Experience in Electronic Commerce: A Protocol Analysis," *Journal of Interactive Marketing*, 15 (3), 13-30.
- , ———, and ——— (in press), "The Role of Virtual Experience in Consumer Learning," *Journal of Consumer Psychology*.
- Lombard, Matthew and Theresa Ditton (1997), "At the Heart of It All: The Concept of Presence," *Journal of Computer-Mediated Communication*, 3 (2), [http://www.ascusc.org/jcmc/vol3/issue2/lombard.html].
- Lutz, Richard J. (1975), "Changing Brand Attitudes Through Modification of Cognitive Structure," *Journal of Consumer Research*, 1 (March), 49-59.
- MacKenzie, Scott B. and Richard J. Lutz (1989), "An Empirical Examination of the Structural Antecedents of Attitude Toward the Ad in an Advertising Pretesting Context," *Journal of Marketing*, 53 (April), 48-65.
- McCabe, Deborah Brown and Stephen M. Nowlis (2001), "Information Integration across Online and Offline Shopping Environments and Its Effects on Consumers' Purchase Decisions," in *Proceedings of the Experiential E-commerce Conference*, Frank Biocca, ed., [CD-ROM], East Lansing, MI: Michigan State University.
- McLuhan, Marshall and Eric McLuhan (1988), *Laws of Media: The New Science*, Toronto: University of Toronto Press.
- Mirapaul, Matthew (2000), "3-D Space as New Frontier," *The New York Times on the Web*, (October 5), [http://www.nytimes.com/2000/10/05/technology/05SPAC.html].
- Nelson, Phillip (1976), "Economic Value of Advertising," in *Advertising and Society*, Yale Brozen, ed., New York: New York University Press.
- (1981), "Consumer Information and Advertising," in *Economics of Information*, Malcolm Galatin and Robert D. Leiter, eds., Boston, MA: N. Nijhoff Publishers.
- Newhagen, John E. and Sheizaf Rafaeli (1996), "Why Communication Researchers Should Study the Internet: A Dialogue," *Journal of Communication*, 46 (1), 4-13.
- Norman, Donald (1998), *The Invisible Computer: Why Good Products Can Fail, the Personal Computer Is So Complex and Information Appliances Are the Solution*, Cambridge: MIT Press.
- Peterson, Robert A., Sridhar Balasubramanian, and Bart J. Bronnenberg (1997), "Exploring the Implications of the Internet for Consumer Marketing," *Journal of the Academy of Marketing Science*, 25 (4), 329-346.
- Pine, B. Joseph and James H. Gilmore (1998), "Welcome to the Experience Economy," *Harvard Business Review*, 76 (4), 97-105.

- Rafaeli, Sheizaf (1985), "If the Computer Is a Medium, What Is the Message: Explicating Interactivity," paper presented at the International Communication Association convention, (May), Honolulu, HI.
- (1988), "Interactivity: From New Media to Communication," in *Advancing Communication Science: Merging Mass and Interpersonal*, R. Hawkins, J.M. Wieman, and S. Pingree, eds., Beverly Hills, CA: Sage Publications, 110-134.
- Reeves, Byron and Clifford Nass (1996), *The Media Equation*, Palo Alto, CA: CSLI Publications.
- Rewick, Jennifer (2001), "Choices, Choices: A Look at the Pros and Cons of Various Types of Web Advertising," *The Wall Street Journal*, (April 23), R12.
- Rice, Ronald (1984), *The New Media: Communication, Research, and Technology*, Beverly Hills, CA: Sage Publications.
- (1987), "Computer-Mediated Communication and Organizational Innovation," *Journal of Communication*, 37 (4), 65-94.
- Richardson, Alan (1984), *The Experiential Dimension of Psychology*, Queensland, Australia: University of Queensland Press.
- Rimal, Rajiv N. and June A. Flora (1997), "Interactive Technology Attributes in Health Promotion: Practical and Theoretical Issues," in *Health Promotion and Interactive Technology: Theoretical Applications and Future Directions*, Richard L. Street, William R. Gold, and Timothy R. Manning, eds., Mahwah, NJ: Lawrence Erlbaum Associates, 19-38.
- Rogers, Everett M. and Sheizaf Rafaeli (1985), "Computers and Communication," in *Information and Behavior*, Vol. 1, Brent D. Ruben, ed., New Brunswick, NJ: Transaction Books.
- Smith, Daniel C. and C. Whan Park (1992), "The Effects of Brand Extensions on Market Share and Advertising Efficiency," *Journal of Marketing Research*, 29 (August), 296-313.
- Smith, Robert E. (1993), "Integrating Information from Advertising and Trial: Processes and Effects on Consumer Response to Product Information," *Journal of Marketing Research*, 30 (May), 204-219.
- and William R. Swinyard (1982), "Information Response Models: An Integrated Approach," *Journal of Marketing*, 46 (Winter), 81-93.
- Steuer, Jonathan (1992), "Defining Virtual Reality: Dimensions Determining Telepresence," *Journal of Communication*, 42 (4), 73-93.
- Winer, Benjamin J., Donald R. Brown, and Kenneth M. Michels (1991), *Statistical Principles in Experimental Design*, 3d ed., New York: McGraw-Hill.
- Witmer, Bob G. and Michael J. Singer (1998), "Measuring Presence in Virtual Environments: A Presence Questionnaire," *Presence*, 7 (3), 225-240.
- Wright, Alice A. and John G. Lynch Jr. (1995), "Communication Effects of Advertising versus Direct Experience When Both Search and Experience Attributes Are Present," *Journal of Consumer Research*, 21 (March), 708-718.
- Wright, Peter (1980), "Message-Evoked Thoughts: Persuasion Research Using Thought Verbalization," *Journal of Consumer Research*, 7 (September), 151-175.