The Effects of Progressive Levels of 3D Authenticity Antecedents and Consequences on Consumers' Virtual Experience

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Abstract

This study investigates the effects of authentic three dimensional (3D) product visualisation antecedents on 3D authenticity, and the effects of 3D authenticity consequences on consumers' virtual experience. A hypothetical retailer Web site presents a variety of laptops for the within-subjects laboratory experiments. In a first experiment, a one-way ANOVA compares telepresence and authenticity scores. The second experiment uses two-way repeated measures ANOVA to determine the effects of the progressive levels of the antecedents on 3D authenticity. In a third experiment, two-way repeated measures ANOVA determine the effects of the progressive levels of 3D authenticity consequences on willingness to purchase. The results show that authenticity is more useful than telepresence in simulating consumers' virtual experience. The high levels of control and animated colours lead to higher authenticity for the site. In addition, the high levels of 3D utilitarian and hedonic constructs enhance willingness to purchase from the online retailer.

Key words: 3D Control and animation, telepresence, authenticity, 3D hedonic and utilitarian values, virtual experience.

Introduction

Scholars (e.g., Li *et al.,* 2001, 2002, 2003) classify experiences, based on the interaction between a product or an environment and an individual, into three types. First, the direct experience permits consumers to interact (e.g., physical and actual) directly with a product. Second, the indirect experience often allows consumers to interact with second-hand source such as static visual pictures. Third, the virtual experience allows consumers to interact with three dimensional (3D) virtual models. According to Steuer (1992, p.78), virtual reality (VR) is "*a real or simulated environment in which a perceiver experiences telepresence*". In contrast, virtual experience derives from VR and can be defined as "*psychological and emotional*

states that consumers undergo while interacting with a 3D environment" (Li *et al.*, 2001, p. 14). A 3D presentation enables consumers to interact with products, enriches their learning processes, and creates a sense of being in a simulated real world. Furthermore, direct and virtual experiences combine within VR, such that the latter enhances and enriches the overall experience because consumers use almost all of their senses when interacting with a 3D product visualisation (Li *et al.*, 2001, 2002, 2003). To that end, scholars such as Klein (2003) and Coyle and Thorson (2001) investigate the effects of virtual experience based on the telepresence construct. Whereas the notion of telepresence relates to a state of illusion or transportation (Lombard and Ditton, 1997), we notice that telepresence is not the proper terminology that marketers should use since it represents a process of being mentally transported into other areas or being immersed into an illusion environment. Instead, using the authenticity construct to simulate a real authentic product that a consumer can experience when engaging with an online retailer might be better. We therefore developed a new scale to measure the authenticity 3D representation and then compared it with the notion of telepresence. Moreover, to understand the influences of 3D authenticity antecedents, we manipulated the control and animated colours constructs and measured their impact on the perceived 3D authenticity construct (the dependent construct). Finally, we manipulated the 3D utilitarian and hedonic values and measured their impact on consumers' willingness to purchase from the online retailer sites (the dependent construct).

3D Authenticity

A 3D virtual experience should be an authentic representation of the direct (offline) experience. We therefore propose a new notion that relates to the simulation of online products and virtual experience, namely, the authenticity of the product visualisation. Telepresence and presence are not particularly well suited to the online retail context, because they reflect illusion and transportation to other places. In contrast, the concept of 3D authenticity of the product visualisation implies that ability to simulate the product experience in bricks-and-clicks contexts. We propose the following definition of perceived authenticity in a computer-mediated environment: authenticity is a *psychological state in which virtual objects presented in 3D in a computer-mediated*

environment are perceived as actual objects in a sensory way. To determine the influences of telepresence and authenticity on consumers' virtual experience in an online retail context, we hypothesise that:

> *H_1: On the online retailer's Web site, 3D authenticity has a greater effect on users than does 3D telepresence.*

3D Authenticity Antecedents (Control and Animated Colours)

To identify the main antecedents of 3D authenticity, we consider two important aspects of the virtual experiences, namely, the interactivity and vividness constructs. In conceptualising consumer experiences in cyberspace, considerable research investigates and empirically tests the interactivity and vividness constructs. For example, Shihn (1998) posits that the vividness of the information (operationalised as multi-sensory information, i.e. breadth and depth) that a consumer receives in cyberspace and the interactivity of the cyberspace technology (operationalised as control, speed and feedback) provide the main antecedents of telepresence. In turn, Coyle and Thorson (2001) investigate the effects of progressive levels of interactivity and vividness on Web marketing sites by manipulating levels of interactivity (number of choices and presence of a clickable image) and vividness (audio and animation). They find that high levels of interactivity and vividness increase participants' feelings of "being there" (i.e., telepresence). Furthermore, Klein (2003) posits interactivity (user control) and media richness (depth and breadth of sense channels) emerge as the main antecedents of telepresence, with significant positive influences on its creation.

There is little agreement on the definition or operationalisation of the Web interactivity construct (e.g., Ariely, 2000; Klein, 2003; Liu and Shrum, 2002; McMillan and Hwang, 2002), which Heeter (2000, p. 75) describes as "*an overused and underdefined concept*". For instance, previous research either defines interactivity as a multi-dimensional construct (to measure a Web site interactivity, e.g., Liu and Shrum, 2002; McMillan and Hwang, 2002), or proposes that interactivity concept should be measured with different antecedents (e.g., Johnson *et al.*, 2006). However, we do belief that within the context of 3D product visualisation, the interactivity construct should be narrowed down to match the context of 3D interactivity instead of

matching the context of a Web site. Moreover, Ariely (2000) advices researchers, within the experimental context, to narrow down the interactivity construct to the user control construct. Following Ariely's (2000) suggestion, we focus on the narrowest definition of interactivity to maximize the perceived similarities between the direct experience and virtual experience.

To conceptualise the antecedents of the 3D authenticity construct, we use the control construct to represent interactivity in an online retail context. Ariely's (2000) definition of control refers to users' abilities to customise and choose website contents to achieve their goals. We focus more on consumers' ability to control (the content and form of the 3D product) and easily interact with the 3D virtual model. Therefore, we define control as *users' abilities to customise and choose the contents of the virtual model (i.e., 3D product visualisation), rotate, and zoom in or out on the product in the virtual model and the ability of the virtual model (3D) to respond to participants' orders properly.* In turn, we hypothesise:

H_2: A high level of control of 3D product visualization increases authenticity.

Furthermore, whereas prior research defines vividness according to sensory breadth and depth, this study argues that the notion of vividness evolves and establishes in an immersive virtual reality environment facilitated by certain technology including head-mounted sensory units that may allow them to touch, smell, see, and/or interact with virtual objects. In turn, the non-immersive VR interfaces within the online retailers, currently generate and transmit only two main stimuli: visual and auditory (Kim and Forsythe, 2008; Suh and Lee, 2005). Some 3D products need visual and auditory channels for facilitating consumer products' inspection; others manifestly need only visual aspects. Pimentel and Teixeira (1994, p. 146) assert that visual stimuli are the main sensory cues in producing virtual experiences. We therefore hypothesise:

H_3: A high level of 3D animated colours increases perceived authenticity.

3D Authenticity Consequences

Scholars (e.g., Fiore and Jin, 2003; Fiore *et al*., 2005a; Kim *et al*., 2007; Klein, 2003; Li *et al*., 2001; 2002, 2003; Suh and Chang 2006) explain the importance of using 3D in enhancing consumers' understanding of product attributes, features and characteristics. 3D visualisation increases consumers' involvement and encourages them to seek more information about the products (Fiore *et al*., 2005a). Suh and Lee (2005) posit a positive relationship between higher levels of 3D and seeking more information about the products' characteristics and features. Suh and Chang (2006) assert a positive relationship between 3D and product knowledge. Using 3D product visualisation helps consumers to imagine how a product may look and provides more details about the products' characteristics (Fortin and Dholakia, 2003; Jiang and Benbasat, 2007; Klein, 2003; Shine, 1998). Kim and Forsythe (2008) posit that a 3D virtual model with high levels of utilitarian values enhances users' attitudes more than a 3D rotation view with low levels of utilitarian values. We therefore hypothesise:

> *H_4: A high level of 3D utilitarian value increases users' willingness to purchase from retail website.*

Scholars (Fiore *et al*., 2005b; Kim and Forsythe, 2007; Lee *et al*., 2006; Schlosser, 2003) report the importance of 3D product visualisation in enhancing the experiential aspects of a virtual shopping. The above researchers find the ability of 3D product visualisation to produce hedonic values for shoppers greater than its ability to produce utilitarian values. Fiore *et al*. (2005b) posit that the hedonic value which image interactivity technology produces is highly correlated with consumers' emotional pleasure and arousal variables. Fiore *et al*. (2005a) assert the importance of virtual models in enhancing hedonic value (enjoyment). Fiore *et al*. (2005a) explain the importance of a high level of image interactivity technology (e.g., using 3D virtual models) in comparison to a low level of image interactivity technology (e.g., enlarging the static picture of clothes) in producing more hedonic value. Kim and Forsythe (2008) posit that a 3D virtual model with high levels of hedonic values enhances users' attitudes more than a 3D rotation view with low levels of hedonic values. Many scholars in the communication field (e.g., Heeter, 1992; Lombard and Ditton, 1997; Song *et al*., 2007) suggest the importance of enjoyment as a consequence of using 3D. We therefore hypothesise:

H_5: A high level of 3D hedonic value increases users' willingness to purchase from retail website.

Study 1

Stimuli and Design

We designed a retailer website with one stimulus for this experiment. The stimulus allowed participants to view the focal product, laptops, from different angles; they also can rotate the products and zoom in or out on them. The website that we created for this study was not previously known to users, nor did users have any knowledge of the fictitious brands on the site. Thus, we eliminated any impact of previous experiences or attitudes (Fiore *et al*., 2005a). The site offers a wide variety of laptops, similar to those that many college-aged women and men currently buy and use.

Participants

Student samples are well suited to online shopping research (e.g., Balabanis and Reynolds, 2001; Fiore *et al*., 2005; Kim *et al*., 2007; Li *et al*., 2002, 2003), because students tend to be computer literate and have few problems using new technology. Students also are likely consumers of electrical goods (Jahng *et al*., 2000). We used a sample of 312 students to perform this experiment. The sample was gender balanced, consisting of 48% women and 52% men, and 90% of the sample ranged from 18 to 30 years of age. Approximately 90% reported having had prior online shopping experience. To eliminate individual differences, we employed a within-subjects design for all the experimental conditions. Each participant therefore represents his or her own control (Greene and d'Oliveira, 1999) and the design helps to reduce error variance associated with individual differences. The design also helps to improve the practicality of collecting data because we take several observations from the same subject (Greenwald, 1976; Keppel and Wickens, 2004).

Instrument

Participants were informed that this study pertained to consumers' evaluations of an electrical retailer's website. The questionnaire contained five-point Likert-type scales, anchored by "strongly disagree" and "strongly agree".

To measure the telepresence construct, we used a modified version of Kim and Biocca's (1997) scale with four items: "I forgot about my immediate surrounding when I was navigating through 3D sites", "While I was on the 3D sites, I sometimes forgot that I was in the middle of an experiment", "While I was on the 3D sites, my body was in the room, but my mind was inside the world created by Brunel site", and "While I was on this site, the world generated by Brunel (3D) was more real or present for me compared to the real world". We could not find an existing scale to measure authenticity so we developed a new five-item scale. We submitted these items to evaluations by academics (lecturers in online retailing and Ph.D. students) who considered the items relevant for measuring the authenticity construct. We followed Churchill's (1979) procedures for developing a marketing construct scale and adopted Christodoulides and colleagues (2006) procedures for developing a scale for the online context. Each item began with "After surfing the 3D sites", and then obtained responses to the following: "3D creates a product experience similar to the one I would have when shopping in a store", "3D let me feel like if I am holding a real laptop and rotating it (i.e. virtual affordance)", "3D let me feel like I am dealing with a salesman who is responding to my orders", "3D let me see the laptop as if it was a real one", and "Being able to zoom in/out and rotate the laptop let me visualise how the laptop might look in an offline retailer".

Findings

We ran a one-way repeated measure ANOVA to compare the scores for the telepresence and authenticity constructs. Participants agreed that the site is best represented by authenticity (M = 18.44) rather than by telepresence, that is, by a sense of being transported into another place (M = 12.01). The Wilks' Lambda is .2764, F (1,311) = 814.078, ($p < .001$), and the multivariate eta squared is .724, which reflects a very large effect size (Cohen, 1988). The results of the post hoc analysis also reveal that authenticity is more significant than telepresence ($p < .001$), in support of H_1.

Discussion

This research highlights the importance of the authenticity construct for 3D product visualisation. Our authenticity scale is suitable and convenient for academics and practitioners interested in using 3D to simulate real products in the online retail

context. Finally, we clarify the main differences between authenticity and telepresence; telepresence involves illusion or a sense of being transported to another place, whereas authenticity refers to the ability to imagine a virtual object as real.

Study 2

Stimuli and Participants

We designed a hypothetical retailer website with one 3D stimulus that allows participants to view the focal product, laptops, from different angles, participants can rotate the laptop, zoom it in or out and they also can change the laptop colours. Similarly to Study 1, the website we created for this study was not previously known to users, nor did users have any knowledge of the fictitious brands on the site. The 3D and colours should help consumers to imagine the product in appropriate and relevant ways and thus enhance their virtual experiences (Li *et al*., 2001).

Design and Participants

We designed four 3D flashes (sites) for the 3D product visualisations. Twenty-four participants surfed four conditions in a 2 (control: high *vs.* low) × 2 (animated colours: high *vs.* low) within-subjects design.

The first flash contained a laptop that participants could zoom in or out, rotate, change the colour and obtain information about its features and attributes. The second flash featured a laptop that participants can zoom in or out, rotate and change the colour, but only limited information about its external appearance was available (i.e., participants could only close and open the laptop). In the third flash, they could still zoom and rotate, but not change the laptop colour. Finally, in the fourth flash, participants could do nothing with the laptop, which simply rotated on its own.

Dependent Variable

To measure the effects of the progressive levels of control and animated colours on 3D authenticity, we used 3D authenticity as the dependent variable and measured it via our scale.

Pre-test

We ran a series of pre-tests to develop the study materials. In the first pre-test (n = 30), respondents were asked to rate several 3D flashes based on their controllability and colourability dimensions (5-point scales). Manipulation checks were used to decide if the participants have noticed the differences between the various conditions of each construct. For controllability, participants explored a 3D flash that they could control by zooming in and out and rotating; and they also explored a 3D flash that zoomed in and out and rotated on its own, which they could not control. After each level they were shown the following question "To what extent do you consider that the 3D flash is controllable?" For colourfulness, participants explored a 3D site on which they could see different colours of the same laptop and they also explored a 3D site on which they could see the laptop only in a single colour. After each level they were shown the following question "to what extent do you consider that the 3D site is colourful?". The results confirmed that participants noticed the different levels of each construct. They perceived that the 3D Web site that they could zoom in or out and rotate as being significantly more controllable than the 3D Web site where they had no control of the zoom and rotation ($M_{\text{high control}} = 15.9$, $M_{\text{low control}} = 9.5$; $F_{1, 29} = 116.4$, $p < .001$). Moreover, they perceived the Web site with more colours as significantly more colourful than the Web site with one colour ($M_{\text{high colours}} = 11$, $M_{\text{low colours}} = 6.4$; $F_{1, 29} = 45.43$, $p < .001$).

Findings

We ran a two-way repeated measures ANOVA to compare the scores for the two levels of control and two levels of colour, with 3D authenticity as the dependent variable. The main effect of the control levels is significant. We find a Wilks' Lambda value of: .275, F (1, 23) = 60.778 ($p <.001$), and an eta squared value of .725 (a large effect size according to Cohen, 1988). The means (M) and standard-errors (SE) of the control levels are as follows: $M_{\text{high}} = 17$, $SE_{\text{high}} = .551$, $M_{\text{low}} = 11.7$ and $SE_{\text{low}} = .68$. The main effect of colour also is significant, with a Wilks' Lambda of .40, F (1, 23) =

34.6 (p <.001), and an eta squared value of .60. The means and standard errors are M_{high} = 16.42, SE_{high} = .54, M_{low} = 12.3, and SE_{low} = .704). The results also indicate an insignificant interaction effect (control × colour; F (1, 23) = 2.272, p >.05, eta^2 = .090). Participants exposed to the condition with high control and high colour agreed that the site attained high authenticity (M = 16.6, SD = 3.55), but the site with low levels of control and colour achieved a low level of authenticity (M = 10.1, SD = 3.47). The high level of control and low level of colour (M = 14.4167, SD = 4.49), and low level of control and high level of colour (M =13.25, SD = 3.54) also prompted ratings of a low level of authenticity. Overall, these results indicate that 3D authenticity increases when control and animated colour levels increase, in support to H_2 and H_3. The stimuli are provided in appendix A.

Discussion

The antecedents of authenticity (i.e., control and colour) seem similar to those of telepresence (e.g., Coyle and Thorson, 2001; Klein, 2003). However, when investigating the antecedents of authenticity, researchers should focus on certain real elements of interactivity and vividness rather than on the abstract constructs. Whereas Heeter (2000, p. 75) describes interactivity as "*an overused and under defined concept*", we posit that control represents a useful construct for 3D models in the online retail context, in support of previous research (Ariely, 2000; Coyle and Thorson, 2001). We narrow our conceptualisation of control to consumers' ability to control the content and form of the 3D flashes. Furthermore, whereas prior research defines vividness according to sensory breadth and depth, we argue that research might benefit from a tighter focus on specific aspects of vividness through illustration, such as we have applied here.

Study 3

Stimulus

The third experiment serves two objectives. First, it measures effects of various levels of hedonic and utilitarian value of 3D flashes on willingness to purchase. Second, it gives an indication of whether the high levels of hedonic and utilitarian value will support hypotheses H_4 and H_5. We designed a retailer's Web site with one stimulus

for this study. The stimulus was illustrated on 3D product visualisation sites that allowed participants to view the focal product, laptops.

Design and Participants

We designed four 3D flashes (sites) for the 3D product visualisations. Twenty-four participants surfed four conditions in a 2 (Hedonic: high *vs.* low) × 2 (Utilitarian: high *vs.* low) within-subjects design.

In the first flash, participants can see a laptop's attributes, functions and characteristics; they can also zoom in or out, rotate it and see it with different colours. The second flash featured a laptop that participants can see attributes, functions and characteristics of, rotate it and see it with one colour, but cannot zoom in or out. In the third flash, participants can see the minimum features of a laptop (e.g., external appearance); they can zoom in or out, rotate it and see it with different colours. Finally, participants can see the minimum features of a laptop (e.g., external appearance) and they cannot zoom in or out, but they can rotate it and see it with one colour. These 3D sites and particularly the flash that contained information distinguishes the current research from previous studies that have reported the significant role of 3D in enhancing fun and enjoyment values more than utilitarian values (e.g., Fiore *et al.*, 2005b; Kim and Forsythe, 2007; Lee *et al.*, 2006; Schlosser, 2003). Moreover, unlike previous studies that focused on perceived product knowledge, our design enhances consumers' actual product knowledge.

Dependent variable

We used the willingness to purchase construct as the dependent variable, indicated by a modified version of Fiore's and colleagues' (2005a) scale. Specifically, we asked: "Assuming the laptops on the websites suit your taste or needs, how willing would you be to purchase a laptop from this online store?", "After seeing the web site, how likely is it that you would buy a laptop from this online store?", and "I would be willing to purchase a laptop through this online store".

Pre-test

A pre-test (n = 30) was run to test several 3D flashes based on the hedonic and utilitarian dimensions (5-point scales). Manipulation checks were used to determine whether the participants noticed the differences between the various conditions of each construct. For utilitarian value, participants explored a 3D flash in which they could get information about the laptop (e.g., speed, capacity, hard disc, and monitor); and they also explored a 3D flash that gave the minimum information (i.e., only the external appearance). After each level they were shown the following question "to what extent do you consider that the 3D site is utilitarian?"

For hedonic value, participants explored a 3D site with animated coloured pictorial images intended to enhance their mental pleasure; and they also explored a 3D site in monochrome without the animated images. After each level they were shown the following question "to what extent do you consider that the 3D site is hedonic?".

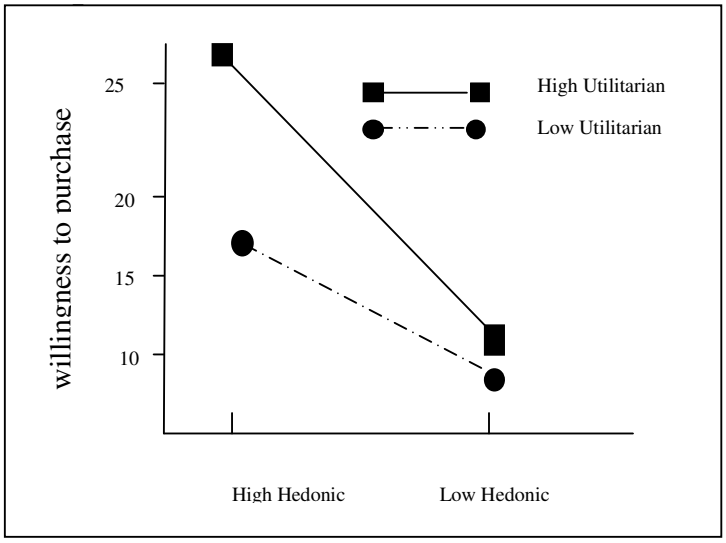
The results show that participants notice the different levels of each construct. They perceived the 3D Web site which gave more information about the laptops as significantly more utilitarian than the 3D Web site that gave less information ($M_{\text{high utilitarian}} = 16.7$, $M_{\text{low utilitarian}} = 8.96$; $F_{1, 29} = 96.02$, $p < .001$). Moreover, they perceived the 3D Web site with animated coloured pictorial images as significantly more hedonic than the 3D Web site in monochrome without the animated images ($M_{\text{high hedonic}} = 14.93$, $M_{\text{low hedonic}} = 8.73$; $F_{1, 29} = 63.243$, $p < .001$).

Findings

We ran another two-way repeated measures ANOVA to compare the scores for the two levels of hedonic and two levels of utilitarian, with willingness to purchase as the dependent variable. The main effect of the hedonic value levels is significant. We find a Wilks' Lambda value of .106, F (1, 23) = 193.039 ($p < .001$), and an eta squared value of .894 (which is a large effect size according to Cohen, 1988). The means (M) and standard-errors (SE) of the hedonic value levels are as follows: $M_{\text{high}} = 20.25$, $SE_{\text{high}} = .62$, $M_{\text{low}} = 9.92$ and $SE_{\text{low}} = .67$. The main effect of utilitarian value also is significant, with a Wilks' Lambda of: .203, F (1, 23) = 90.030 (p <.001), and an eta squared value of .797. The means and standard errors are $M_{\text{high}} = 18.02$, $SE_{\text{high}} = .588$, $M_{\text{low}} = 12.15$, and $SE_{\text{low}} = .63$). The results also indicate a significant interaction effect (hedonic × utilitarian; F (1, 23) = 36.074, $p < .001$ $eta^2 = .611$, see Figure 1). Participants exposed to the condition with high hedonic and high utilitarian

value agreed that the site attained high willingness to purchase (M = 25.21, SD = 2.93), but the site with low levels of hedonic and utilitarian value achieved a low level of willingness to purchase (M = 9.0, SD = 3.47). The high level of hedonic and low level of utilitarian (M = 14.4167, SD = 3.7), and low level of hedonic and high level of utilitarian (M =10.8, SD = 4.3) also prompted ratings of a low level of willingness to purchase. Overall, these results indicate that willingness to purchase increases when hedonic and utilitarian levels increase. The participants noticed the manipulated conditions, and the results support H_4 and H_5. The stimuli are provided in appendix B.

FIGURE 1. The Interaction Effects



Discussion

Results of this experiment (authenticity consequences) support previous research that reports the ability of 3D to provide customers with information and fun (e.g., Fiore *et al*., 2005a; 2005b). Moreover, the way that we designed the 3D flashes and the authenticity of the flashes in simulating a real laptop give this research more validity in providing consumers with more information. In contrast, as a result of focusing on the telepresence construct, previous research has focused on the importance of the experiential value that consumers can gain from navigating 3D products rather than the instrumental value (e.g., Fiore *et al.,* 2005b; Kim and Forsythe, 2007; Lee *et al.,* 2006; Schlosser, 2003). The authenticity construct reveals the importance of information as well as fun in affecting the willingness to purchase construct. The

interaction between hedonic and utilitarian values reveals a significant interaction F (1, 23) = 36.074, p <.001. Participants primed with the high utilitarian condition reported a higher willingness to purchase when exposed to the high hedonic *vs.* the low hedonic conditions ($M_{\text{High hedonic}} = 25.21$, $M_{\text{low hedonic}} = 10.8$, $F_{1, 23} = 36.05$, $p >$ .001). However, participants primed with the low utilitarian condition reported a lower willingness to purchase when exposed to the high hedonic *vs.* the low hedonic conditions ($M_{\text{High hedonic}} = 15.3$, $M_{\text{low hedonic}} = 9$, $F_{1, 23} = 36.05$, $p > .001$).

General Discussion

Our results support the previous theoretical work of Lee (2004) which revised previous definitions of telepresence and presence and argued that none of the previous definitions could be used to tap the concept of using virtual environment to reflect the consumer experience. Lee proposed using "Para-authentic objects" to simulate virtual versions of real life objects. Our results provide empirical support for that proposition. Furthermore, our 3D authenticity construct reflects Klein's (2003) notion of realism in telepresence, which Klein advised marketers to apply in order to positively influence product beliefs. Our results reveal that using the notion of 3D authenticity is better than using the notion of 3D telepresence for marketers using 3D within the online retailer context

Our results provide strong evidence of the influence of the high levels of control and colour on 3D authenticity. Control and colours are the main tools that enhance consumers' virtual experience. 3D authenticity enables consumers to experience online products without directly inspecting them. Our results supported past findings that using advanced technology such as 3D provides consumers with enriched product information (Fiore and Jin, 2003; Fiore *et al.*, 2005b; Li *et al.,* 2001) and hedonic value of the shopping experience (Li *et al*., 2003).

Theoretical Implications

This research adds to the literature the notion of 3D authenticity and presents a valid scale to measure it. As such, it is the first study to empirically explore the antecedents of 3D authenticity. Previous scholarly literature that used and applied the notion of telepresence to reflect consumers' experience in simulating the bricks-and-clicks retailers' product makes consumers feel that they are dealing with products that do not

exist. Moreover, In line with other online retail researchers who investigated the influence of using 3D, we find that marketers should focus on specific aspects of interactivity and vividness when designing their 3D sites. For example, the empirical support for control as representative of interactivity solved a long debate among previous researchers. When it comes to virtual models, we prefer focusing on the narrowest, most relevant aspects of interactivity (i.e., control). Furthermore, the vividness construct should be narrowed down to visual stimulus. Researchers might benefit from a tighter focus on specific aspects of vividness through illustration, as we have in this research.

Given that the importance of utilitarian value in the 3D context, online marketing researchers should focus more on designing 3D sites to reflect the essential information that consumers need and seek. Previous researchers focused on 3D's ability to reflect general information to the audience such as the overall appearance of the products but did not provide extra, specific detailed information at the same time (e.g., Fiore *et al*., 2005a).

Managerial Implications

E-retailers should pay more attention to the 3D authenticity antecedents, i.e., control and colour when designing their 3D virtual models. Including real colours and flashes that consumers can control easily will lead to more authentic online experiences. The positive effect of utilitarian and hedonic values is only achieved when both are used together and not by either one in isolation. Therefore, retail website designers can contribute to enhancing consumers' virtual experience by focusing on both the utilitarian and hedonic values that consumers can gain when navigating a 3D virtual model. Any 3D flash should include the essential information that consumers seek rather than just a pretty picture. For example, consumers should be able to click on any part of the 3D flash to get access to information about it.

Web site developers should take advantage of the technological advancement and keep developing and updating the online retailers' 3D flashes. Pechtl (2003) asserts a positive relationship between perceived innovation attributes and online adoption behaviour. Managers and Web sites designers should work together to ensure that the 3D product visualisation provides customers with the complete and accurate

information they need. In addition, marketers should decide what information (or knowledge) to focus on before developing any 3D flash. It should be accepted that developing 3D flashes is not a money free issue. Nevertheless, many companies have already claimed to improve their sales as a result of designing and using 3D flashes. For example, J.C. Penny, eBags and Wal-Mart claimed that their online sales have increased 10% to 50% after using rich media such as 3D flashes (Demery, 2003). Moreover, Demery (2006) posits that the numbers of companies who are investing in the 3D virtual models is increasing steadily because these companies are seeing the potential of selling more products. Nantel (2004) asserts that consumers who are using 3D virtual models (within the online clothing sector) are 26% more likely to purchase from the site that has 3D virtual model than the sites that have not. Moreover, Fiore (2008) posits that media richness is an important way to differentiate retailers.

Wagner (2000) asserts that online retailers with 3D product visualisations may reap benefits that extend beyond sales. For example, 3D increases site stickiness: users will spend more time on the online retailer, which leads to more opportunities to learn more about the products, interact with them, build trust and confidence.

Finally, based on the Social Issues Research Centre (SIRC, as cited in Herrod, 2007) study it is expected that "by 2020 virtual commerce (v-commerce) will replace e-commerce", the development of 3D virtual models (such as 3D virtual shopping malls) will be leading the whole industry by 2020. All the above advantages will help users to get more tangible online shopping experiences.

Limitations and Further Research

Although the generalisability of the results is limited by the student sample, and cannot be generalised to all online consumer groups, we argue that students represent the shoppers of tomorrow (Balabanis and Reynolds, 2001) and the research thus has prescient value. Second, since this study has focused only on 3D online laptops, which we considered to be products that are associated with more search or experience, it is unclear to what extent the results can be generalised and applied to other online products.

Future research may investigate non-student samples. Moreover, other researchers might apply this study in a non-electrical context (e.g., clothing). Further research may add and test other stimuli to investigate how auditory and visual vividness may influence 3D authenticity, for example by simulating real sounds.

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Appendix A: Manipulation Control and Animated Colours constructs

Appendix B: Manipulating Hedonic and Utilitarian Constructs.