

The Impact of Virtual Manipulatives and Informative Control on the Attitude of Consumers Toward 3D Virtual Products

Wu-Yuin Hwang^{1*}, Jung-Lung Hsu²

¹Graduate School of Network Learning Technology, NCU, Taiwan

²Department of Information Management, Kainan University, Taiwan

Email Address of Contact Author: wyhwang@cc.ncu.edu.tw

Abstract

Participants who have not been exposed to 3D representations of products online may simply be more curious than if the product was presented in 2D format. Besides, while combining Uncertainty Reduction Theory and Cognitive Load Theory, this study also considered that informative control is a critical factor along with visual and functional control in 3D interactive online settings. In this study two laboratory experiments were conducted with 33 participants recruited. The first experiment was to compare the effects of level of interactivity, whereas the last was to compare the effects of affordance of informative control. Our findings indicated that except their perceptions of patronage intention, participants considered no difference in attitude toward the products been demonstrated and shopping enjoyment in a fully 3D-to-3D comparison. However, while providing informative control, participants had higher perceptions of attitude toward the products, shopping enjoyment and patronage intention than their counterparts who had not such support.

Key word: *Product presentation, Web3D, Shopping enjoyment, Patronage intention.*

1. Introduction

Traditionally, customers acquire needed information to make purchase decisions from two ways, namely direct and indirect experience. The former, direct experience, stems from an unmediated interaction between the consumer and the product, such as brochures or advertising. Indirect experience, the latter, refers to symbolic representations of the world, such as trial or inspection. Despite the fact that the predictive power of both experiences on consumer purchasing is widely accepted (Hoch & Deighton, 1989; Kempf & Smith, 1998), many researchers doubt if both experiences have equivalent effects on electronic shopping environments (Bhatnagar, Misra & Rao, 2000; Rose, Khoo & Straub, 1999; Wolfinbarger & Gilly, 2001). This study considers there are two urgent issues should be addressed before applying the findings. First, prior studies relevant to the virtual experience, to our knowledge, focus on the comparison of the influences between 3D and 2D visual controls. However, participants who have not been exposed to 3D representations of products online may simply be more curious than if the product was presented in 2D format. Thus, it is possible that the previous findings could be conceptualized as a byproduct of interacting in a 3D environment. To get rid of this suspicion, a study conducting

3D-to-3D comparisons with/without high interactivity is suggested.

Second, the amount and variety of product information are found to be the key factors that influence customers' satisfactions with their shopping experience (Palmer 2002). Nevertheless, in 3D space, it is not easy for users to explain 3D products well because shopping websites often present 3D products without detailed illustrations. First, this study was intended to develop a Virtual Products Presentation with Whiteboard system (hereafter VPPW), which allows users immediately manipulate virtual products and read the information relevant to the products at the same time. Second, this study was attempted to investigate its influences on a user's perception and attitude in a fully 3D-to-3D comparison. Our presumption is that by using VPPW system, users would have higher shopping enjoyment and more positive attitude toward the products. In this paper shopping enjoyment and attitude toward the products are two leading factors of determining a user's patronage intention. Accordingly, this study can contribute to the practical field by suggesting critical components for the practitioners planning effective 3D demonstration systems on the website.

2. Literature review

2.1 Interactivity as a process of facilitating product understanding

Business, in the past, relied on the ways of direct and indirect experience to impress customers with superior or attractive product features. Although the effects of both of the ways have been documented to significantly affect the consumer's attitude toward the product (Hoch & Deighton, 1989; Kempf & Smith, 1998), many researchers argue their potential to explain an online customer's attitude toward the goods in a virtual store. For instance, Peterson et al. (1997) have argued that "Internet-based marketing would seem to be a poor substitute for traditional transaction channels, where the goods are available for inspection" (p. 335). Seeing the fact, Li et al (2001) conceived virtual experience as an online shopping experience that provides the contexts in which consumers can interact with and try products via technology-supported tools.

Some studies have focused on two types of virtual experience implementation: functional control and visual control. Visual control allows consumers to rotate, zoom in and out, and to move product images with their computers. If some external software, such as flash, is provided, customers can even view the products from different angles. On the contrary, functional control allows customers to see how the product will virtually react in response to the functional mechanism been excited. Virtual reality, one of the common techniques to embody virtual experience in 3D settings, can be employed to support both visual and functional control, and then afford customers the way to highly interact with virtual products. In this regard, both visual and functional controls can be seen as attributes of interactivity and the effects of which have indeed been acknowledged.

Eckman (2006) stated that consumers usually consider virtual products intricate and thereby requires more in-depth examination before purchase. As a result, allowing

customers to interact with a remote product may offer detailed indirect however vivid experiences. Another research studying the effects of level of interactive technology found a significant positive effect of interactive technology on user perceptions of online shopping enjoyment (Eckman, 2006). In fact, Li, Daugherty and Biocca (2001) found that virtual experience created by 3D environments was much better than indirect experience created by traditional media in facilitating learning. Therefore, it is vital for online stores to consider using 3D technology with high interaction to present virtual products online.

2.2 Informative control as a process of facilitating product understanding

Apart from visual control and functional control in 3D settings, which may impact consumer perceptions, *informative control* might affect online shopping. Informative control, in this study, indicates that consumers have their own control over the information been demonstrated. For example, users may read a message associated with the product on the screen, or, on the contrary, they may hide the message anytime when they choose not to see it. This study considers this freedom of informative control as another critical factor mainly because of Uncertainty Reduction Theory URT and Cognitive Load Theory CLT.

According to Uncertainty Reduction Theory (URT; Berger & Calabrese, 1975), individuals in a highly uncertain situation rely heavily on information exchange and regard it as an input to make a better decision. The tenet of URT is especially remarkable in online shopping settings, where customers are physically distant from the real products and this thereby leads to intensive information asymmetry. Given the lack of direct experience, consumers cannot directly touch and observe the product to justify if it really satisfies their different preferences and demands. On the contrary, customers in online settings receive less information as an input to eliminate unfamiliarity with the product due to the inherent nature of the internet. Information associated with the product, in this point of view, not only helps customers to reduce uncertainty of the product, but has essential influences on their purchase decision. Furthermore, in line with Information Processing Theory (IRT; Miller, 1956), an individual receives information through his sensory systems and then transforms the message by a variety of mental operations. These operations help the individual constructs needed cognitive processes to understand the object which the input information describes. As a result, both URT and IRT would predict the importance of affording information associated with the products demonstrated in online settings. More specifically, in line with Mayer's contention (2003), a meaningful learning arises as learners work on processing information presented to them, and as they actively construct mental presentations. Given that understanding a product is also a process of learning, this study thereby posits that more information is required for a customer to form the attitude toward the product and to enjoy the shopping experience.

However, after a careful review of the literature, the opposite opinion was found based on the Cognitive Load Theory (CLT). Results from the studies based on this theory consider that the effect of information is not simply a linear function of amount of information. The tenet of CLT is that although capacity of long-term memory is virtually unlimited, one's processing capacity of working memory is actually limited (Chi, Glaser & Rees, 1982; Miller, 1956). Thus, it is obvious that the processing capacity is a mental resource that varies with individuals. If the amount of information does not exceed one's limits, cognitive load probably will not happen in terms of CLT. This study thereby considers that while a consumer is allowed to control information associated with the product, he is more likely to better understand the product because only himself knows how much information is pertinent and when presence of information is timely.

3 Research Design

3.1 Experiment Design

In this study two laboratory experiments were conducted. Thirty-three undergraduate students were recruited and randomly divided into two groups in order to join different experiments. Based on previous studies, it is considered that interacting with products in 3D settings is a crucial factor in online shopping environment. However, many argue that the effect of the interactivity in 3D settings might be byproducts of interacting in a 3D environment. Thus, an objective of this study is to investigate whether a user's attitude toward virtual products would vary with different levels of interactivity. Therefore, the first experiment of this study defined two levels of interactivity. In *low interactivity* setting participants could view a virtual product from different angles, which means they could change perspectives to inspect the product. In this condition, participants had the visual control to see the product in a 3D way. In *high interactivity*, not only could participants rotate a virtual product in any angle, but they were equipped with the power of functional control to interact with the 3D virtual product and then to see what reaction would appear.

The second experiment investigated the effect of informative control in online shopping environment. In this regard, a comparison of high interactivity without informative control and high interactivity with informative control was conducted. To provide participants with extra informative control, this study created a VPPW system to implement a virtual semi-transparent whiteboards to help users understand products by posting questions or making annotations on it. And whiteboards can be seamlessly integrated on the back of 3D products and be put in anywhere in the 3D environment. Each experiment lasted about 40 minutes. After each experimental scenario was done, a questionnaire was given to each participant.

3.2 3D Product presentation environment

This study incorporated a semi-transparent multimedia whiteboards into a 3D product presentation system. The 3D products in VPPW system were implemented

and integrated multimedia whiteboard into the system. Users can explore products easily without other assistant tools on Internet in VPPW system. With virtual whiteboard, users could represent different signs such as graphics, texts, and annotations to express their ideas and share with others by transferring whiteboard contents. Whiteboard can be put in right position and seamlessly integrated with 3D products. It could be unfolded to read information (see Figure 1) and folded to manipulate the products at behind so that users can easily compare the characteristics and functions of products, thereby bringing more convenience and usefulness than traditional advertisements. Different from popup spec sheets in web pages, virtual whiteboard is designed for 3D theme which is a 2D object and can be created or deleted with flexibility anywhere in 3D space that suit user needs. A high level of interactivity on the 3D virtual product is available for consumers, thus they can explore the essential functions of products and obtain sufficient product information. It also enhances their perception experiences and shopping enjoyment.

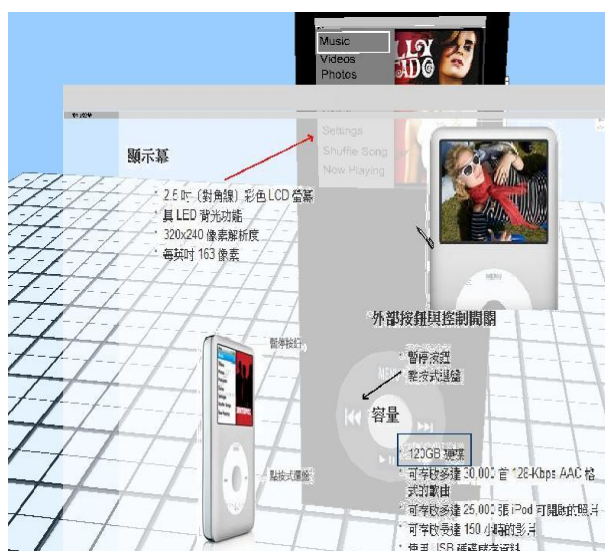


Figure 1. Virtual whiteboard is unfolded to display the product information.

4 Results and Discussion

4.1 Results of only interactivity embedded groups

There were very few differences with respect to 3D functional support in the dependent sample t-test in Table 1. Participants' perceptions of attitude toward the products, shopping enjoyment and patronage intention were higher in high interactivity group than that in low interactivity group. Based on the value of mean in these groups, participants seem incline to have more positive perceptions on the virtual product as they were equipped with the ability to manipulate it. However, it also appears in Table 1 that the participant's patronage intentions were significantly different in these two groups. Accordingly, participants in high interactivity had stronger intention to purchase the virtual product, where they could manipulate functions of the product and then evaluate its reactions immediately.

Table 1. Comparison results of the interactivity groups

	Variables	Mean	S.D	t value	Sig.
Attitude	Low interactivity	3.2191	.47578	-1.414	.181
	High interactivity	3.4143	.30346		
Enjoyment	Low interactivity	3.4797	.44655	-1.348	.207
	High interactivity	3.7013	.18018		
Patronage	Low interactivity	3.2619	.50937	-3.003	.010*
	High interactivity	3.5595	.44147		

*p<.05

4.2 Results of both interactivity and information control embedded groups

Two kinds of group were formed in this comparison, namely high interactivity without informative control and high interactivity with informative control. Participants in the first group could manipulate the virtual product to see its reactions. On the contrary, participants in high interactivity with informative control group not only could manipulate the virtual product, but they were equipped with the ability to freely control information relevant to the product. As shown in Table 2, participants generally had higher level of perceptions while they could determine when and how to display information. It has been documented in previous analysis that level of interactivity only influences participants' patronage intention. Taken together, it is obvious that the participant had more positive attitude toward the products and felt that the shopping experience was interesting, when they were allowed to control information.

Table 2. Comparison results of the interactivity and information groups

	Variables	Mean	S.D	t value	Sig.
Attitude	High interactivity	3.1421	.42704	-4.082	.001**
	+ Informative control	3.6351	.58125		
Enjoyment	High interactivity	3.4187	.46801	-2.630	.017*
	+ Informative control	3.7430	.48427		
Patronage	High interactivity	3.1228	.53531	-2.149	.045*
	+ Informative control	3.4386	.86639		

*p<.05, **p<.001

In order to further explore the links and their relative importance of the constructs, a regression analysis between these constructs were conducted. A positive coefficient was obtained for shopping enjoyment and attitude toward 3D products ($\beta = .592$, $R^2 = .35$, $t = 3.028$, $p < .01$). The regression analysis results also indicated that both shopping enjoyment ($\beta = .516$, $R^2 = .266$, $t = 2.485$, $p < .05$) and attitude toward 3D products ($\beta = .669$, $R^2 = .447$, $t = 3.710$, $p < .01$) were significantly related to the participant's patronage intention. Accordingly, participants with more positive attitude toward the 3D products, and higher perception of shopping enjoyment rated the

patronage intention more favorably.

5 Discussions

The meaning of the result associated with the first question is that participant's patronage intention was exactly influenced by functional control. Unlike in the low interactivity setting, which solely supported visual control, users in the high interactivity scenario could arbitrarily interact with the product being introduced, leading them to being more inclined to revisit the site. In this regard, functional control serves as the oil, which lubricates the process of determining a shopping site, rather than a product simulator. Based on the finding, it is conceptualized that virtual experience might have impacted on, at least, three dimensions, namely attitude toward shopping channel, attitude toward shopping process, and attitude toward products. In this study, we found visual control has no effect on one of the three dimensions whereas functional control has on attitude toward shopping channel. Given that customers in online shopping are physically distant from the real products, they need a way to evaluate if the response of the product is reasonable and acceptable. If the shopping channel provides instant feedbacks of the online products, customers would glean more needed information to make an accurate purchase decision. This might be the reason why functional control, in this study, had impact only on a customer's intended patronage. Specifically, customers expect to evaluate the reactions of products and then refer to the feedback as a critical factor, while selecting an online channel to better understand a product.

As to the second question, this study examined the question if equipping customers with the ability of informative control, along with visual and functional control, would have impact on the research variables. In 3D space, it is not easy for users to completely understand the properties, functions and reactions of a virtual product, because a detailed illustration concerning the product is often ignored. To deal with this issue, in our research design, participants in the high interactivity condition with freedom of informative control could post messages on the 3D virtual space nearby the product. Thus, they could completely manipulate the shared message such as modifying, hiding, annotating and recording voice. It was ascertained in the first experiment that the effect of functional control on the customer's attitude toward products and shopping enjoyment was not found. However, when combining visual and functional control together with informative control, this study found that an individual's attitude toward products and shopping enjoyment were significantly affected.

6 Conclusions

This study demonstrated the effects of the two dimensions of interactivity, namely *visual and functional control*, on attitude toward the products, shopping enjoyment and patronage intention in 3D settings. Furthermore, this study also interested in whether affording *informative control* would have impacts on one of the participants'

perceptions been studied in this research. Results of the analysis show that perceived attitude toward products, shopping enjoyment and patronage intention were all positively related to the affordance of informative control in the experiment.

Inherent in studies are the limitations that may distort the validity and reliability of the results. In this regard, a couple of limitations should be taken into account while explaining the findings. First, this study recruited students as the sample along with conducting laboratory experiments. This kind of experiment has limited generalizability and thereby should be careful in its applicability. Second, results of this study excluded numerous products for examining the effects of each of the variables.

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