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# Adding Dimension to Content: Immersive Virtual Reality for e-Commerce

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## **Abstract**

This paper outlines a plan of research to investigate whether consumers prefer an immersive virtual reality format for information search rather than static picture format in an e-commerce context. The research uses the Expectation Confirmation Theory as a foundation to propose a research model for examining how two presentation formats for information search, static picture and immersive virtual reality, affect online consumers' continuance intention to use the website. The proposed constructs theorised to be directly affected by presentation format are the confirmation and post-usage beliefs of enjoyment and perceived diagnosticity. The confirmation, the extent to which the expectation of the website matches the perceived performance, is proposed to affect online consumers' continuance intention via modified beliefs and attitudes toward website providing a certain format.

**Keywords** virtual reality, Expectation Confirmation Theory, user experience.

## 1 Introduction

As market competition is fierce and competitive advantage is highly sought after, vendors are attempting to attract consumers and promote their products through user experiences that apply the newest technology and innovations. Immersive Virtual Reality (VR) has been adopted only recently for such reasons. For example, Shangri-La Hotels and Resorts provides immersive VR content for presenting hotel facilities and scenery around the hotel and resort to increase bookings. In 2015, soft cheese supplier Boursin created a Master of Marketing award winning VR ride through delightful treats in a fridge to promote their new product. Despite the sudden explosion in public attention towards VR, it is not a new concept and can trace its roots back to the 1950s. However, it only recently became affordable and accessible to the masses (i.e. consumers) in recent years. Specifically, US\$6.1 billion of investment between 2012 to 2015 (Llamas and Ngai 2016) has triggered an influx of VR devices and content flowing onto the market. Devices range from the high-end, such as the HTC Vive, Oculus Rift and Samsung VR headsets, to more affordable Google Cardboard implementations.

What started for many early adopters as a revolution in the gaming industry, has now expanded to other use cases like social networks, cinema, tourism, and online shopping. In 2014, consumer VR hardware and content sales were only US\$108.0 million (Foster and Wheelock 2015) but are expected to grow to US\$1 billion in 2016 (Lee and Stewart 2016). By 2020, worldwide VR revenue is expected to increase to US\$21.8 billion, with a compound annual growth rate of 142%. However, the majority of this growth is expected to be in hardware sales and until the market penetration of headsets is large enough to support mainstream adoption of emergent VR content, head-mounted displays (HMDs) will continue to account for the largest portion of total revenues, with more than 200 million consumer VR HMDs expected to be sold worldwide by 2020 (Gaudiosi 2016). Within this 'problem' exists an opportunity for developers to tap an audience of consumers 'hungry' for new VR-based experiences.

Though immersive VR using HMDs is becoming the mainstream choice for consumers to enjoy contemporary VR content, the extant literature often refers to VR of non-immersive form (i.e. 2D or 3D web-based platforms) when examining the concepts of virtual world (VW), virtual environment (VE), Virtual Product Experience (VPE) or VR in the information systems (IS) field (Jiang & Benbasat, 2007a; Suh & Lee, 2005; Yi et al., 2015). Non-immersive VR does not isolate users from the real world, whereas immersive VR offers a user-centred head-tracked view with a wide angle stereoscopic vision, and interactive control, providing visual and audio immersion. With immersion comes an ability to evoke cognitive absorption, the feeling of presence and engagement, which is currently absent.

The research proposed in this plan will use immersive VR (via HMDs) to address the gap in previous research that largely focused on non-immersive VR (e.g. 3D games and product representations). Furthermore, where previous research did use immersive VR to present a VE for investigating certain relationships (mostly found in the computer science field rather than information systems), the dependent variable previously used is typically related to task performance, in terms of completing time (Pausch et al. 1997), under different level of stress (Kim et al. 2012) or memory correctness (Bailey et al. 2012). This is primarily a result of early VR devices being very expensive and limited to specialised applications (e.g. aviation training) where task performance is of greater concern. However, as barriers to entry dropped with VR device prices, the potential applications for VR grew with expansion of user types and usage scenarios. New contexts with different dependent variables and contexts avail research to study immersive VR's potential. Accordingly, this research addresses the impact of immersive VR in a variety of commercial uses. To achieve this aim, the Expectation-Confirmation Theory (ECT) will be used as a foundation to address the following research question:

*How does the application of immersive Virtual Reality influence consumers' continued use of an e-commerce website?*

This study is expected to have two contributions. First, this study is expected to contribute to the presentation format impact research literature on online customer shopping experience. The research will empirically investigate the impact of immersive VR on potential consumers' beliefs (i.e. enjoyment and perceived diagnosticity), attitudes and intentions, compared to static pictures. Although VR is again topical, whether VR interest will fade away again (i.e. Nintendo's ill-fated Virtual Boy) is still unknown. This research aims to provide a lens for investors to decide whether incorporating VR format into their platforms will 'pay off'. Additionally, this research will provide evidence on whether the Expectation Confirmation (Disconfirmation) Theory-based model is valid when the expectation of a system falls outside of improving efficiency, performance, and productivity (i.e. Perceived Usefulness). It has potential to explain whether and how the hedonic values that an e-commerce website brings to consumers affect their continuance intention to use that website for information search.

This paper proceeds as follows. Section 2 presents the definition of virtual reality and surveys the relevant literature of ECT and outlines hypothesis development and research model derived from this theory. Section 3 presents the proposed research method and briefly discusses future plans.

## 2 Literature Review

In this section, the concept and classification of virtual reality (VR) is explained, with immersive VR being the focus of this study. Next, the theoretical foundation of this research, i.e. Expectations Confirmation Theory (ECT), is elaborated.

### 2.1 Presentation Format and Immersive Virtual Reality

Presentation format has a strong relationship with consumers' information acquisition patterns as they process the information that highly matches their purchasing task, i.e. helping the to form a clear understanding of products or services (Jiang and Benbasat 2007a) and that they perceive as easiest to process (Bettman and Kakkar 1977). Although current online product presentations are predominantly text and image-based, previous research examined a wide range of presentation formats in the e-commerce environment. The result showed different effects of presentation format on consumers' memory, attitudes and intentions by making comparisons between textual and visual content (Li et al. 2015), between textual and verbal content (Blanco et al. 2010), and between visual and verbal content (Kim and Lennon 2008), with conflicting results. In addition, researchers examined whether video (Li et al. 2012), 3D (Nah et al. 2011; Visinescu et al. 2015) and multimedia (Dimoka et al. 2012) is a better format than text or pictures for convincing consumers about the trustworthiness of product information provided. Others (Jiang and Benbasat 2004; Yi et al. 2015) put emphasis on Virtual Product Experience (non-immersive VR) and found that the distance between consumers and product can be reduced by increasing the virtual control. However immersive VR format is yet to be examined.

VR is defined as "*a display and control technology that can envelop a person in an interactive computer-generated or computer-mediated virtual environment*". It "immerses" the user in artificial worlds that might otherwise be inaccessible due to distance, scale, time, and/or physical incompatibilities (Wexelblat 2014). Immersion refers to "*the extent to which a user is isolated from the real world*" (Guttentag 2010). Depending on the extent of immersion, VR applications can be classified into: non-immersive, semi-immersive and immersive.

- **Non-immersive VR** is where the VR content is displayed via a computer screen. Interaction with such a virtual environment occurs through the traditional medium, i.e. keyboards and mice (Costello 1997), therefore it is the least expensive VR solution and does not require users to wear the costly, large and heavy equipment that specialised immersive VR experiences required at the time. These barriers were likely the reason why non-immersive VR was the more predominant form investigated in extant IS literature. The contexts typically used are popular 3D social games like Second Life and Minecraft.
- **Semi-immersive VR** refers to VR systems with higher performing graphics computing power and use one (or more) large display monitors or projection screens (e.g. cave automatic virtual environments) to provide a wide field of view.
- **Immersive VR** is where the user is completely encompassed by the virtual environment and does not feel any interaction with the real world (Gutierrez et al. 2008; Witmer and Singer 1998). Such environments in prior IS research typically focused on specialised task simulation (e.g. military and aviation simulators), whereas this research will place emphasize on HMD-enabled immersive VR formats in e-commerce contexts.

### 2.2 Expectation Confirmation Theory and Expectation Disconfirmation Model

Expectation Confirmation Theory (ECT - also known as Expectation Disconfirmation Theory or EDT) (Oliver 1980) is a consumer behaviour theory to examine consumers' satisfaction and repurchase intention. ECT posits that consumer repurchase intention is based on satisfaction with their previous experience with products or services from a vendor. It relates satisfaction to 1) "*a cognitive appraisal of the expectation-performance confirmation*" (Bhattacharjee 2001); 2) consumers initial expectation which is the baseline to decide the extent of confirmation; and advocates that 3) satisfaction is different from attitude as "*satisfaction is a transient, experience-specific affect, while attitude is a relatively more enduring affect transcending all prior experiences*" (Bhattacharjee 2001).

Based on this theory, Bhattacharjee and Premkumar (2004) developed their Expectation Disconfirmation Model to examine IS users' continuance intention of using a system. Similar to how

consumers decide to repurchase or not, the process (see Figure 1) of how a IS user decides to continue or not is: 1) first generating pre-usage beliefs (denoted by Beliefs (t<sub>1</sub>)) which serves as a frame of reference about which one makes a comparative judgment (Oliver 1980), and initial attitude (t<sub>1</sub>); 2) using a system, forming perception of the system performance and comparing it with the initial beliefs, and determining the extent to which the beliefs is confirmed; 3) forming satisfaction based on pre-usage expectation and confirmation; 4) forming post-usage belief (denoted by Belief (t<sub>2</sub>)) and modified attitude (t<sub>2</sub>); 5) forming continuance intention.

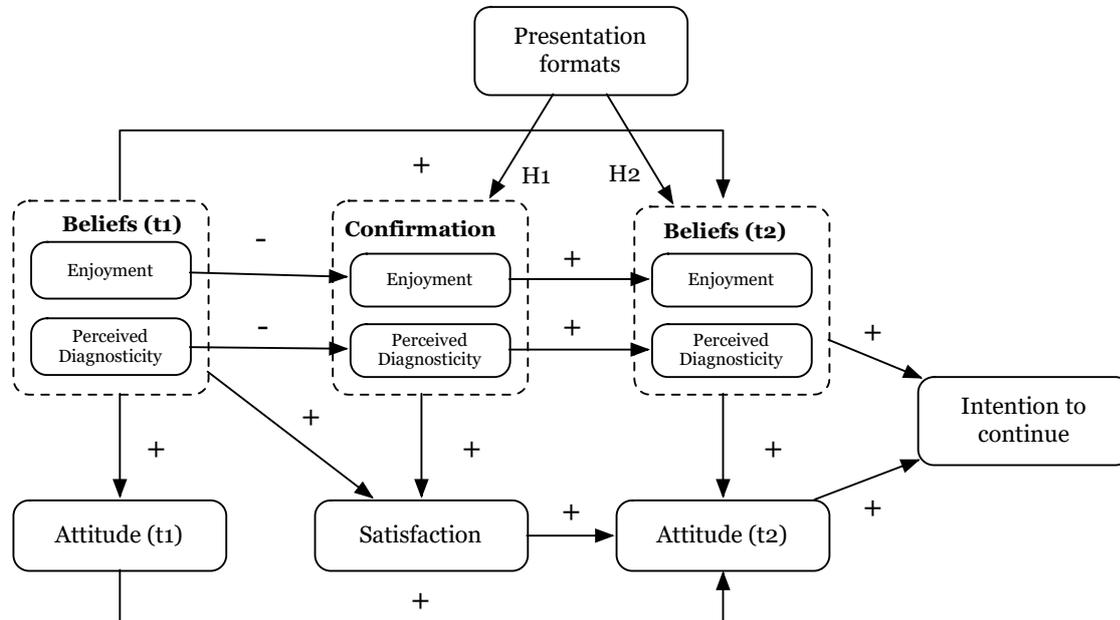


Figure 1: Research Model based on Expectation-Confirmation Model

Bhattacharjee and Premkumar (2004) point out one of limitations of their Expectation Disconfirmation Model is that it only uses Perceived Usefulness in terms of improving efficiency, performance, and productivity, as the usage-related belief to examine as it is the most salient belief related to IT usage. Whether their model applies to understanding changes in other usage-related beliefs is to be tested. Lowry et al. (2015) improve this model by considering the impact of motivation to use a system on expectation (Belief (t<sub>1</sub>)). They suggest motivations are a direct antecedent of expectations, so to find other usage-related beliefs to test, one needs to understand what motivates use of a particular system.

The motivation for consumers to use an e-commerce website includes both extrinsic and intrinsic aspects. Extrinsic motivation refers to doing an activity to obtain a separate outcome (Ryan and Deci 2000), and e-commerce examples of separate outcomes are searching product or service information for making purchasing decision, saving time, and gaining a better price (Shang et al. 2005). While intrinsic motivation is “*doing an activity simply for the enjoyment of the activity itself*” rather than achieving any specific goal (Ryan and Deci 2000). Therefore, the construct Perceived Usefulness in the Expectation Disconfirmation Model does not fully capture the expectation of online consumers derived from their motivations. To address this gap, for the extrinsic motivation, this research utilizes the concept of “Perceived Diagnosticity” (i.e. extent to which a website is helpful for customers to understand products) from Jiang and Benbasat (2007a), to address what online customers’ expect from information search when using an e-commerce system. For expectation derived from intrinsic motivation, we use the construct “Enjoyment” (i.e. the extent to which shopping online is perceived to be enjoyable inherently) from van der Heijden (2004), to represent the expectation of online shopping that does not involve any anticipation of functional results.

### 2.2.1 Immersive VR and Extrinsic Motivation

From an extrinsic motivation perspective, the task is to acquire helpful information for making purchasing decisions. Compared to direct interaction with products or services in physical stores, online exhibition does not afford such intimate contact, which gives a less trustworthy and less informative presentation of products or services. This research proposes an immersive VR format is more helpful for consumers to evaluate products or services, negating the lack of intimate physical contact. This concept is captured by “perceived diagnosticity”, which is predicted by vividness and interactivity (Jiang and Benbasat 2007b).

Compared with static pictures, immersive VR provides a higher level of vividness. Vividness is stimulus driven and relies entirely upon technical characteristics of a medium (Steuer 1992). It is determined by the sensory breadth (i.e. the number of sensory dimensions presented) and the sensory depth (i.e. the quality of information presented in each dimensions). Immersive VR increases the sensory breadth through enhancing space perception and including audio effects (i.e. spatial sound). However, VR, especially the mobile-rendered VR such as Google Cardboard, may suffer from low graphical quality which yields an unsatisfactory sensory depth. Nevertheless, VR's zoom and rotation functions can complement the low graphical quality (Boos et al. 2016). Interactivity relates to the prominent features of VR, which offers a higher level of control compared with static pictures. It allows users to actively choose what information to received according to their own interests and needs rather than passively receive pictures from fixed perspectives that the seller decides to provide (Jiang et al. 2010; Suh and Lee 2005). The perceived diagnosticity relates to whether the website can help consumers to understanding the product better, when the presentation provides a more comprehensive knowledge of the product or service, the confirmation between expectation and the system's actual performance will be higher. So an immersive VR format is expected to fit the purchasing task better, thus the proposed hypotheses:

*H1a: The confirmation of web diagnosticity will be higher when product information is presented in immersive VR format compared with that in static picture format.*

*H2a: The perceived diagnosticity (t2) will be higher when product information is presented in an immersive VR format.*

### **2.2.2 Immersive VR and Intrinsic Motivation**

IS designers often must also consider intrinsic motivations of users that increase the possibility that users want to use a system (Lowry et al. 2015). "Enjoyment" is important 'offline' for forming consumers' attitude and intention (i.e. higher possibility of impulsive buying and store loyalty compared with consumers motivated by extrinsic factors), whereas shopping online lowers enjoyment. The lowering of enjoyment online is due to consumers only having two dimensional pictures and text, and engaging in less enriching and less emotionally fulfilling activities (Koufaris 2002). This disadvantage of online shopping can be diminished by using immersive VR, as it provides a high level of product visualisation and a sense of space. Consumers think the more vivid the product presentation is, the more emotionally attractive the website is for yielding enjoyment (Jiang and Benbasat 2007b). In addition, the immersive VR format gives users a higher locus of control by allowing them to explore and discover the product and space themselves. Jiang et al. (2010) shows that active control of information acquisition leads to increased pleasure and affective involvement. Accordingly, consumers develop higher affinity toward the website.

*H1b: The confirmation of enjoyment will be higher when product information is presented in an immersive VR format compared with that in static picture format.*

*H2b: The enjoyment (t2) will be higher when product information is presented in an immersive VR format.*

## **3 Proposed Research Method and Future Work**

The current state of this research in progress is that the literature review is still being undertaken and the research model, its constructs, hypotheses and research context are being further defined. The following are preliminary thoughts regarding the research method envisioned for use in an accommodation booking context where customers rely heavily upon the description provided by the hotel (and customer reviews) to form their opinion. Preferential-choice task of selecting accommodation is a common task in behavioural decision making research (van der Land et al. 2013). It is a real life situation and provides a basis for comparative analysis with previous studies. The timeline for completion of this initial study is by mid-2017.

According to the literature analysis of Chan et al. (2016), studies of the effects of particular website features or presentations on online shopping behaviours generally used laboratory experimental manipulations. This study follows the experimental method as it can better control other website features. Simulated hotel booking websites will be prepared, using the same descriptions of hotel rooms and website layout derived from common accommodation e-commerce websites (e.g. Airbnb and Hotels.com). The way in which the website presents hotel room product information will be manipulated to examine differences between static photos and the immersive VR format, and participants will be randomly assigned into two groups. Potential confounding factors such as price, website name, hotel brands and customer reviews will be controlled for. Pre-testing will be conducted to develop and modify

the static picture and VR stimuli to ensure their validity, as well as other experiment materials. Data will be analysed using the partial least squares (PLS) which is suitable for identifying key “driver” construct and the structural model contains many constructs (Hair et al. 2014). Consistent with marketing research guidelines, to detect  $R^2$  values of at least 0.25 in endogenous constructs at a 5% significance level and statistical power of 80% when up to 5 arrows pointing to a latent construct, no less than 70 participants (within subject design) will be recruited.

In terms of measurement instruments, the question items of “Perceived Diagnosticity” will likely be adopted from Jiang and Benbasat (2007b) involving a website’s helpfulness in evaluating, familiarizing and understanding the performance of products or services, those of “Enjoyment” from van der Heijden (2004) involving an evaluation of how enjoyable, pleasant, interesting, arousing and fun using the website is, and variables related to ECT from Lowry et al. (2015).

Future work will consider the effect of different presentation formats on online customers’ intention to purchase and the relationship between the intention to use a website providing a certain presentation format for information search and the intention to purchase from that website. Other constructs also influenced, including performance-related (e.g. product attribute recall) and also technology-related (immersion, involvement, engagement and presence) will be examined in a more extensive model.

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