



# The influence of website dimensionality on customer experiences, perceptions and behavioral intentions: An exploration of 2D vs. 3D web design



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## ARTICLE INFO

### Article history:

Received 26 September 2012

Received in revised form 19 September 2014

Accepted 1 October 2014

Available online 23 October 2014

### Keywords:

Cognitive absorption

Website design

Intention to buy

TAM

## ABSTRACT

As online retailers seek to attract customers through innovative electronic storefront designs, some are experimenting with three-dimensional (3D) websites. This study examines the influence of website dimensionality on cognitive absorption, perceived ease of use, and, indirectly, perceived website usefulness and intentions to buy online using the website. Findings indicate that shopping websites using 3D environments are associated with lower perceived ease of use and lower cognitive absorption, compared to traditional 2D websites. The effect of website dimensionality on cognitive absorption is moderated by user experience. The implications of the study for research and practice are discussed.

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## 1. Introduction

The rise of the Internet in the 1990s and the evolution of Internet technologies have dramatically changed social and business practices, from shopping and banking to making friends and dating. Online shopping has become a viable, and often preferred, alternative to visiting traditional brick and mortar stores. As the technology through which we access the Internet continues to evolve, businesses are pressed to create and refine web-access applications in response to user demand [60]. Research indicates that the design of online storefronts has a significant influence on sales [55]. Thus, companies continue to innovate their website designs to gain a competitive advantage [51,91] and to enhance customer experience by creating an enjoyable website atmosphere<sup>1</sup> [24].

The illusion of the three-dimensionality of visual representations has proven to attract customers in the entertainment industry. PricewaterhouseCoopers found that 3D movies

accounted for 50–70% of box office revenue [79]. Improvements in the bandwidth and increases in the processing power of personal computers made it possible to create websites that include immersive three-dimensional environments [75]. The use of such 3D computer generated environments has become one of the signature characteristics of virtual worlds [90]. The evolution of computer generated 3D environments is likely to spur website developers and further increase the importance of 3D websites. The number of virtual worlds has increased to almost 900 in 2012 from 450 in 2011, and virtual world revenue has reached 9 billion in 2013 compared with 6 billion in 2012, according to one virtual space consulting firm (<http://www.kzero.co.uk/blog/growth-forecasts-for-the-virtual-worlds-sector/>).

Lured by the increasing number of users seeking the immersive experience offered by virtual worlds and computer games, online retailers are experimenting with utilizing 3D designs for their electronic storefronts to replicate the shopping atmosphere of traditional shopping venues. These 3D shopping websites allow customers to move through a three-dimensional store in a manner similar to playing a computer game and to select and view products in a manner that imitates shopping in a brick-and-mortar store (i.e., [www.enjoy3d.com](http://www.enjoy3d.com), [www.kinset.com](http://www.kinset.com), [www.virtway-world.com](http://www.virtway-world.com)). Although the concept of 3D design is intuitively attractive, the effect of dimensionality on online shopping behaviors has largely not been empirically explored. Among the notable exceptions, a study of the effects of website dimensionality

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<sup>1</sup> The atmosphere of a website is defined as “the conscious design of space to create certain buyer effects, specifically, the designing of buyer environments to produce specific emotional effects in the buyer that enhance purchase probability” [46]. Atmospheric cues affect the emotional and cognitive states of online shoppers and thus influence buyers’ intentions [24].

on brand equity and user intention grounded in the theory of flow found 3D virtual world environments to have both a positive and negative effect on brand equity [59]. The positive effect has been attributed to feelings such as telepresence and enjoyment, whereas the negative effects were explained through distraction-conflict theory [59]. In another study, Debbabi et al. [19] investigated the mediating role of telepresence on the effect of online 3D advertising on consumer responses. They list as a limitation of their study the failure to consider the familiarity of users with the website environment. Our study provides insights into this matter by considering both first time users and experienced users. A study by Jeong and Choi [39] investigating the effects of picture presentations on customers' behavioral intentions suggests that customers' hedonic and utilitarian attitudes should be included in future studies.

Interestingly, several attributes of a website design that are related to dimensionality were identified as important predictors of user experiences. The results of a study examining the relationship between image interactivity, intention to buy and other psychological and perceptual factors suggest that image interactivity influences the global attitude, willingness to patronize, and willingness to purchase of online buyers [28]. A study investigating the impacts of web page visual complexity and order on psychological outcomes and behavioral intention found that visual attributes of the website influence users' affective reactions but that the relationship is moderated by the meta-motivational state of the user [21].

The purpose of this paper is to extend existing research [2,59,89] and to examine the effect of 3D environments (compared to traditional 2D website designs) on psychological and perceptual factors that were demonstrated to influence online shopping behaviors. Specifically, we draw on Kaplan's theory of environmental preferences [42], the cognitive absorption nomological net [2], and the technology acceptance model [17] and examine the effects of 3D environments on dimensions of cognitive absorption associated with the use of the website and perceived ease of use of the website. As a part of this study, we also seek to deepen our understanding of the relationships among cognitive absorption, ease of use, usefulness and intentions to buy online outlined in the cognitive absorption nomological net. Motivated by the evidence suggesting that combining all four dimensions of cognitive absorption into a single construct is problematic [94], we examine the role played by individual dimensions of cognitive absorption.

The contribution of this manuscript is threefold. First and foremost, this study examines the effects of 3D computer generated environments on user outcomes in the context of utilitarian information systems. Although the use of 3D environments was widely examined in the context of hedonic systems, such as games and virtual worlds, this is among the first studies to examine user outcomes of introducing a 3D environment in the online shopping context. Our results suggest a significant negative effect of the 3D environment on both perceived ease of use and cognitive absorption dimensions and an indirect effect on perceived usefulness and intention to buy. This study illuminates challenges and opportunities associated with incorporating novel interfaces into utilitarian systems. Interestingly, the negative effect of the 3D environment on the cognitive absorption dimensions is only significant for first time users of the website, which once again highlights the importance of user experience in evaluating novel types of user interface designs.

The second contribution of this study is that it deepens our understanding of cognitive absorption because it decomposes the cognitive absorption construct into its dimensions and tests the relationship between individual dimensions and antecedents and

consequences of cognitive absorption. As a result, we are able to demonstrate that the relationships outlined in the cognitive nomological net hold for some, but not all, dimensions. This may also help practitioners to develop websites that trigger a high level of cognitive absorption in users. Previous studies have investigated the relationship between cognitive absorption and perceived ease of use or perceived usefulness as a whole, but none of them, to the best of our knowledge, have investigated whether the models hold for dimensionally different websites. Finally, the results of our study confirm the moderating effect of user experience with the website on the relationships between cognitive absorption, ease of use and usefulness.

## 2. Theoretical underpinnings

In this section, we discuss the concept of dimensionality in the design of the user interface and provide an overview of three theoretical frameworks that inform this research study, including Kaplan's theory of environmental preferences, the technology acceptance model (TAM) and the cognitive absorption nomological net and related research.

### 2.1. Illusion of three-dimensionality and its use in human-computer interface

The term "three-dimensional" (3D) is broadly defined as relating to three dimensions or aspects. In the context of visual media and design, the term involves creating an illusion of depth and varying distances in flat images and other visual representations [57]. The illusion of depth is achieved when we look at a flat surface but perceive that objects on that surface are located at different distances from us. However skillfully executed, traditional flat representations of 3D images fail to completely fool the observer as to their shape. When viewing paintings or photographs, humans are able to perceive the 3D nature of the objects represented on the painting/photograph but are also aware of the fact that the painting is flat.

Advances in computer graphics and stereoscopic technology help to create a more realistic illusion of three-dimensionality. Some tools work with the motion scale and display different visual representations depending on the movements of the observer [13]. Other tools help to create a binocular disparity illusion [36]. The former is usually employed in computer games, where the movement of the observer is critical to the creation of the illusion of the 3D reality. The latter is more frequently utilized in cinematography, where the viewer is presumed to be static. In IS research, the term 3D environment is usually utilized to refer to computer systems that create the 3D illusion by varying the perspective and motion scales, i.e., that allow users to "walk" through the computer generated 3D space by altering the images presented to the user in real time depending on the "movements" of the user. This is the sense in which the term 3D is employed in this work. Although 3D effects have long been utilized in computer games where depth and distance to objects are critical to the achievement of game objectives, advances in 3D technologies and increased bandwidth have allowed the creation of the 3D illusion in web-based systems where users can interact with each other in real time.

Although a three-dimensional interactive computer generated environment is a signature feature of virtual worlds [90], a distinction exists between a 3D environment and a virtual world. In the context of this research, we consider a system to provide a 3D environment if its user interface creates the illusion of depth in two-dimensional representations and allows the user to navigate in the three-dimensional space. In contrast, virtual worlds have been defined as 3D interactive environments wherein the user

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