International Journal of Human–Computer Interaction

ISSN: 1044-7318 (Print) 1532-7590 (Online) Journal homepage: http://www.tandfonline.com/loi/hihc20

The Engagement of Website Initial Aesthetic Impressions: An Experimental Investigation

Supavich (Fone) Pengnate, Rathindra Sarathy & JinKyu Lee

To cite this article: Supavich (Fone) Pengnate, Rathindra Sarathy & JinKyu Lee (2018): The Engagement of Website Initial Aesthetic Impressions: An Experimental Investigation, International Journal of Human–Computer Interaction, DOI: 10.1080/10447318.2018.1554319

To link to this article: https://doi.org/10.1080/10447318.2018.1554319

Published online: 12 Dec 2018.

INTERNATIONAL JOURNAL OF HUMAN–COMPUTER INTERACTION
https://doi.org/10.1080/10447318.2018.1554319

The Engagement of Website Initial Aesthetic Impressions: An Experimental Investigation

Supavich (Fone) Pengnate[a], Rathindra Sarathy[b], and JinKyu Lee[b]

[a]Department of Accounting and Information Systems, North Dakota State University, Fargo, ND, USA; [b]Department of Management Science and Information Systems, Oklahoma State University, Stillwater, OK, USA

ABSTRACT

This study investigates how website design features, web page order and visual complexity, influence users' initial website aesthetic impressions and how such impressions subsequently enhance engagement and intention to use the website. A laboratory experiment was conducted to test the hypotheses using different levels of web page order (high vs. low), visual complexity (high vs. low), and exposure time (one-second vs. no-time-constraint). Overall, the results from structural equation modeling (SEM) analysis suggest that web page order significantly influences visual appeal, engagement, and intention. In addition, the results of multigroup SEM analysis reveal that users evaluate website design very quickly (within 1 s), and that these evaluations remain remarkably consistent over time.

1. Introduction

Online retail sales in the United States have been increasing at an average annual rate of 9.4%, resulting in more than $409 billion in 2016 (Statista, 2018) This increase is driven primarily by the growing number of businesses that are choosing emerging technologies and the Internet as channels for developing a brand reputation, transacting with and servicing customers and investors, or building public relations (e.g., Sengupta, Balaji, & Krishnan, 2015). Given the staggering choices of vendors on the Internet, customers can easily switch online vendors whose competitors are just a click away. Therefore, online vendors are currently faced with the challenge of engaging potential customers very quickly; thereby minimizing the chances of the user switching to another vendor.

Several studies in the areas of information systems (IS) and human–computer interaction (HCI) domains have shown the significant effects of website design features on engagement and intention to use websites. However, most studies have focused on the functional aspect of the features and much less attention has been devoted to the aesthetic design feature aspect (e.g., Jiang, Wang, Tan, & Yu, 2016). Therefore, in this study, we focus on investigating the influence of website aesthetic design features on users' responses.

In general, existing studies have demonstrated that website aesthetic design features are important predictors of users' overall impression and satisfaction. Such features include color and saturation (Cyr, Head, & Larios, 2010; Skulmowski et al., 2016), layout (Geissler, Zinkhan, & Watson, 2006), and use of images (Cyr, Head, Larios, & Pan, 2009; Hassanein, Head, & Ju, 2009; Karimov, Brengman, & Van Hove, 2011). However, while previous studies have provided evidence of the influence of website aesthetic design features on user responses, the underlying mechanism of such influence remains relatively unexplored. Thus, this study aims to shed light on how online users form their perceptions toward website through website aesthetic design features. The findings of this study could enhance understanding of how website aesthetic design features affect users' perceptions and; thus, online vendors can consequently develop strategies to engage their users and create desired responses.

Existing studies in the area of website aesthetics have demonstrated that website aesthetics can evoke online users' first impressions of a website very rapidly (approximately 50 milliseconds) and that these impressions can further influence users' perceptions (Lindgaard, Dudek, Sen, Sumegi, & Noonan, 2011; Lindgaard, Fernandes, Dudek, & Browñ, 2006; Schaik & Ling, 2009; Tractinsky, Cokhavi, Kirschenbaum, & Sharfi, 2006). Research in this area tends to view website aesthetic design features as a holistic perception; for example, "website visual appeal" (Lindgaard et al., 2011) and "perception of website aesthetics" (Skulmowski et al., 2016). Therefore, some issues remain unresolved especially how and what are the key aesthetic design features that determine such first impressions.

In this regard, this study focuses on investigating the effects of website aesthetic design features on users' first impressions and their subsequent effects on users' responses. Specifically, this study investigates two key aesthetic design features, *web page order* and *visual complexity*, which are essential to the creation of first impressions and are of interest to e-commerce business researchers and practitioners. Visual order and complexity were derived from the field of visual psychology and

CONTACT Supavich (Fone) Pengnate fone.pengnate@ndsu.edu College of Business, NDSU Dept. 2400, PO Box 6050, Fargo, ND 58108-6050, USA.
Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/hihc.

have been considered as a foundation for establishing viewers' first aesthetic impression (Jacobsen & Höfel, 2002). Thus, the key contribution of this research is to investigate such visual design components in the area of online commerce settings. We note these features as web page order and visual complexity, respectively, in our context and examine their effects on the formation of website users' first impressions. Web page order refers to the degree of organization of the information on the web page and reflects the extent of coherence, congruity, legibility, and clarity (Nasar, 2000). Visual complexity is defined as the degree of density and the number of visual design elements presented on the web page (Berlyne, 1971; Deng & Poole, 2010; Wang, Yang, Liu, Cao, & Ma, 2014). Consequently, our first research question is:

(1) How do visual design features of a web page[1] (web page order and visual complexity) impact users' initial aesthetic impressions and, in turn, their behavioral responses, such as emotional engagement and intention to use the website?

The second key contribution of this study concerns the durability of the effects of first impressions. Past studies have provided preliminary evidence that online users' first aesthetic impressions of a web page not only are formed very rapidly, but are also stable (Lindgaard et al., 2011, 2006; Schaik & Ling, 2009; Tractinsky et al., 2006). This study extends the findings from previous research by examining the stability of the relationships between user responses and website design features, web page order and complexity, over time. We provide a theoretical basis for these relationships by synthesizing evidence from the disciplines of visual psychology, HCI, and IS. Consequently, our second research question is:

(2) Do the effects of website visual design features (web page order and visual complexity) on user responses, as well as on the relationships among the antecedents, remain consistent over different exposure time periods? That is, are they both quick and lasting?

In the following sections, we first review relevant literature from the HCI and IS disciplines regarding visual appeal and its influence on first impressions. Next, we propose a research model to examine the relationships between web page order, visual complexity, and user responses, including engagement and behavioral intention to use the website. We then describe the research methodology for the study, including the sample, experimental procedure, and measurement. The subsequent section describes the data analysis. The last section provides a summary of the results, theoretical and practical contributions, limitations of the study, and directions for future research.

2. Theoretical framework and hypotheses

Figure 1 illustrates our research model. The model was developed to test the hypotheses between web page order and visual complexity as the antecedences of perceived visual appeal, which is further hypothesized to influence engagement and intention to use the web site. Details of the hypotheses are provided in the following sections.

2.1. Speed and durability of visual appeal judgements of website design aesthetics

In the past decade, research in a wide range of disciplines has embraced the importance of website aesthetic impressions or visual appeal. In our context, we consider visual appeal as a user's perception of website aesthetics derived from website visual design factors such as color, shape, and layout (Bloch, 1995). An important characteristic of this visual appeal is its *immediate* effect on the aesthetic perceptions of the users, which leads to the formation of their first impressions toward the website that, in turn, shape the users' judgments of the website as a whole (Lindgaard et al., 2006; Schaik & Ling, 2009; Tractinsky et al., 2006).

The influence of initial aesthetic impressions can be explained by the seminal work of Chaiken (1980), which suggests that the initial opinion judgments of subjects is strongly influenced by

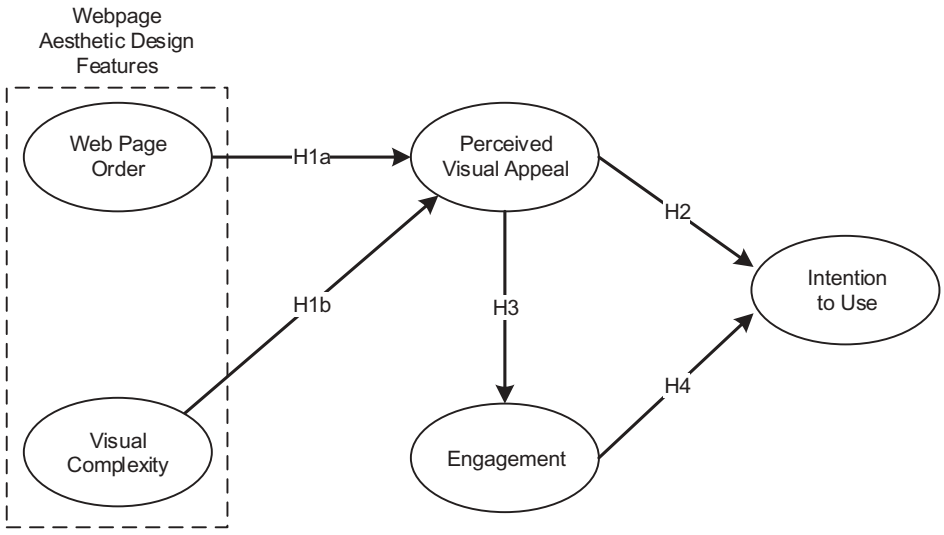


Figure 1. Proposed research model.

certain message cues (e.g., website design features in our study). This type of processing evokes cognitive and emotional evaluations to form a judgement, which is an artifact further developing first impressions (Meyers-Levy & Malaviya, 1999). This conceptual framework is in line with Norman's (2004) emotional design model, which proposes that users subconsciously form rapid judgments of stimuli (e.g., good-bad or safe-dangerous) based on the visual appearance of the stimuli and, consequently, such judgements shape the users' cognitive evaluations of the stimuli.

Existing studies on website first impressions have shown that users' aesthetic impressions of websites can be formed very rapidly. For example, in a series of experiments, Lindgaard et al. (2006) provided evidence that users develop their first impressions of a web page in as little as 50 milliseconds. In one of their experiments, participants watched images of 50 web pages, each for 500 milliseconds. After each page had been displayed, participants viewed the 50 pages for the second time in a randomized order without a time limitation. The correlation between the mean evaluation of the visual attractiveness of the web pages in the first phase and the second phases, in which the exposure time was set to 50 milliseconds, is remarkably high. This finding indicates the speed and durability of website design aesthetics on evaluations of website attractiveness, even after a very short exposure to the website.

In the same vein, Tractinsky et al. (2006) extended the findings of Lindgaard et al. (2006) by examining aesthetic features of websites at higher levels of abstraction, namely classical and expressive aesthetics. Their findings are generally in line with those of Lindgaard et al. (2006), revealing that users were able to form an *immediate* and *durable* evaluation of the web page's attractiveness. Thereafter, Lindgaard and her colleagues replicated their first studies and the results are very consistent (Lindgaard et al., 2011).

While traditional studies on initial website aesthetic impressions focused on design components at a high level of abstraction (e.g., visual appeal as a whole), more recent studies have provided evidence of website design features at lower levels of abstraction to address the importance of specific design features on influencing users' aesthetic impressions. For example, Thielsch and Hirschfeld (2012) investigated the importance of low-spatial frequencies on users' first impressions. They reported high correlations of aesthetic impressions between low-pass filtered, high-pass filtered, and unfiltered websites. In addition, Tuch, Presslaber, Stöcklin, Opwis, and Bargas-Avila (2012) investigated the effect of visual complexity and prototypicality on users' first aesthetic impressions. Their findings suggest that visual complexity and prototypicality are antecedents of users' first aesthetic impressions after as little as 17 milliseconds of exposure and that visual complexity produces a noticeably stronger effect than prototypicality. Reinecke et al. (2013) also provided evidence to support the importance of design features at a lower level of abstraction. Specifically, their study suggested that visual complexity and colorfulness are important factors in developing aesthetic impressions and subsequent responses, such as perceived usability and trustworthiness.

Thus far, existing research in website aesthetic impressions has yielded useful information about the effects of website design features on the formation of first impressions. However, investigation of the antecedents of aesthetic impressions is still preliminary and an understanding of the effects of aesthetics on user responses is still elusive. Therefore, additional effort is needed to extend the prior studies to enhance the understanding of the underlying mechanism of the development of initial website aesthetic impressions. Thus, this study aims to address these issues by focusing on how such a mechanism is formed, especially, in the context of e-commerce website design.

2.2. User responses to web page order and visual complexity

In the field of visual psychology, visual symmetry and complexity are considered the strongest and second-strongest factors, respectively, that positively influence viewers' perceptions of visual aesthetics (Jacobsen & Höfel, 2002), especially the viewers' *spontaneous* emotional perceptions and responses (e.g., Jacobsen, 2004; Jacobsen & Höfel, 2002, 2003). In addition, visual symmetry and complexity are recognized as prominent dimensions of visual aesthetics that evokes individuals' automatic emotional responses to signal distinctions among different environments (e.g., websites in this study) (Arnheim, 1966; Berlyne, 1971; Gilboa & Rafaeli, 2003; Kaplan & Kaplan, 1983).

While past studies in the visual psychology field have provided evidence of the strong relationship between visual symmetry and aesthetic impressions (e.g., Jacobsen & Höfel, 2002), this concept has rarely been adopted into the online commerce context. However, recently, researchers in the HCI domain have recognized the importance of visual symmetry and considered this concept as web page order which is a key factor of website aesthetics (e.g., Tuch, Bargas-Avila, & Opwis, 2010).

In addition, another website design feature that is closely related to visual symmetry is design balance, which refers to the distribution of design elements on the screen and has been reported to rapidly influence the formation of website aesthetic impressions (Zheng, Chakraborty, Lin, & Rauschenberger, 2009). The design balance then appeared to be highly correlated with visual symmetry and could be considered as the same construct (Zheng et al., 2009). Subsequently, based on the concept of visual symmetry, the idea of web page order, and its importance, was emphasized by Deng and Poole (2010) who reported that web page order can create significantly positive effects on arousal and pleasantness toward websites. Therefore, this study adopts the definition of web page order from Deng and Poole (2010), which refers to the extent of logical organization, clarity, and coherence of elements presented on a web page (Deng & Poole, 2010). This research then extends the previous studies by addressing the relationships between web page order and initial perceived visual appeal, which has not been explored in the literature. Consequently, we propose that web page order produces a positive effect on perceived visual appeal.

Hypothesis 1a: A high level of web page order positively influences perceived web page visual appeal.

In contrast to web page order, web page visual complexity has been widely studied in the literature. In general, previous studies have suggested an inverted U-shaped relationship between visual complexity and visual appeal; that is, participants rated visual

appeal the highest when exposed to moderately complex visual stimuli (Berlyne, 1970). In the website design context, prior studies have reported the effects of visual complexity on users' perceptions, such as cognitive processing and emotion (Tuch, Bargas-Avila, Opwis, & Wilhelm, 2009), arousal (Deng & Poole, 2010), and attitudes (Mai, Hoffmann, Schwarz, Niemand, & Seidel, 2014). Specifically, consistent with the results in the visual psychology, the relationship between user responses and web page complexity was also found to be an inverted U-shaped function (Mai et al., 2014) – when users perceive a web page to be too complex, they may not be willing to spend the cognitive effort to process the information on the web page. On the other hand, when users perceive that a web page is too simple, they may feel bored when using the website (Cox & Cox, 2002).

However, more recent studies related to web page complexity and visual appeal have provided evidence that such a relationship is not necessarily an inverted U-shaped function. Tuch et al. (2012) reported an overall negative linear relationship between visual complexity and visual appeal – web pages with low visual complexity are more visually attractive. In addition, they reported that participants perceive visual complexity as quickly as within 17 milliseconds of exposure. Reinecke et al. (2013) provided computational models based on a certain set of visual complexity factors to predict perceived visual complexity. Their findings are somewhat consistent with those of Tuch et al. (2012) in that website visual appeal decreases when visual complexity is high; however, the visual appeal of web pages with low and moderate levels of visual complexity are not significantly different (Reinecke et al., 2013). Furthermore, Seckler, Opwis, and Tuch (2015) reported that visual complexity influences different aspects of website design features, such as simplicity, diversity, colorfulness, craftsmanship, and aesthetic perception. Their results also revealed that, in general, low visual complexity was preferable by online users (Seckler et al., 2015).

While several past studies have explored the effects of web page complexity on users' perceptions (e.g., arousal and emotional responses), little empirical research has investigated the association between web page complexity and visual appeal, essentially in the context of e-commerce. Therefore, our study extends the previous findings by examining such a discrepancy in the literature, especially in the area of initial aesthetic impressions. Consequently, we propose the following hypothesis:

Hypothesis 1b: A high level of web page visual complexity negatively influences perceived web page visual appeal.

There is consistent evidence from past studies that visual appeal stimulates positive emotional states (e.g., pleasantness and joy) or negative emotional states (e.g., fear, frustration, and dislike), which then directly determine users' intention to use websites (Éthier, Hadaya, Talbot, & Cadieux, 2006; Roseman, Antoniou, & Jose, 1996). Studies have also suggested that visual appeal is an executional cue that fulfills viewers' intrinsic hedonic needs (Holbrook & Hirschman, 1982) and that visually-pleasing stimuli makes them feel good (MacInnis, Moorman, & Jaworski, 1991). In the website context, it has been found that visual appeal can create users' positive emotional states (Éthier et al., 2006; Éthier, Hadaya, Talbot, & Cadieux, 2008; Hwang & Kim, 2007; Lin, Fernandez, & Gregor, 2012), which further shape the users' subsequent judgment of the websites (Loken, 2006), as well as their behavioral intention (Cyr, 2008). Such an effect can be considered as a halo effect (Nisbett & Wilson, 1977) which carries over to the evaluation of other attributes of the websites. Thus, we suggest that perceived website visual appeal will motivate intention to use websites.

Hypothesis 2: A high level of perceived web page visual appeal positively influences intention to use the website.

2.3. Visual appeal, engagement and behavioral intention

While there is a substantial basis for the direct effect of visual appeal on behavioral intention (to use the website) (e.g., O'Brien & Toms, 2010), we also posit an indirect (mediated) effect through the engagement with a website. In this study, engagement refers to the feelings that the system evokes, such as curiosity, arousal of imagination, and capturing of users' interest (Jacques, Precce, & Carey, 1995). Studies in the marketing literature have suggested that visual appeal is an executional cue that enhances customer attention and engagement in advertising by evoking emotional responses (MacInnis et al., 1991). Engaged users enjoy the activity or product, which may make them want to prolong the activity or use the product again (Sandelands & Buekner, 1989). Therefore, we predict that web page visual appeal determines the level of engagement of online users. As a result, we hypothesize that:

Hypothesis 3: Perceived web page visual appeal positively influences engagement with the website.

In addition, in the IS literature, engagement has been shown to influence user behavior and behavioral intention, for example, behavioral intention and user performance on a task (Webster & Ahuja, 2006), intention to revisit the websites (Luna, Peracchio, & de Juan, 2002), and intention to use websites (Lederer, Maupin, Sena, & Zhuang, 1998). Therefore, based on empirical evidence from previous studies, we hypothesize that higher engagement results in higher intention to use or revisit the website.

Hypothesis 4: Engagement with a website positively influences intention to use the website.

3. Methodology

3.1. Experiment participants and settings

A total of 293 undergraduate students enrolled in a major Midwestern university participated in the experiment. A unit of extra course credit was offered as an inducement. According to the nature of our experimental settings, students represent a large population of web users and such a sample is appropriate for our study (Pastore, 2000).

3.2. Measurement

Our measurement instruments were developed based on existing valid and reliable scales. We adapted Palmer's (2002) and Cyr's (2008) measures of web page order and Geissler et al.'s

(2006) and Nadkarni and Gupta's (2007) measures of perceived visual complexity. The measures of perceived visual appeal were derived from Cyr, Head, and Ivanov's (2006) instruments. The measures of engagement were adapted from Everard and Galletta's (2005) instruments. The measures of intention to use were adapted from Jarvenpaa et al.'s (2000) instruments. All items in the survey were constructed on a seven-point Likert scale. Detailed scales for each construct are provided in the Appendix.

3.3. Web page stimuli

A set of hypothetical web pages of an online vendor was created by a professional website developer to test the effects of web page order and visual complexity on users' responses. According to the context of this study, the web page was designed to meet the following criteria: (1) be unfamiliar to users (to reduce branding effects), (2) have content and other characteristics that evoke a neutral affect in users, and (3) be designed for the online shopping context. Consequently, four versions of an online shopping web page were developed.

Web page order was manipulated by varying the symmetry, coherence, and clarity of the web page features and layout. The web page presented a set of products in matrix display format. In the high visual order web page conditions, the design features were placed on the web page to confirm with the conventional guidelines of visual proximity for placing web page elements in relation to each other on the web page (Williams & Tollett, 2006). For example, the products were presented in grids which were laid out evenly both vertically and horizontally with other grids.

In contrast, our choices of web page order manipulations for the low visual order web page conditions especially followed the concepts of waterfall display design (Yanzhen, 2014) and visual symmetry (Jacobsen & Höfel, 2002). The same product information as those in the high visual order web page conditions was presented; however, the layout was manipulated such that the grids were not aligned with each other and the heights are not consistent to create a sense of visual disorganization. While these web page conditions appeared to be unnatural and unrealistic, there were legitimate websites that adopted the waterfall display design concept and low visual symmetry, for example, the Pinterest website and the MIT Center for Advanced Visual Studies website as shown in Figure 2(a,b).

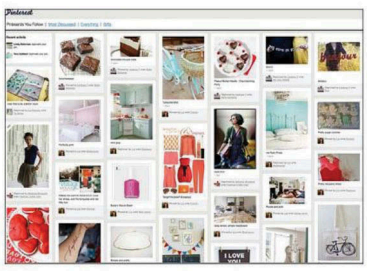
Furthermore, previous studies also manipulated web page visual presentation in this fashion to observe the impact of visual order. For example, Tuch et al. (2010) manipulated web page symmetry to examine users' perceptions toward the web page, Bauerly and Liu (2008) conducted an experiment using different levels of clutter in web page designs to evaluate aesthetic judgement, and Bi, Fan, and Liu (2011) designed web page stimuli in line with those used in Bauerly and Liu's (2008) study to replicate their experiment on a different population. An example of Bi et al.'s (2011) stimuli is presented in Figure 2 (c.).

In the high visual order web page conditions, the design features were displayed by following the conventional guidelines of visual proximity, for example, the web page elements were placed in relation to each other and the layout was symmetrical. The design elements were laid out nicely and evenly across the web page.

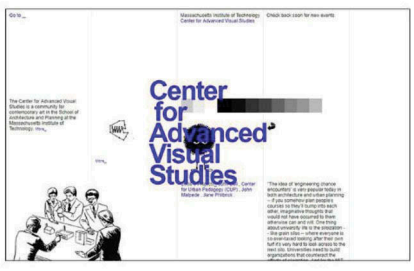
Regarding visual complexity, we followed the suggestion from Geissler, Zinkhan, and Watson (2001) that the amount of text, number of links, and number of graphics influence users' perception of visual complexity. Therefore, the experimental stimuli were manipulated in terms of the text, links, and images. The high visual complexity conditions included 112 text items that also worked as links and 18 images. In the low visual complexity conditions, the web pages included 20 text links and six images. Figure 3 shows the four versions of web pages of an online store that provides dorm room furniture products and accessories.

3.4. Stimuli exposure times

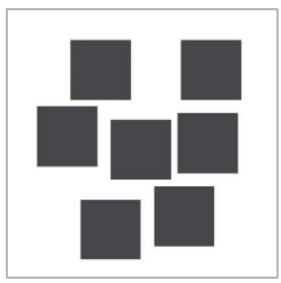
We created two exposure time conditions, a brief exposure time and no time constraint. For the first condition, there were several suggestions in the literature regarding the time threshold required for the formation of a first impression, for example 50 milliseconds (Lindgaard et al., 2006), one second (Dong, Ling, & Hua, 2007), four seconds (Kaiser, 2001), and seven seconds (Kim & Fesenmaier, 2008). In this study, the one-second exposure time was selected because it is long enough for participants not only to form a first impression, but also to reliably recall three to five aspects of the visual



a. Pinterest Website (http://www.pinterest.com)



b. MIT Center for Advanced Visual Studies Website (http://act.mit.edu/cavs)



c. One of the Stimuli in Bi et al.'s (2011) Study

Figure 2. Examples of web pages with waterfall display design and asymmetrical design.

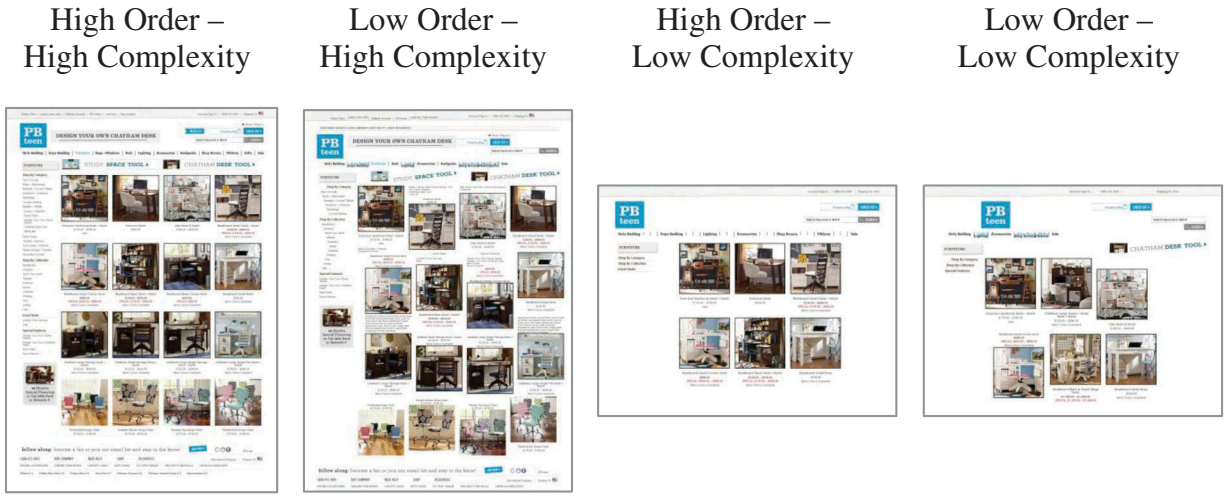


Figure 3. Web page stimuli.

design (Dong et al., 2007). According to Thielsch, Blotenberg, and Jaron (2013), this condition produces *deliberate first impressions*, in which reflective cognitive processes and reasoning are involved in the evaluation of websites; therefore, participants use cognitive cues conveying the value and the quality of the web pages to evaluate the website (e.g., intention to use). For the second experimental website condition, the exposure time was not limited, although we recorded the time spent by participants on the web pages.

3.5. Experimental procedure

The experiment was conducted in a controlled computer laboratory setting with 52 2.4GHz Dual-Core CPU desktop computers with 4GB of RAM and 21-inch monitors at a resolution of 1280 × 960 pixels, and a frame rate of 60 Hz. The main experiment included a total of eight between-subject experimental design treatment groups – 2 (visual complexity: high vs. low) × 2 (web page order: high vs. low) × 2 (exposure time: 1s vs. unconstrained). Subjects were randomly assigned to one of the eight groups. Each group was then assigned to an individual experimental session. An online application was created using Java Script to control the procedure, which included presenting the experimental web pages, controlling the exposure times, and collecting data. Participants were asked to imagine that they wanted to buy a dorm-room furniture product from the website. The experimental sessions for the one-second exposure time group lasted approximately 20 minutes and for the no-time-constraint group, approximately 30 minutes.

3.6. Experimental procedure for exposure times: One-second exposure time and no-time-constraint groups

Before the experimental stimuli set was administered for the one-second exposure time participant group, a block of trial web pages was administered on a test web page to get the participants acquainted with the rating method and the short display time (one second). Next, participants randomly viewed one of the four web pages (two levels of web page order × two levels of visual complexity). A prompt with a text message asked participants to pay attention to the monitor before the web page was presented on the computer monitor. A second-countdown timer was also used to keep participants' attention on the monitor before the web page was displayed. For the high-complexity conditions, the web pages were designed to fit on 21-inch computer monitors used in the experiment so that participants did not need to scroll down to see the bottom area of the web page. After the web page presentation, participants rated the web page order, visual complexity, visual appeal, their engagement, and their intention to use the website they had just viewed, and then they answered demographic questions. For the no-time-constraint group, participants were asked to freely explore the web page and then close the website when they wished to proceed to the questionnaire.

4. Analysis and results

Manipulation checks were first performed to examine the treatments for web page order and visual complexity. The results from a *t*-test reveal that subjects exposed to higher web page order conditions were more likely to agree that the website has greater order than those assigned to lower web page order conditions ($p < 0.05$). Similarly, the *t*-test results also suggest that participants who viewed web pages with higher visual complexity were more likely to agree that the web pages were more complex than were participants who viewed the lower visual complexity web pages ($p < 0.05$). These results indicate that we successfully manipulated web page order and visual complexity.

We then inspected the data for participants who might not have paid attention to the experiment and might have participated just for the reward by examining the two reversed questions in the questionnaire and evaluated their response time to the questions. These responses were removed to prevent contaminating the data set and analysis. Consequently, the data set was reduced to 217 usable responses. The sample consisted of 99 females (45.6 percent) and 118 males. The majority of the subjects were between 18 and 21 years old (81.1 percent). From all the participants, 192 (88.5 percent)

checked or sent email messages every day and 95 (43.7 percent) made one to three online purchases per month.

4.1. Measurement model assessment

The measurement model was assessed for the quality of the research instrument by testing construct validity and construct reliability. Construct validity is demonstrated when there are relatively high correlations between measures of the same construct (convergent validity) and low correlations between measures of different constructs (discriminant validity). Construct reliability was assessed using composite reliability (CR) and Cronbach's alpha. Factor loadings of the constructs, CR values, Cronbach's alpha, and average variance extracted (AVE) are presented in the Appendix. The results reveal that CR values ranged from 0.778 to 0.958 and the Cronbach's alpha values ranged from 0.643 to 0.934. Both the CR and Cronbach's alpha values are above the acceptable level suggested by Hair, Black, Babin, and Anderson (2006). According to studies in IS and other disciplines, items in a construct do not load highly if the coefficient is below 0.4 (Hair, Tatham, Anderson, & Black, 1995), and a value of 0.6 or higher is acceptable (e.g., Bagozzi, Yi, & Phillips, 1991; Chin, Gopal, & Salisbury, 1997; Straub, 1989). After removing high-cross loading items, the lowest loading is 0.619. Thus, the constructs in the survey used in this study demonstrate convergent validity.

Discriminant validity was determined to ensure that constructs differed from each other. The correlation between items in any two constructs should be lower than the square root of the average variance shared by items (e.g., AVE) within a construct (Hair et al., 1995). As shown in the Appendix, the square root of the variance shared between a construct and its measurement items is greater than the correlations between the construct and other constructs in the model. Therefore, the measures satisfy the criteria for discriminant validity.

4.2. Structural model assessment

The research model was then tested using the partial least squares (PLS) technique. The software program used to conduct the PLS analysis was SmartPLS (version 2.0). PLS is a structural equation modeling (SEM) technique that requires fewer data points than covariance-based SEM techniques like LISREL (Chin, 1998). PLS is relatively robust to deviations from a multivariate distribution (Gage, 1999) and more appropriate for studies in the development stage. Based on these considerations, PLS-based SEM better fits our study. However, it is important to note that while this method of analysis is prevalent in the IS behavioral research literature, PLS-based SEM does not generate the model's goodness-of-fit indices as reported in the covariance-based SEM (Wetzels, Odekerken-Schröder, & van Oppen, 2009).

4.3. Influences of web page order and visual complexity on user responses: The combined SEM model

The proposed research model was tested on the overall data set to determine how web page order and visual complexity influence perceived visual appeal, engagement, and intention. Initially, demographic data from the participants were analyzed across the two group conditions to examine whether such factors affect the constructors in the research model. A series of *t*-test analyses was performed on gender, online shopping experience, and Internet usage between the two exposure-time groups. The results do not indicate any significant differences in the demographic factors across the groups and suggest that combining the two data sets will not lead to biased conclusions. Therefore, we carried out the PLS analysis on the proposed research model based on the combined data set from both experimental conditions.

Figure 4 summarizes the results of the hypothesis tests for the overall model (combined exposure times, $n = 217$) including standardized path estimates, *t*-values, and the amount of variance explained in each endogenous variable (R^2). All the hypotheses are supported except for the path from visual complexity to perceived visual appeal. With respect to the variance explained, web page order and complexity together explain approximately 41% of the variance in perceived visual appeal. Perceived visual appeal explains approximately 46% of the variance in engagement, and perceived visual appeal and engagement together explain approximately 60% of the

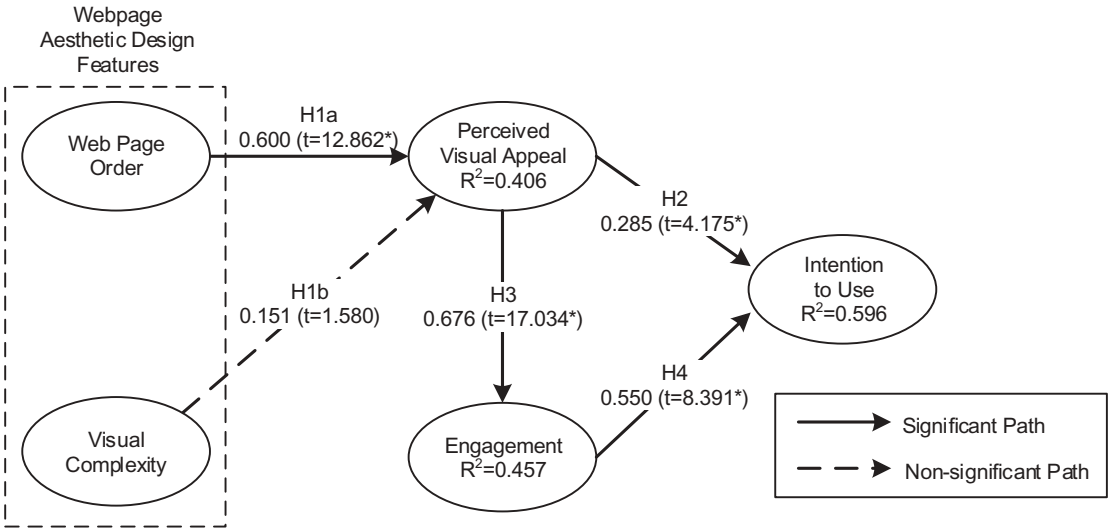


Figure 4. All exposure times (*$p < 0.05$).

variance in intention to use. All the R^2 values of the endogenous constructs in the model exceed the 10% threshold recommended by Falk and Miller (1992). These values are remarkably high and indicate a generally well-specified model.

4.4. Analysis of the initial response: One-second and no-time-constraint models

The relationships between the variables in the proposed research model were evaluated across the two exposure time groups – one second (n = 105) and no-time-constraint (n = 112). The results are exhibited in Figures 5 and 6. The path coefficients across the two models are very consistent with the combined exposure time model (Figure 4). All the causal paths are statistically significant except for the path from visual complexity to perceived visual appeal.

4.5. Multigroup analysis

A PLS-based multigroup SEM analysis (Sarstedt, Henseler, & Ringle, 2011) was performed to determine if the constructs and relationships changed according to the moderating effect of the exposure times (one-second and no-time-constraint). Specifically, the goal was to detect whether the one-second group and the no-time-constraint group make different associations with the constructs in the research model.

According to Sarstedt et al. (2011), a group difference is statistically significant if the p-value is either smaller than 0.05

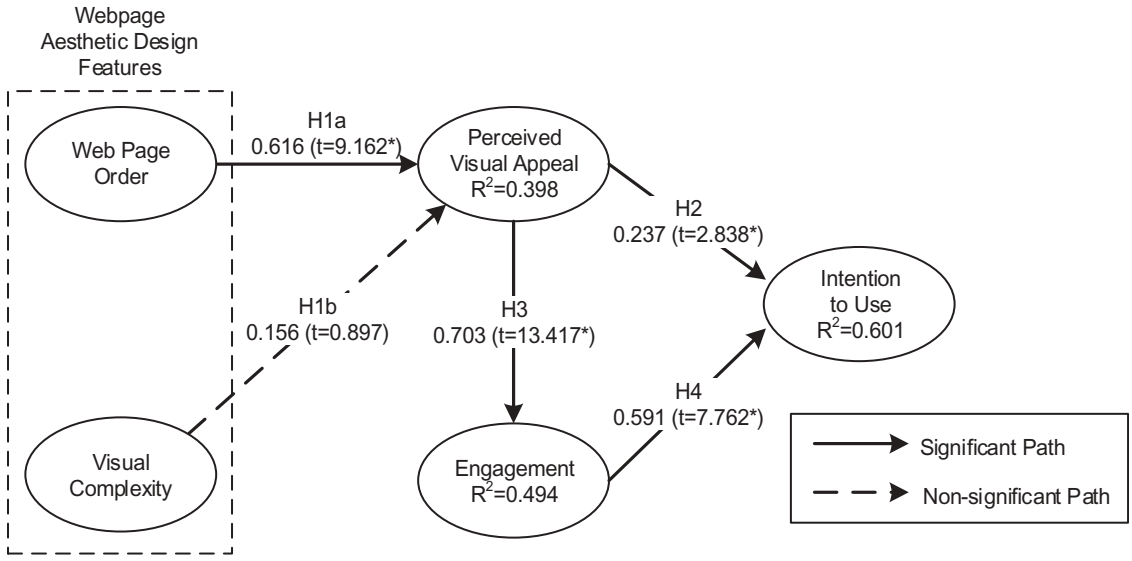


Figure 5. One-second exposure time (*p < 0.05).

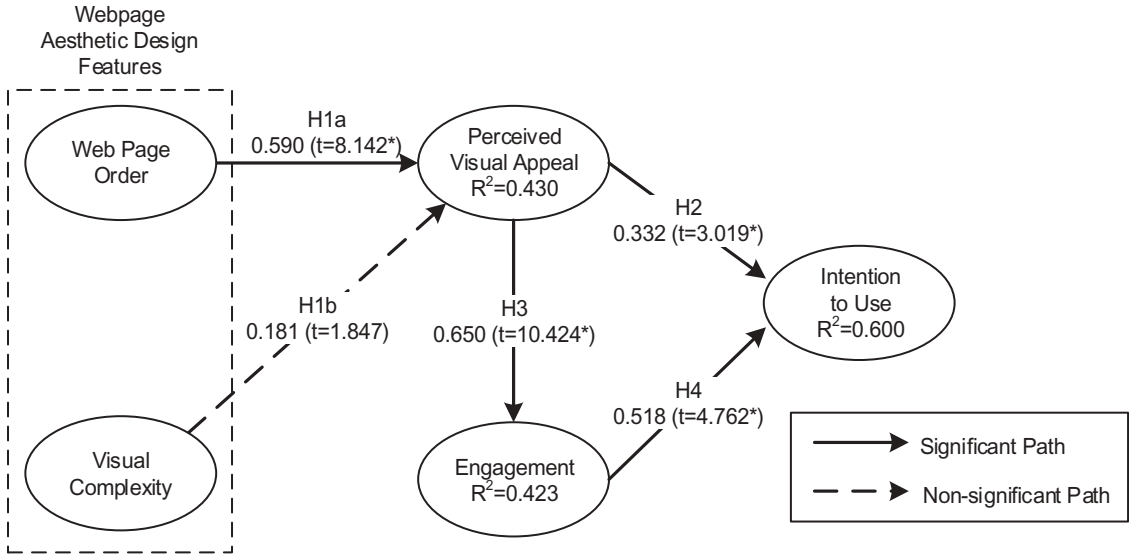


Figure 6. No time constraint (*p < 0.05).

Table 1. Results of multigroup analysis (one-second vs. no-time-constraint).

Path	Absolute Path Difference	*p*-value
Web Page Order → Perceived Visual Appeal	0.026	0.397
Visual Complexity → Perceived Visual Appeal	0.025	0.498
Perceived Visual Appeal → Engagement	0.053	0.267
Perceived Visual Appeal → Intention to Use	0.095	0.760
Engagement → Intention to Use	0.073	0.289

or larger than 0.95 for a certain different group-specific path coefficient. The results, presented in Table 1, do not indicate any significant differences in the causal relations across the exposure time groups. This finding provides evidence that the effects of website design features on user responses are remarkably consistent across exposure times. In other words, the results suggest that users evaluate website designs very quickly (within one second), and these evaluations remain consistent even when time constraints are removed.

4.6. Analysis of the consistency of users' evaluations

In addition to the SEM analysis, a two-way ANOVA was conducted to examine the durability of users' perceptions of visual appeal, engagement, and intention to use across the eight website conditions (two levels of web page order × two levels of visual complexity × two exposure times). The results indicate that the interaction effects of web page order, visual complexity, and exposure time are not statistically significant (order × exposure time, $F = 0.561$ and $p = 0.453$; complexity × exposure time, $F = 0.186$ and $p = 0.667$; order × complexity × exposure time, $F = 0.766$ and $p = 0.384$) and that the web pages with higher order tend to have higher means of perceived visual appeal, engagement, and intention to use websites. Specifically, the results suggest that there is no statistical difference between the two exposure times across the web page conditions. Therefore, participants' ratings of perceived visual appeal, engagement, and intention to use websites appear to be highly consistent across the exposure times. Table 2 presents means and standard deviations of perceived visual appeal, engagement, and intention to use for each of the web page conditions.

4.7. Analysis of attention span

An additional analysis of users' attention span was conducted to evaluate users' attention to website design features. Attention span refers to the ability of an individual to concentrate on exploring relevant information, specifically, in our context, on a web page. The analysis of attention span was conducted on the four conditions of the experimental web page that did not have a time constraint. Note that although participants were asked to freely explore the web pages, the experiment was conducted in a controlled computer lab and the participants were asked to concentrate on the website to minimize distraction.

The averages of time spent viewing the web pages are graphically displayed in Figure 7. The results were analyzed using ANOVA, followed by Tukey's HSD. The results reveal that users' attention span is longer in the high-order-high-complexity web page condition than in the other web page conditions, and the results are statistically significant ($F = 30.225$ $p < 0.05$). There is no significant time difference between the low-order-high complexity, high-order-low-complexity, and low-order-low-complexity conditions ($F = 0.032$, $p = 0.148$). Therefore, considering the web page conditions with high complexity, the results suggest that while both of the web pages contained the same amount of data, the viewing time of the web page with the higher level of web page

Table 2. Means (Std. Dev.) of perceived visual appeal, engagement, and intention to use for each web page condition.

	High Order High Complexity		High Order Low Complexity		Low Order High Complexity		Low Order Low Complexity	
Dependent Variables	One Second	No Time Limit	One Second	No Time Limit	One Second	No Time Limit	One Second	No Time Limit
Perceived Visual Appeal	5.39 (1.46)	5.59 (.98)	5.01 (1.49)	5.12 (1.02)	4.46 (1.23)	4.47 (1.55)	4.83 (1.45)	4.64 (1.50)
Engagement	4.81 (1.52)	4.93 (1.34)	4.62 (1.48)	4.39 (1.27)	4.64 (1.16)	4.48 (1.47)	4.51 (1.48)	4.31 (1.48)
Intention to Use	5.45 (1.43)	5.62 (1.17)	5.36 (1.08)	5.02 (1.27)	4.96 (1.25)	4.35 (1.54)	5.23 (1.54)	4.97 (1.46)

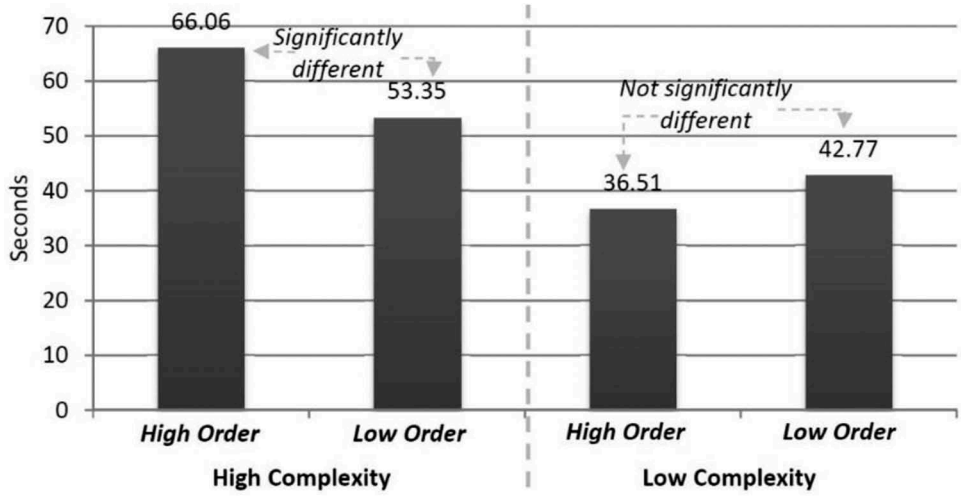


Figure 7. Average time spent viewing web page.

order is significantly longer than the web page with the lower level of order. This result could indicate that users show more interest in web pages with higher levels of order.

5. Discussion and conclusions

5.1. Summary of the findings and discussion

In general, the results of our experiment confirm the findings of previous studies that web users' perceptions of visual appeal, engagement, and intention to use websites are formed quickly (less than 1 second) and are influenced by website visual aesthetic design features. This study extends earlier work in the domain of IS and HCI by investigating the relationships between design features and users' perceptions and behavior across different exposure times. The major findings of this study can be summarized as follows.

Regarding the durability of the effect of website aesthetics on user responses, the SEM results obtained from two different exposure times (one-second vs. no-time-constraint) are remarkably consistent as shown in Figures 5 and 6. Furthermore, these results are confirmed by the results of multigroup analysis (Table 1), suggesting that the paths between the two conditions are not significantly different. Therefore, we can conclude that the one-second and no-time -constraint models are essentially identical and highly stable. These findings confirm that visual processing begins very shortly after the stimulus onset (Vanrullen & Thorpe, 2001). While the results resemble previous studies examining overall initial aesthetic impressions (e.g., Lindgaard et al., 2011), this study goes beyond existing research by investigating order and complexity aspects of website design features to enhance our understanding of the underlying mechanism that establishes aesthetic impressions in the context of online commerce.

Another important finding of this study is the influence of the mediating effect of engagement on the relationship between perceived visual appeal and intention to use websites. It is interesting that both the direct and indirect effects of perceived visual appeal on intention to use websites are comparable in strength and the results are notably reliable across the three models, as shown in Table 3. Therefore, corroborated by existing literature, the findings regarding the effects of initial aesthetic impressions imply that engagement is an important factor in the relationship between visual appeal and intention to use websites and that engagement can be formed within a very short exposure time. In other words, not only does visual appeal determine intention through the halo effect, it also enhances intention to use the website by increasing engagement.

Table 3. The direct, indirect, and total effects of perceived visual appeal (PVA), engagement (EN) on intention to use websites (INT).

	Combined Exposure Time Model			One Second Model			No Time Constraint Model		
Path	Ind. Effect	Direct Effect	Total Effect	Ind. Effect	Direct Effect	Total Effect	Ind. Effect	Direct Effect	Total Effect
PVA → INT	0.372	0.285	0.657	0.415	0.237	0.652	0.337	0.332	0.669
PVA → EN	-	0.676	0.676	-	0.703	0.703	-	0.650	0.650
EN → INT	-	0.550	0.550	-	0.591	0.591	-	0.518	0.518

As proposed in the research model, we hypothesized that web page order and visual complexity would play important roles in determining perceived visual appeal. However, only web page order shows a statistically significant impact on perceived visual appeal. Furthermore, the results are consistent across all three models; 0.60 vs. 0.15 in the combined model; 0.61 vs. 0.15 in the one-second model; 0.59 vs. 0.18 in the no-time-constraint model. Thus, the results suggest that web page order can create a strong positive effect on visual appeal. These results are consistent with previous HCI studies: while visual symmetry (as a dimension of web page order) has repeatedly been reported to highly influence visual appeal. However, our results do not indicate significant effect of visual complexity on visual appeal as suggested by the previous studies. Note that our context is online commerce where websites generally include a smaller number of design elements than those in other areas, such as sports, entertainment, or games. Therefore, the effects of visual complexity, in our case, may not be strong enough to influence visual appeal.

In the context of this study, the ratings of perceived visual appeal, engagement, and intention across exposure times (one-second vs. no-time-constraint) serve as an indicator of online users' evaluation consistency. The results from a series of *t*- tests show no significant difference in the ratings across the two exposure time conditions for all these variables. While these results resemble previous studies on users' immediate response (Lindgaard et al., 2011, 2006; Papachristos & Avouris, 2011; Schaik & Ling, 2009; Tractinsky et al., 2006), this study constitutes a new contribution to IS and HCI research by delineating visual design elements as well as the durability of the underlying mechanism of aesthetic impressions and the effects on user response.

According to the analysis of users' attention span, the average time users spent viewing the web page is 62.81 s for the high-order-high-complexity web page and 54.65 s for the low-order-high-complexity web page. Therefore, given the equal amount of information presented in both web page conditions, participants tend to lose interest in the web pages with a higher level of visual complexity and spent a shorter time viewing them. These results may be explained by cognitive load theory (CLT) (Sweller, van Merrienboer, & Paas, 1998), which hypothesizes that the relationships between visual design features of information displayed on web pages influences users' working memory. If the extraneous cognitive load is increased by a cluttered presentation format, additional working memory is required to process the information, which subsequently decreases users' performance and attention (Paas, Renkl, & Sweller, 2003).

5.2. Theoretical and practical contributions

The major theoretical contribution of this study is the investigation of how website visual design features influence online users' first impressions toward websites. It advances knowledge of the role of user's initial responses to a web page in shaping subsequent judgments toward the website by providing a link between web page order, visual complexity, perceived visual appeal, engagement, and intention to use the website. While visual complexity has been widely studied in

the literature, web page order has received much less attention from researchers. This study extends the previous research by providing evidence that web page order is an important factor in determining initial aesthetic impressions and should be considered in further investigations.

Regarding website engagement, our results indicate that engagement emerges as a key mediator of the path between perceived visual appeal and intention to use the website. The mediating effect of engagement is in addition to the direct effect between visual appeal and intention and is comparable in strength to the direct effect. Furthermore, these results are highly consistent across the three research model analyses. Therefore, we have established the importance of examining engagement in the causal relationship between perceived visual appeal and intention. Specifically, in future studies, we suggest taking engagement into account to fully understand the impact of website aesthetic design features on behavioral intention.

In addition to the investigation of the effects of perceived visual appeal on user responses, the current study draws attention to the presence of the exposure times in the interaction between users and websites. This study extends previous work with respect to the explanation of the influence of perceived visual appeal across different exposure times. The results indicate that the relationships among the constructs hypothesized in the research model are notably consistent across different samples presented in two exposure times. These results suggest that the research model is highly reliable.

Furthermore, the current study indicates that the processing capability of online users may be limited and that it is affected by web page order and visual complexity, as shown by the time spent viewing the web pages. While studies in the marketing domain have investigated how users' attention is allocated to different physical properties of the ads (e.g., size, color, and distances) (see, e.g., MacInnis et al., 1991; Rosbergen, Pieters, & Wedel, 1997), our results provide evidence that the characteristics of websites (especially web page order) influence users' attention, and that how exactly this occurs should be further investigated.

As for practical contributions, the findings of this research provide a better understanding of the relationships between website design features and users' evaluations and responses, especially in the business domain, which can help managers develop strategies for websites that elicit the desired responses. The results of our study clearly set forth principles of website aesthetics design by investigating major design features that constitute aesthetic aspects for designers: complexity and order. As demonstrated by the results, users' evaluation of a website can occur within one second and is primarily influenced by web page order and visual appeal. Websites with a high level of order received a higher rating on visual appeal by users, which consequently increases engagement. Therefore, website designers should enhance the visual order of website design to increase visual appeal. With respect to this goal, designers may want to pursue design principles such as alignment and proximity (Williams & Tollett, 2006).

In addition, our research suggests the importance of web page order and visual complexity in influencing user behavior. While the relationship between visual complexity and visual appeal was not supported in the hypothesis testing, the results from the attention span analysis reveal that both web page order and visual complexity may encourage users to browse websites. However, website designers should be cautioned that complexity is bounded by additional factors. Increasing the number of design elements and features could also increase cognitive load (Sweller et al., 1998) and impact the visual order of the web page.

5.3. Limitations and conclusions

Some limitations of this study should be noted. First, it is important to mention that while prior studies have yielded mixed results regarding the relationship between visual complexity and visual appeal, we only examined elementary components of visual complexity (text links and images) and hypothesized that it has a negative relationship with visual appeal. Therefore, in a different context (e.g., entertainment, sports, and games), where the comprehensive dimensions of more visual complexity components are investigated, the results might be different. Second, while visual order and complexity of the stimuli were manipulated based on accepted design guidelines of actual websites, the stimuli were configured to extreme levels so that the effects of visual order and complexity would be highly prominent and could be easily recognized by participants. However, some participants may have felt that the web pages appeared unnatural, and this could have confounded the conclusions of the study. Third, in order to control for the confounding effects of other attributes of websites (e.g., usability) and increase the internal validity of the results, we used static rather than dynamic website stimuli in this study. The links on the web pages were deactivated, which may have adversely affected the realism of the experimental task. Finally, we used a single website category, a dorm room furniture store. While such a website is of interest for college students, it may limit the generalizability of the results to other website categories.

With the evolution of search engines as a portal for online commerce channels, recent attention by researchers has been focused on how a website, in the presence of an extensive list of online vendors competing to offer products/services, engages users and encourages them to use the website. The results from the combined sample of participants, from both exposure times, confirm the relationships of web page order, visual appeal, engagement, and intention to use and support earlier work in user perceptions and responses.

To conclude, the current research is the beginning of a stream of research based on investigating the influences of website interface design on users' initial responses and their consequences. The study reveals that online users can evaluate websites within a very short period of exposure and the evaluations are highly reliable, being relatively consistent over time. The relevance of this work for online customer behavior is evident. Given billions of websites, online vendors are vigorously competing to "lock" their potential customers into their website. As the competitive landscape has become increasingly aggressive in the online market, this stream of research is critical to the success of online vendors.

Note

1. We use the term "web page" and "website" interchangeably, with the understanding that website often refers to the home page of a website, which is a web page.

References

Arnheim, R. (1966). Order and complexity in landscape design. In R. Arnheim (Ed.), *Toward a Psychology of Art* (pp. 123–135). Berkeley, CA: University of California Press.

Bagozzi, R. P., Yi, Y., & Phillips, L. W. (1991). Assessing construct validity in organizational research. *Administrative Science Quarterly*, *36*(3), 421–458. doi:10.2307/2393203

Bauerly, M., & Liu, Y. (2008). Effects of symmetry and number of compositional elements on interface and design aesthetics. *International Journal of Human–Computer Interaction*, *24*(3), 275–287. doi:10.1080/10447310801920508

Berlyne, D. E. (1970). Novelty, complexity, and hedonic value. *Attention, Perception, & Psychophysics*, *8*(5), 279–286. doi:10.3758/bf03212593

Berlyne, D. E. (1971). *Aesthetics and psychobiology*. New York, NY: Appleton-Century-Crofts.

Bi, L., Fan, X., & Liu, Y. (2011). Effects of symmetry and number of compositional elements on chinese users' aesthetic ratings of interfaces: Experimental and modeling investigations. *International Journal of Human–Computer Interaction*, *27*(3), 245–259. doi:10.1080/10447318.2011.537208

Bloch, P. H. (1995). Seeking the ideal form: Product design and consumer response. *The Journal of Marketing*, *59*(3), 16–29. doi:10.1177/002224299505900302

Chaiken, S. (1980). Heuristic versus systematic information processing and the use of source versus message cues in persuasion. *Journal of Personality and Social Psychology*, *39*(5), 752–766. doi:10.1037/0022-3514.39.5.752

Chin, W. W. (1998). The partial least squares approach for structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295–336). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Chin, W. W., Gopal, A., & Salisbury, W. D. (1997). Advancing the theory of adaptive structuration: The development of a scale to measure faithfullness of appropriation. *Information Systems Research*, *8*(4), 342. doi:10.1287/isre.8.4.342

Cox, D., & Cox, A. D. (2002). Beyond first impressions: The effects of repeated exposure on consumer liking of visually complex and simple product designs. *Journal of the Academy of Marketing Science*, *30*(2), 119–130. doi:10.1177/03079459994371

Cyr, D. (2008). Modeling web site design across cultures: Relationships to trust, satisfaction, and e-Loyalty. *Journal of Management Information Systems*, *24*(4), 47–72. doi:10.2753/MIS0742-1222240402

Cyr, D., Head, M., & Ivanov, A. (2006). Design aesthetics leading to m-loyalty in mobile commerce. *Information & Management*, *43*(8), 950–963. doi:10.1016/j.im.2006.08.009

Cyr, D., Head, M., & Larios, H. (2010). Colour appeal in website design within and across cultures: A multi-method evaluation. *International Journal of Human-Computer Studies*, *68*(1–2), 1–21. doi:10.1016/j.ijhcs.2009.08.005

Cyr, D., Head, M., Larios, H., & Pan, B. (2009). Exploring human images in website design: A multi-method approach. *MIS Quarterly*, *33*(3), 539–566. doi:10.2307/20650308

Deng, L., & Poole, M. S. (2010). Affect in web interfaces: A study of the impacts of web page visual complexity and order. *MIS Quarterly*, *34*(4), 711–730. doi:10.2307/25750702

Dong, Y., Ling, C., & Hua, L. (2007). *Effect of glance duration on perceived complexity and segmentation of user interfaces. Proceedings of the 12th international conference on human-computer interaction: Intelligent multimodal interaction environments*, Beijing, China.

Éthier, J., Hadaya, P., Talbot, J., & Cadieux, J. (2006). B2C website quality and emotions during online shopping episodes: An empirical study. *Information & Management*, *43*, 627–639. doi:10.1016/j.im.2006.03.004

Éthier, J., Hadaya, P., Talbot, J., & Cadieux, J. (2008). Interface design and emotions experienced on B2C web sites: Empirical testing of a research model. *Computers in Human Behavior*, *24*(6), 2771–2791. doi:10.1016/j.chb.2008.04.004

Everard, A., & Galletta, D. F. (2005). How presentation flaws affect perceived site quality, trust, and intention to purchase from an online store. *Journal of Management Information Systems*, *22*(3), 56–95. doi:10.2753/MIS0742-1222220303

Falk, R. F., & Miller, N. B. (1992). *A primer for soft modeling*. Akron, OH: University of Akron Press.

Gage, J. (1999). *Color and culture: Practice and meaning from antiquity to abstraction*. Berkeley, CA: The University of California Press.

Geissler, G. L., Zinkhan, G. M., & Watson, R. T. (2001). Web home page complexity and communication effectiveness. *Journal of the Association for Information Systems*, *2*, 1.

Geissler, G. L., Zinkhan, G. M., & Watson, R. T. (2006). The influence of home page complexity on consumer attention, attitudes, and purchase intent. *Journal of Advertising*, *35*(2), 69–80. doi:10.1080/00913367.2006.10639232

Gilboa, S., & Rafaeli, A. (2003). Store environment, emotions and approach behaviour: Applying environmental aesthetics to retailing. *The International Review of Retail, Distribution and Consumer Research*, *13*(2), 195–211. doi:10.1080/0959396032000069568

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2006). *Multivariate data analysis*. Uppder Saddle River, NJ: Prentice Hall.

Hair, J. F., Tatham, R. L., Anderson, R. E., & Black, W. C. (1995). *Multivariate data analysis*. Englewood Cliffs, NJ: Prentice Hall.

Hassanein, K., Head, M., & Ju, C. (2009). A cross-cultural comparison of the impact of social presence on website trust, usefulness and enjoyment. *International Journal of Electronic Business*, *7*(6), 625–641. doi:10.1504/ijeb.2009.02905

Holbrook, M. B., & Hirschman, E. C. (1982). The experiential aspects of consumption: Consumer fantasies, feelings, and fun. *Journal of Consumer Research*, *9*(2), 132–140. doi:10.1086/jcr.1982.9.issue-2

Hwang, Y., & Kim, D. J. (2007). Customer self-service systems: The effects of perceived web quality with service contents on enjoyment, anxiety, and e-trust. *Decision Support Systems*, *43*(3), 746–760. doi:10.1016/j.dss.2006.12.008

Jacobsen, T. (2004). Individual and group modelling of aesthetic judgment strategies. *British Journal of Psychology*, *95*(1), 41–56. doi:10.1348/000712604322779451

Jacobsen, T., & Höfel, L. (2002). Aesthetic judgments of novel graphic patterns: Analyses of individual judgments. *Perceptual and Motor Skills*, *95*(2002), 755–766. doi:10.2466/pms.2002.95.3.755

Jacobsen, T., & Höfel, L. (2003). Descriptive and evaluative judgment processes: Behavioral and electrophysiological indices of processing symmetry and aesthetics. *Cognitive, Affective, & Behavioral Neuroscience*, *3*(4), 289–299. doi:10.3758/cabn.3.4.289

Jacques, R., Precce, J., & Carey, J. T. (1995). Engagement as a design concept for hypermedia. *Canadian Journal of Educational Communications, Spring*, 49–59.

Jarvenpaa, S., Tractinsky, N., & Vitale, M. (2000). Consumer trust in an Internet store. *Information Technology and Management*, *1*(1), 45–71. doi:10.1023/A:1019104520776

Jiang, Z., Wang, W., Tan, B. C. Y., & Yu, J. (2016). The determinants and impacts of aesthetics in users' first interaction with websites. *Journal of Management Information Systems*, *33*(1), 229–259. doi:10.1080/07421222.2016.1172443

Kaiser, S. (2001). Your website's first impression happens only once. Retrieved from http://skdesigns.com/newsletter/v2n2.shtml

Kaplan, S., & Kaplan, R. (1983). *Cognition and environment: Functioning in an uncertain world*. Belmont, CA: Praeger Publishers.

Karimov, F. P., Brengman, M., & Van Hove, L. (2011). The effect of website design dimensions on initial trust: A synthesis of the empirical literature. *Journal of Electronic Commerce Research*, *12*(4), 272–301.

Kim, H., & Fesenmaier, D. R. (2008). Persuasive design of destination web sites: An analysis of first impression. *Journal of Travel Research*, *47*(1), 3–13. doi:10.1177/0047287507312405

Lederer, A. L., Maupin, D. J., Sena, M. P., & Zhuang, Y. (1998). *The role of ease of use, usefulness and attitude in the prediction of World Wide Web usage. Proceedings of the 1998 ACM SIGCPR conference on computer personnel research*, Boston, Massachusetts, United States.

Lin, A. C. H., Fernandez, W. D., & Gregor, S. (2012). Understanding web enjoyment experiences and informal learning: A study in a museum context. *Decision Support Systems*, *53*(4), 846–858. doi:10.1016/j.dss.2012.05.020

Lindgaard, G., Dudek, C., Sen, D., Sumegi, L., & Noonan, P. (2011). An exploration of relations between visual appeal, trustworthiness and perceived usability of homepages. *ACM Trans. Computer-Human Interaction*, *18*(1), 1–30. doi:10.1145/1959022.1959023

Lindgaard, G., Fernandes, G., Dudek, C., & Browñ, J. (2006). Attention web designers: You have 50 milliseconds to make a good first impression! *Behaviour & Information Technology*, *25*(2), 115–126. doi:10.1080/01449290500330448

Loken, B. (2006). Consumer psychology: Categorization, inferences, affect, and persuasion. *Annual Review of Psychology*, *57*(1), 453–485. doi:10.1146/annurev.psych.57.102904.190136

Luna, D., Peracchio, L., & de Juan, M. (2002). Cross-cultural and cognitive aspects of web site navigation. *Journal of the Academy of Marketing Science*, *30*(4), 397–410. doi:10.1177/009207002236913

MacInnis, D. J., Moorman, C., & Jaworski, B. J. (1991). Enhancing and measuring consumers' motivation, opportunity, and ability to process brand information from ads. *Journal of Marketing*, *55*(4), 32–53. doi:10.2307/1251955

Mai, R., Hoffmann, S., Schwarz, U., Niemand, T., & Seidel, J. (2014). The shifting range of optimal web site complexity. *Journal of Interactive Marketing*, *28*(2), 101–116. doi:10.1016/j.intmar.2013.10.001

Meyers-Levy, J., & Malaviya, P. (1999). Consumers' processing of persuasive advertisements: An integrative framework of persuasion theories. *Journal of Marketing*, *63*, 45–60. doi:10.2307/1252100

Nadkarni, S., & Gupta, R. (2007). A task-based model of perceived website complexity. *MIS Quarterly*, *31*(3), 501–524. doi:10.2307/25148805

Nasar, J. L. (2000). The evaluative image of places. In W. B. Walsh, K. H. Craik, & R. H. Price (Eds.), *Person-environment psychology* (pp. 117–168). Mahwah, NJ: Erlbaum.

Nisbett, R. E., & Wilson, T. D. (1977). The halo effect: Evidence for unconscious alteration of judgments. *Journal of Personality and Social Psychology*, *35*(4), 250–256. doi:10.1037/0022-3514.35.4.250

Norman, D. A. (2004). *Emotional design: Why we love (or hate) everyday things*. New York, NY: Basic Books.

O'Brien, H. L., & Toms, E. G. (2010). The development and evaluation of a survey to measure user engagement. *Journal of the American Society for Information Science and Technology*, *61*(1), 50–69. doi:10.1002/asi.21229

Paas, F., Renkl, A., & Sweller, J. (2003). Cognitive load theory and instructional design: Recent developments. *Educational Psychologist*, *38*(1), 1–4. doi:10.1207/S15326985EP3801_1

Palmer, J. W. (2002). Web site usability, design, and performance metrics. *Information Systems Research*, *13*(2), 151–167. doi:10.1287/isre.13.2.151.88

Papachristos, E., & Avouris, N. (2011). Are first impressions about websites only related to visual appeal? In P. Campos, N. Graham, J. Jorge, N. Nunes, P. Palanque, & M. Winckler (Eds.), *Human-Computer Interaction – INTERACT 2011* (Vol. 6946, pp. 489–496). Berlin, Heidelberg.: Springer.

Pastore, M. (2000). U.S. college students use net for shopping. Retrieved from http://www.clickz.com/stats/sectors/demographics/article.php/432631

Reinecke, K., Yeh, T., Miratrix, L., Mardiko, R., Zhao, Y., Liu, J., & Gajos, K. Z. (2013). *Predicting users' first impressions of website aesthetics with a quantification of perceived visual complexity and colorfulness. Proceedings of the SIGCHI conference on human factors in computing systems*, Paris, France.

Rosbergen, E., Pieters, R., & Wedel, M. (1997). Visual attention to advertising: A segment level analysis. *Journal of Consumer Research*, *24*(3), 305–314. doi:10.1086/jcr.1997.24.issue-3

Roseman, I. J., Antoniou, A. A., & Jose, P. E. (1996). Appraisal determinants of emotions: Constructing a more accurate and comprehensive theory. *Cognition and Emotion*, *10*(3), 241–278. doi:10.1080/026999396380240

Sandelands, L. E., & Buekner, G. C. (1989). Of art and work: Aesthetic experience and the psychology of work feelings. In L. L. Cummings & B. M. Staw (Eds.), *Research in organizational behaviour* (pp. 105–131). Greenwich, CT: JAI Press.

Sarstedt, M., Henseler, J., & Ringle, C. M. (2011). Multigroup analysis in partial least squares (PLS) path modeling: Alternative methods and empirical results. In M. Sarstedt, M. Schwaiger, & C. R. Taylor (Eds.), *Measurement and research methods in international marketing* (pp. 195–218). Bingley, UK: Emerald Group Publishing Limited.

Schaik, P., & Ling, J. (2009). The role of context in perceptions of the aesthetics of web pages over time. *International Journal of Human-Computer Studies*, *67*(1), 79–89. doi:10.1016/j.ijhcs.2008.09.012

Seckler, M., Opwis, K., & Tuch, A. N. (2015). Linking objective design factors with subjective aesthetics: An experimental study on how structure and color of websites affect the facets of users' visual aesthetic perception. *Computers in Human Behavior*, *49*, 375–389. doi:10.1016/j.chb.2015.02.056

Sengupta, S. A., Balaji, M. S., & Krishnan, B. C. (2015). How customers cope with service failure? A study of brand reputation and customer satisfaction. *Journal of Business Research*, *68*(3), 665–674. doi:10.1016/j.jbusres.2014.08.005

Skulmowski, A., Augustin, Y., Pradel, S., Nebel, S., Schneider, S., & Rey, G. D. (2016). The negative impact of saturation on website trustworthiness and appeal: A temporal model of aesthetic website perception. *Computers in Human Behavior*, *61*, 386–393. doi:10.1016/j.chb.2016.03.054

Statista. (2018). Retail e-commerce sales in the United States from 2016 to 2022 (in million U.S. dollars). Retrieved from https://www.statista.com/statistics/272391/us-retail-e-commerce-sales-forecast/

Straub, D. W. (1989). Validating instruments in MIS research. *MIS Quarterly*, *13*(2), 147–169. doi:10.2307/248922

Sweller, J., van Merrienboer, J., & Paas, F. (1998). Cognitive architecture and instructional design. *Educational Psychology Review*, *10*(3), 251–296. doi:10.1023/a:1022193728205

Thielsch, M. T., Blotenberg, I., & Jaron, R. (2013). User evaluation of websites: From first impression to recommendation. *Interacting with Computers*, *26*(1), 89–102. doi:10.1093/iwc/iwt033

Thielsch, M. T., & Hirschfeld, G. (2012). Spatial frequencies in aesthetic website evaluations – Explaining how ultra-rapid evaluations are formed. *Ergonomics*, *55*(7), 731–742. doi:10.1080/00140139.2012.665496

Tractinsky, N., Cokhavi, A., Kirschenbaum, M., & Sharfi, T. (2006). Evaluating the consistency of immediate aesthetic perceptions of web pages. *International Journal of Human-Computer Studies*, *64*(11), 1071–1083. doi:10.1016/j.ijhcs.2006.06.009

Tuch, A. N., Bargas-Avila, J. A., & Opwis, K. (2010). Symmetry and aesthetics in website design: It's a man's business. *Computers in Human Behavior*, *26*(6), 1831–1837. doi:10.1016/j.chb.2010.07.016

Tuch, A. N., Bargas-Avila, J. A., Opwis, K., & Wilhelm, F. H. (2009). Visual complexity of websites: Effects on users' experience, physiology, performance, and memory. *International Journal of Human-Computer Studies*, *67*(9), 703–715. doi:10.1016/j.ijhcs.2009.04.002

Tuch, A. N., Presslaber, E. E., Stöcklin, M., Opwis, K., & Bargas-Avila, J. A. (2012). The role of visual complexity and prototypicality regarding first impression of websites: Working towards understanding aesthetic judgments. *International Journal of Human-Computer Studies*, *70*(11), 794–811. doi:10.1016/j.ijhcs.2012.06.003

Vanrullen, R., & Thorpe, S. J. (2001). The time course of visual processing: From early perception to decision-making. *Journal of Cognitive Neuroscience*, *13*(4), 454–461. doi:10.1162/089892901520018880

Wang, Q., Yang, S., Liu, M., Cao, Z., & Ma, Q. (2014). An eye-tracking study of website complexity from cognitive load perspective. *Decision Support Systems*, *62*, 1–10. doi:10.1016/j.dss.2014.02.007

Webster, J., & Ahuja, J. S. (2006). Enhancing the design of web navigation systems: The influence of user disorientation on engagement and performance. *MIS Quarterly*, *30*(3), 661–678. doi:10.2307/25148744

Wetzels, M., Odekerken-Schröder, G., & van Oppen, C. (2009). Using PLS path modeling for assessing hierarchical construct models: Guidelines and empirical illustration. *MIS Quarterly*, *33*(1), 177–195. doi:10.2307/20650284

Williams, R., & Tollett, J. (2006). *The non-designer's web book*. Berkley, CA: Peachpit Press.

Yanzhen, Y. (2014). *Two essays on interface designs in collaborative and social e-commerce*. (Unpublished doctoral dissertation), National University of Singapore, Singapore.

Zheng, X. S., Chakraborty, I., Lin, J. J.-W., & Rauschenberger, R. (2009). *Correlating low-level image statistics with users - rapid aesthetic and affective judgments of web pages. Proceedings of the SIGCHI conference on human factors in computing systems*, Boston, MA, USA.

About the Authors

Supavich (Fone) Pengnate is currently an Assistant Professor of Management Information Systems in the College of Business, North Dakota State University. He holds a Ph.D. in Business Administration from Oklahoma State University. His research interests include technologies adoption, interface design for interactive environments, and business analytics.

Rathindra Sarathy is the Ardmore Professor of Business Administration in the Department of Management Science of Information Systems at Oklahoma State University. He received his Ph.D. from Texas A&M University. His current research interests include privacy and confidentiality, data masking, data and information security, and e-commerce.

JinKyu Lee is an Associate Professor of Management Science and Information Systems at Oklahoma State University. He holds a Ph.D. in Business Administration from the State University of New York at Buffalo. His current research interests include inter-organizational information sharing and organizational transformation and effective information security and privacy measures.

Appendix

Convergent and Discriminant Validity Instrument, factor loadings, composite reliability, Cronbach's alpha, and AVE.

		Factor				
Construct	Items	1	2	3	4	5
Web Page Order						
The layout of the information presented on the website was effective.	ORD1	**0.738**	0.006	0.266	0.208	0.192
The layout of the website was well organized and clear.	ORD2	**0.864**	0.047	0.182	0.146	0.228
*The location of the items displayed on the website (i.e. logo, search functions, menus and navigation tools etc.) was predictable.**	ORD3	-	-	-	-	-
I find the information on the website to be well organized.	ORD4	**0.854**	0.136	0.194	0.067	0.137
CR = 0.942, Alpha = 0.908, AVE = 0.845						
Visual Complexity						
Visually, the visual design of the website was (Very Complex – Very Simple).	COM1	0.088	**0.754**	0.100	0.055	0.018
Visually, the information presented on the website was (Very Dense – Very Scattered).	COM2	0.019	**0.643**	0.198	0.014	0.108
*The graphics on the web page were (Very Dense – Very Scattered).**	COM3	-	-	-	-	-
*The choice of both image and text clicks was (Very Broad – Very Narrow).**	COM4	-	-	-	-	-
CR = 0.778, Alpha = 0.634, AVE = 0.654						
Visual Appeal						
The website was visually attractive.	VA1	0.434	0.064	**0.722**	0.276	0.332
*The website did not use visually appealing graphics.***	VA2	0.275	0.068	**0.787**	0.260	0.208
The visual design of this website was attractive.	VA3	0.279	0.075	**0.619**	0.361	0.285
*The overall look and feel of the website was visually appealing.**	VA4	-	-	-	-	-
CR = 0.943, Alpha = 0.910, AVE = 0.848						
Engagement						
*I believe that the website would hold my attention.**	ENG1	-	-	-	-	-
I believe that the website would excite my curiosity.	ENG2	0.174	0.023	0.335	**0.681**	0.401
I believe that the website would arouse my imagination.	ENG3	0.105	0.031	0.192	**0.818**	0.291
I believe that the website would engage me.	ENG4	0.232	0.019	0.282	**0.679**	0.397
CR = 0.938, Alpha = 0.902, AVE = 0.836						
Intention to Use						
I would enjoy exploring or investigating this website.	INT1	0.256	0.067	0.224	0.365	**0.744**
I like to spend much time browsing this website.	INT2	0.213	0.041	0.207	0.324	**0.845**
It is likely that I would return to this website.	INT3	0.241	0.102	0.283	0.352	**0.715**
CR = 0.958, Alpha = 0.934, AVE = 0.884						

*Removed Item, **Reversed Item, Bold text indicates the items in the construct

Discriminant Validity Tests

	Web Page Order	Visual Complexity	Visual Appeal	Engagement	Intention to Use
Web Page Order	**0.919**				
Visual Complexity	0.131	**0.808**			
Visual Appeal	0.619	0.224	**0.920**		
Engagement	0.445	0.111	0.675	**0.914**	
Intention to Use	0.180	0.180	0.656	0.742	**0.940**