Research

Modeling virtual exploratory and shopping dynamics: an environmental psychology approach

Ming-Hui Huang^{*}

Graduate Institute of Electronic Commerce, National Chung Hsing University, Taichung 402, Taiwan

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Abstract

A huge amount of research in academia and industry has focused on the hardware and technological side of information systems, while the role of emotions in the way these systems are utilized has been largely neglected. However, recent developments in other disciplines have suggested that emotions play a significant role in decision-making. To address this state of affairs, this study draws upon hypotheses from environmental psychology; specifically, that users' tendencies to approach or avoid environments are modeled on the basis of user reaction to the information load of a virtual environment and the emotions that such an environment elicits. A field experiment was conducted in which users visited popular shopping websites. The work demonstrated how information load and emotions influence virtual exploratory and shopping decisions.

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1. Introduction

Much research in the past ignored the role of emotions and how they affect purchasing decisions. However, in other disciplines have suggested that emotions, reason, and quality of information all play a major role in the decision-making process (e.g. see [1,25,31]). To address this state of affairs, this study draws upon hypotheses from Mehrabian and Russell's [26] environmental psychology approach; specifically, this states that users' tendencies to approach or avoid environments are modeled on the basis of their reaction to the information load of the virtual shopping environment and the emotions that this environment elicits. Thus, the following three issues jointly determine the users' desires to use the web:

- The differences between individuals and the way their interest is stimulated on-line (by inspiring "arousal seeking tendencies").
- The information characteristics of virtual shopping environments (the information available).
- The emotions experienced in using the environments.

The environmental psychology approach has been widely used to examine traditional shopping dynamics (e.g. [8,13,39]). The application of this approach to virtual on-line shopping demands revision of the theoretical framework and empirical examination of shopper behavior to take into account the distinguishing characteristics of the virtual environment.

1. Users not only search the web for specific information, they also surf it for entertainment, stimulation, and to socialize. These are all important aspects of on-line shopping dynamics [11,27,38].

^{*} Tel.: +886-4-22854910.

E-mail address: mhuang@nchu.edu.tw (M.-H. Huang).

2. Virtual on-line shopping environments are more technically complex and information-intensive than traditional ones. This influences the extent to which on-line users perceive themselves to be able to dominate their interaction with the environments they encounter. Dominance, one of the emotional dimensions specified in the environmental psychology model, has been found to have significant impact on users' behavioral decisions.

2. The Mehrabian–Russell model

2.1. The theoretical framework

The theory of environmental psychology includes two major topics: the effects of the information characteristics of environments on decisions to approach or avoid those environments, and the impacts of emotions experienced in the environments due to those decisions. The model makes three major predictions about an individual's decisions to approach or avoid environments.

1. The arousal-seeking tendency (AST) of an individual determines the types of environments he or she prefers. AST involves the characteristic response of an individual to the information characteristics of his or her environment. Individuals who have a low AST prefer *calm* environments, whereas individuals who have a high AST actively seek stimulation to increase their arousal by selecting *novel*, *complex*, or *unpredictable* environments.
2. The information load of an environment determines the emotional level experienced by individuals in that environment. Information rate (load) depends on information characteristics, which involve complex spatial and temporal factors (such as volume and rate of change) of information in the environment. These information characteristics therefore include attributes of the information, e.g. is it complex, random, intense, jarring, heterogeneous, dissonant, intermittent, rare, novel, surprising, meaningless, asymmetrical, close, crowded, and dense? Environments with a large amount of information are more likely to elicit unpleasant emotions, such as the user feeling that he or she has lost control over interaction with the environment.

3. Emotions experienced in an environment determine the individuals' decision to approach or avoid the environment. Three emotional dimensions characterize an individual's feelings in the environment: arousal, pleasure, and dominance.
 - *Arousal* ranging from sleep to frenzied excitement.
 - *Pleasure* ranging from extreme pain or unhappiness to extreme happiness or ecstasy.
 - *Dominance* depending whether the individual feels restricted or unrestricted (free to act a variety of ways) within the environment.

Thus, the tendency of individuals to approach or avoid an environment is broadly defined to include physical movement toward or away from, degree of attention to, extent of exploration in, and favorable attitudes toward the environment. Pleasant emotions increase willingness to approach the environment that elicits those emotions, whereas unpleasant emotions lead to the tendency to avoid the environment. Thus, web users who have different arousal-seeking tendencies will respond differently to the same environment [18].

2.2. Environmental psychology in virtual environments

Information load has been operationalized in different ways, including the amount of information [28], number of alternative outcomes [32], and overall diversity of the information [20]. In the context of virtual environments, it can be used to refer to the number of different elements, features, or information cues of a site.

The *emotions* experienced by users in virtual environments are commonly conceptualized as flow. This is characterized by two factors: intense concentration and enjoyment [15]. In flow states, users experience feelings of control over human and computer interaction, and thus feel in control of their own actions and choices [34]. The three major dimensions used to measure flow, enjoyment, concentration, and control [15], correspond closely to the three emotional dimensions, pleasure, arousal, and dominance of the environmental psychology model.

Users' *decisions to approach or avoid virtual environments* can be conceptualized as falling into one of two broad categories of on-line behavior: virtual

exploration and shopping. Virtual exploration involves a desire or willingness to move through or interact with the web. During exploration, some interaction takes place between the surfer and the web page; this may involve the user spending time reading the text or looking at the graphics, or it could involve the user completing a form or querying a database. Because this requires user effort, virtual shopping requires a desire or willingness to carry out transactions on the web. Transactions involve processes such as ordering, delivery and payment [35]. The desire to shop indicates that the surfers are willing to become buyers and contribute to the profit stream of the companies that have defined their presence by a set of web pages. The willingness of users to e-shop on the Internet has been used to gauge the success or failure of e-commerce [23].

3. The hypotheses of this research

Three hypotheses are presented. The AST–arousal hypothesis recognizes that users seek environmental stimulation to match their AST. The information load–emotion hypothesis specifies that highly information laden virtual environments are unpleasant. The emotion–approach hypothesis predicts that users will want to approach pleasant, stimulating, and controllable virtual environments.

3.1. The AST–arousal hypothesis

The ASTs of users determine their preferred levels of stimulation and the degrees of arousal they experience in virtual shopping environments. Individuals attempt to maintain an optimal level of stimulation that minimizes their boredom while ensuring there is not too much stimulation [3]. As such, individuals with high ASTs actively seek out new stimuli and situations because of their greater need for environmental stimulation. Individuals with low ASTs, on the other hand, are likely to feel more comfortable with familiar stimuli and situations [29]. Hoffman and Novak claimed that, in computer-mediated environments, users with low ASTs tend to screen out irrelevant information and are thus less aroused by a given information load than users with high ASTs. These studies suggest that users will actively seek out environmental stimulations that match

their AST in order to experience their optimal level of arousal.

Research has suggested that on-line shoppers have higher ASTs and are therefore more likely to experience higher levels of arousal due to the stimulation provided by novel and complex virtual environments. For example, Donthu and Garcia [10] found that Internet shoppers are more innovative, impulsive, variety seeking, and less risk averse than Internet non-shoppers. Kierzkowski et al. [22] found that digital consumers are more likely than their non-wired counterparts to make an effort to use new devices and methods.

Since it would seem that a customer at a high optimal arousal level would be the most likely to purchase an object, we posit a positive association between a user's AST and the arousal he or she experiences in a given virtual environment. Thus:

H1. The AST of a user is positively related to arousal experienced in virtual shopping environments.

3.2. The information load–emotion hypothesis

The information load of a virtual environment affects the emotions that users experience in them. Heavily laden virtual environments are more likely to elicit unpleasant emotions. Csikszentmihalyi [7] stated that users frequently felt that the challenges imposed by computer-mediated environments exceed their skills, resulting in negative emotions about the operation. Trevino and Webster found that the difficulties that users experienced when interacting with computer-mediated communication technologies made them experience the unpleasant feelings of losing control over their own actions and consequently with their interactions with the computer. Webster et al. [36] stated that, within the human–computer interaction, if the computer activity is too demanding, it could cause unpleasant anxiety rather than pleasant flows. Hoffman and Novak claimed that, when navigators are overwhelmed by the wide variety of options available to them in computer-mediated environments, they experience negative feelings because they perceive their skills to be insufficient to meet the challenges imposed by the environment. Burke [5] reported a survey of 220 consumers who had shopped on the Internet and discovered that they complained that the

web was hard to navigate and that it was difficult to find specific items. Shoppers thus expressed disappointment with retailers on the Internet. Chang and Cheung [6] found that complexity is negatively related to the affect experienced when using the web. On the basis of this, they suggested that designing an easy-to-use system is an important goal for system development projects.

With the recognition of the information intensive and technologically complex nature of virtual environments, a negative function is specified to test the argument that highly information-laden virtual environments are deemed unpleasant. This leads to:

H2. The information load of a virtual shopping environment is negatively related to the emotions (arousal, pleasure, and dominance) experienced in the environment.

3.3. The emotion–approach hypothesis

Extant literature suggests that optimal arousal, pleasant feelings, and feeling in control are all positively related to the decision to explore or shop. For example, Liu and Arnett [24] found that websites that are enjoyable, exciting, participatory, and charming are successful because they offer hedonic pleasures to attract users and to help them enjoy their visit. Chang and Cheung reported that users who found surfing the web to be an enjoyable, exciting, pleasant, and interesting experience had higher intentions to use it.

Specifically, *arousal* has been demonstrated to increase shoppers' intentions to remain and to spend money in conventional retail environments [14,16]. However, the relationship between arousal and approach decisions is often an inverted U-shaped function [19]: in other words, exploration and shopping are both maximized at an optimal level of arousal. Extremely high or low levels of arousal are avoided. Given that Internet shoppers have greater arousal seeking tendencies than Internet non-shoppers, they are more likely to approach a stimulating virtual shopping environment than to withdraw from it. There is ample evidence supporting the influence of *pleasure* on the decision to approach an environment. Pleasure is found to be positively related to such aspects of consumer behavior as spending extra time on shopping and consumption [9] as well as on satisfaction [37].

The effect of *dominance* on consumer and other human behavior is less clear. When the concept of flow is employed to describe the human–virtual environment interaction experience, a feeling of dominance is more likely to lead users to approach the environment because controllability is a more relevant consideration in technologically complex environments. In flow states, users experience feelings of control over the human–computer interaction, and thus feel in control of their actions and choices. Such feelings of control, according to Trevino and Webster, lead to playful and exploratory behavior. This study thus hypothesizes a positive relationship between emotions and the approach decision:

H3. The emotions (arousal, pleasure, and dominance) experienced in virtual shopping environments are positively related to the decisions to approach those environments.

4. The research method

To ensure a reasonable sized sample, it was necessary to pick several sites and make sure that several people visited and reported on each. The following 10 popular shopping websites were first selected to represent a variety of product categories and varying degrees of information load:

- Amazon bookstore (amazon.com);
- CDnow music store (cdnow.com);
- Reel video store (reel.com);
- Virtual vineyards winery (virtualvin.com);
- Virtual flowers florist (virtualflowers.com);
- Auto-by-tel price quotes for cars (autobytel.com);
- NetGrocer groceries on-line (netgrocer.com);
- Computer discount warehouse (cdw.com);
- OnSale computer auctions (onsale.com);
- Chumbo commercial software (chumbo.com).

The overall process involved using a set of 115 web users (including students, staffs, and faculty from a large university) who had been recruited to surf two shopping sites and report on their feelings about them. The majority of the users were male (63.8%). User age ranged from 17 to 40, with an average of 23.6. Among the users, 84.9% had previous experience of searching for products or service information on-line and 29.8%

had experience of shopping on-line. In order to determine the psychological interaction between them and the site, they were all profiled by administering an AST test to them.

4.1. Testing for the user profiles

Each user was tested to determine his or her important psychological profile. Thus, 115 users' ASTs were measured and recorded before they visited any shopping site.

The AST scale consisted of 40 items to measure five dimensions of the ASTs of users: arousal associated with (a) change, (b) unusual stimuli, (c) risk, (d) sensuality, and (e) new environments. This scale was scored on a nine-point Likert scale ranging from -4 (very strong disagreement) to +4 (very strong agreement). The scale's developers and other researchers (e.g. [33]) found the AST scale to have reliability and validity.

4.2. Assessment of the websites

Each of the users in the experiment was randomly linked to two of the pre-selected shopping sites. The users were instructed to explore the sites for as long as they liked using their usual method of navigation. Having completed the visit to a website, the user reaction was measured using a special on-line questionnaire that consisted of the following three parts:

1. *The information rate scale*, which gauged the information load of a shopping site. It included 14 items: varied–redundant, simple–complex, novel–familiar, small scale–large scale, similar–contrasting, dense–sparse, intermittent–continuous, usual–surprising, heterogeneous–homogeneous, uncrowded–crowded, asymmetrical–symmetrical, immediate–distant, common–rare, and patterned–random. Similarly, responses to each of these items were scored from -4 (minimal information load) to +4 (maximal information load).
2. *The pleasure, arousal, and dominance scale*, which measured users' emotions. Four items measured each dimension as follows: pleasure (unhappy–happy, melancholic–contented, annoyed–pleased, unsatisfied–satisfied), arousal (sluggish–frenzied,

calm–excited, relaxed–stimulated, unaroused–aroused), and dominance (controlled–controlling, guided–autonomous, influenced–influential, submissive–dominant). Responses to each of these scales were scored from -4 (maximal displeasure/minimal stimulation/least dominance) to +4 (maximal pleasure/maximal stimulation/maximal dominance).

3. *The desire to explore or shop in a shopping site*, which was measured by using four items. *Desire to explore* required two items: "How much would you enjoy exploring this site?" and "Do you like this site?" The other two items for *the desire to shop* were: "To what extent is this site a good opportunity to shop?" and "Would you enjoy shopping in this site?" Responses to each of these items were scored on an eight-point scale ranging from 0 ("not at all") to 7 ("very much so").

The final sample consisted of $n = 218$ observations obtained from the 115 web users. A few users visited only one site.

5. Results

The reliabilities of the scales and the proposed hypotheses were tested using LISREL 8 with maximum likelihood estimation [21] to test the effect of AST on arousal (H1), the effect of information load on emotions (H2), and the effect of emotions on approach decisions (H3).

5.1. Measurement model results

The scale items of AST, information load, emotions, and approach decisions were refined in the measurement model through an iterative procedure. Scale items with low squared multiple correlations (individual item reliabilities) were dropped from the analysis until all retained items demonstrated satisfactory reliabilities. This procedure resulted in six items for two AST dimensions, three items for information load, and nine items for three emotion dimensions. Table 1 reports the measurement model results. Parameter estimates are large for almost all scale items; likewise, estimates of reliability for the variables are high. Finally, the percent of variance

Table 1
The measurement model and reliability and variance extracted^{a,b}

Parameter	Unstd. ML estimates		Reliability	Variance extracted (%)	Descriptive statistics	
	λ	δ or ε			Mean	S.D.
Information load			0.73	0.49	−0.19	1.43
Complex–simple	1.00	0.68				
Crowded–uncrowded	0.69	2.31				
Large scale–small scale	0.66	1.98				
Arousal seeking tendency						
Arousal from change			0.82	0.61	0.95	1.43
I like surprises	1.00	1.39				
I like continually changing activities	1.06	0.59				
I like a job that offers change, variety, and travel, even if it involves some danger	0.97	1.32				
Arousal from new stimuli			0.76	0.51	1.38	1.19
I like meeting people who give me new ideas	1.00	1.01				
I am continually seeking new ideas and experiences	1.19	0.73				
I am interested in new and varied interpretations of different art forms	1.00	1.36				
Emotions						
Arousal			0.89	0.74	−0.32	1.61
Stimulated–relaxed	1.00	1.20				
Excited–calm	1.40	0.31				
Frenzied–sluggish	1.15	0.97				
Pleasure			0.92	0.79	0.92	1.43
Happy–unhappy	1.00	0.44				
Pleased–annoyed	0.87	0.37				
Satisfied–unsatisfied	1.00	0.69				
Dominance			0.84	0.64	0.31	0.48
Controlling–controlled	1.00	1.62				
Dominant–submissive	1.13	0.76				
Autonomous–guided	1.40	0.81				
Approach decisions						
Exploration decision			0.82	0.70	2.95	1.43
How much would you enjoy exploring around?	1.00	0.88				
Do you like this site?	1.29	0.57				
Shopping decision			0.81	0.68	2.92	1.52
To what extent is this site a good opportunity to shop?	1.00	1.04				
Would you enjoy shopping in this site?	1.17	0.74				

^a The measurement model is estimated simultaneously with the structural model. All estimated parameters are statistically significant, $P < 0.05$.

^b The range of measurement is from −4 to +4 for AST, information load, and emotions; and from 0 to 7 for approach decisions.

extracted exceeds or approximately equals 0.50 for all variables [12].

5.2. Structural model results

The path diagram for the structural relationship of the eight components of the model is shown in Fig. 1. As expected, the causal relationships of the two aspects of AST and information load were related to exploration and shopping decisions through emotions, which in turn were directly related to the two aspects of approach decisions. Several fit indices suggest a good fit for the model. The model's goodness-of-fit index was 0.89; this measures the relative amount of variables and covariances jointly accounted for by the model. The adjusted-goodness-of-fit was 0.86. The root mean square residual was 0.05; this is a measure of the average of the residuals, and values ranging from 0.05 to 0.08 were deemed acceptable [4]. The comparative fit index was 0.96; this is an index of choice when assessing the goodness-of-fit of the model, which is greater than the 0.90 benchmark suggested by Bentler [2]. These measures of overall fit indicate the explanatory power of the model.

The R^2 values of arousal, pleasure, and dominance were at 0.07, 0.15, and 0.16, respectively. This indicates that the model explained 7–16% of the variances

in emotions. The R^2 values of the decisions to explore and shop were 0.23 and 0.24, respectively, indicating that the model explained 23–24% of the variances in the approach decisions.

The three hypotheses received general support with some exceptions. The exceptions suggest the need to extend the environmental psychology model taking web characteristics into account.

Hypothesis H1, which predicted that users of high AST would be more aroused by websites, yielded mixed results. Users who tend to seek stimulation from change were more aroused by websites ($\gamma = 0.30$, S.E. = 0.13), whereas users who tend to seek stimulation from new stimuli were less aroused by websites ($\gamma = -0.52$, S.E. = 0.18).

Hypothesis H2, which predicted that highly information-laden environments are unpleasant, received support for the pleasure and dominance dimensions. Information intensive websites were found to be unpleasant ($\gamma = -0.35$, S.E. = 0.07) and uncontrollable ($\gamma = -0.29$, S.E. = 0.06).

Hypothesis H3, which predicted that users would approach websites that are arousing, pleasant, and controllable, was partially supported. As predicted, users desired to shop at arousing websites ($\beta = 0.13$, S.E. = 0.05), and to explore ($\beta = 0.41$, S.E. = 0.07) and shop ($\beta = 0.40$, S.E. = 0.07) at pleasant websites.

Path coefficients and standard errors are reported.

Fig. 1. Results of testing the hypotheses.

However, they tended to avoid exploring ($\beta = -0.19$, S.E. = 0.08) and shopping ($\beta = -0.26$, S.E. = 0.09) at controllable websites.

6. Discussion

6.1. Discussion and implications

The environmental psychology approach has suggested that both information and emotions play a role in the decisions of users to approach or avoid an environment. The results obtained using a structural equations model lend further credence to the use of this approach in virtual shopping environments. We demonstrated that the information load of a shopping site affects the emotions experienced while navigating the site, and these emotions in turn influence the decision to approach the site. The findings of this study have the following implications for IS managers.

6.1.1. What stimulates web users?

Web users were found to differ not only in the way their interest is stimulated on-line, but also in the sources that satisfy this need for stimulation. Web users prefer stimulation from changes associated with the introduction of new stimuli. Thus, IS managers are advised to stimulate users by offering virtual environments that are full of surprises, changes and variety, and not to stimulate them by means of new ideas and experiences.

6.1.2. Is information pleasant or unpleasant?

The consistent negative impacts of information load on pleasure and dominance deserve attention when managing virtual environments. The rapid growth of the web has made available a large amount of information, but it is becoming increasingly difficult to find the pieces that are useful. Thus, simplification of the information environment is the key to creating a pleasant virtual atmosphere. Information personalization is one technique developed to help users filter irrelevant information, thus reducing the amount of information that has to be processed [17,30]. Nevertheless, the information environment should not be simplified to such an extent that it imposes no challenges to users, because dominance was found to lead to avoidance, both at the exploration and shopping levels.

6.1.3. Can emotions increase the desire to approach?

Different emotional dimensions were found to have different impacts on approach decisions. The findings suggest that virtual environments that happily challenge users tend to encourage exploration, and the environments that arouse and challenge users tend to promote shopping. Websites that offer easy environments that bore users tend to drive them away. Thus, IS managers should endeavor to communicate product information and build corporate images in which on-line exploration is important through virtual environments that are pleasant and impose a certain level of challenge to the users. Alternatively, IS managers should try to facilitate on-line transactions (in which on-line shopping is important) by arousing and challenging users because this will increase their desire to shop.

6.2. Conclusion

The study contributes to our understanding of virtual exploratory and shopping dynamics by empirically examining the Mehrabian–Russell environmental psychology model in the virtual shopping environment. It demonstrates that both information and emotion play significant roles in users' virtual shopping decisions. When the information load of a virtual environment is maintained at a level that elicits pleasure, users will tend to explore and shop. Alternatively, a virtual environment full of surprises and changing activities that excite users will tend to solicit on-line transactions.

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Ming-Hui Huang is chair and professor of Electronic Commerce at the Graduate Institute of Electronic Commerce, National Chung Hsing University. Professor Huang received her PhD from the University of Wisconsin-Madison and has published in numerous journals, including *Computers in Human Behavior*, *International Journal of Information Management*, *Psychology and Marketing*, *Journal of Consumer Psychology*, *Journal of Business and Psychology*, *Psychological Reports*, and *International Journal of Advertising*. She is editor-in-chief of the *International Journal of Advanced Media and Communication*, and an associate editor of the *International Journal of Internet Marketing and Advertising*.