MIS Quarterly

SPECIAL ISSUE

FROM SPACE TO PLACE: PREDICTING USERS' INTENTIONS TO RETURN TO VIRTUAL WORLDS[1]

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Virtual worlds have received considerable attention as platforms for entertainment, education, and commerce. But organizations are experiencing failures in their early attempts to lure customers, employees, or partners into these worlds. Among the more grievous problems is the inability to attract users back into a virtual environment. In this study, we propose and test a model to predict users' intentions to return to a virtual world. Our model is based on the idea that users intend to return to a virtual world having conceived of it as a "place" in which they have had meaningful experiences. We rely on the interactionist theory of place attachment to explain the links among the constructs of our model. Our model is tested via a lab experiment. We find that users' intentions to return to a virtual world is determined by a state of deep involvement (termed cognitive absorption) that users experience as they perform an activity and tend to lose track of time. In turn, cognitive absorption is determined by users' awareness of whom they interact with and how they interact within a virtual world, what they interact about, and where, in a virtual sense, such interaction occurs. Our work contributes to theory in the following ways: it identifies state predictors of cognitive absorption, it conceives of virtual worlds in such a way as to account for users' experiences through the notion of place, and it explains how the properties of a virtual world contribute to users' awareness.

Keywords: Virtual worlds, cognitive absorption, intention to return, social awareness, location awareness, task awareness, sense of place, place attachment

[1]Molly Wasko was the accepting senior editor for this paper. Noam Tractinsky served as the associate editor.

The appendices for this paper are located in the "Online Supplements" section of the *MIS Quarterly*'s website (http://www.misq.org).

Introduction

Virtual worlds have been touted as one of the most promising emerging technological breakthroughs (HBR 2008). Virtual worlds (VWs) are computer-based simulated environments where users, represented "in-world" by avatars, can communicate synchronously over a network (Robbins and Bell 2008). The potential usefulness of VWs to many constituents has not gone unnoticed by practitioners. ICANN's[2] CEO, Paul Twomey, elevated VWs as the future of global commerce (Riley 2007). According to the Gartner Research group, "eighty percent of active Internet users will have a 'second life' in the virtual world by the end of 2011" (Gartner Research 2007). The number of VWs available is believed to have grown exponentially since 2005 (Castronova 2005). As of January 2009, there were over 200 worlds serving the youth market alone (Virtual Worlds Management 2009).

Many organizations have a keen interest in VWs as they recognize the potential usefulness of these environments for reaching customers and business partners (Barnes 2007; Lui et al. 2007), for recruiting employees (Schalch 2007), and for intra-firm communication (Fuller et al. 2007; Kahai et al. 2007; Kock 2008). Organizations are already using VWs in a variety of ways. For example, IBM has set up "islands" in Second Life[3] in order to provide, among other purposes, a virtual meeting place for employees to interact. Toyota and Reebok have used Second Life to collect customer preference information (Goel and Mousavidin 2007). Many universities, such as Harvard, Virginia Tech, Drexel, and Emory, use Second Life as a platform for teaching and providing information about their academic programs.

There is evidence that organizations are still only exploring if, and how, they can take advantage of VWs in the face of unique challenges (MacInnes 2006; Noam 2007; Warr 2008). Statistics on the users of VWs show promising numbers,[4] and some organizations entering these worlds have attracted many initial visitors. Companies such as IBM and Dell are also considering virtual worlds as platforms for intra-firm communication and training. However, a difficult challenge us getting users to return to VWs (Nelson 2007; Sydell 2006). Consequently, some organizations abandon their presence in VWs as initial patronage wanes (Gartner Research 2008). These failures inspired us to speculate on the factors that impact a user's intention to return to an environment set in a virtual world. Our specific research question is: *What factors predict users' intentions to return to a VW created in an environment like Second Life?*

While the behavior of returning to the VW is of importance to the organizations that build a presence in these worlds, our focus is on intention to return, as intentions are highly correlated with, and are immediate and strong predictors of, actual behavior (Ajzen 2002; Ajzen and Fishbein 1980; Sheeran 2001). Intention to return to a VW refers to the idea that a user is inclined to come back to a place represented in the VW for the experience it affords to the user. There is evidence that users of VWs do develop a sense of place (Ciolfi et al. 2008; Turner et al. 2005), as it is not uncommon for them to ask questions such as "where am I?" or "where do I go?" or "what should we do here?" when their avatars are in these VWs (Corbett 2009; Sherry 2000).

If researchers in the IS field want to understand more about VWs, there is a need for us to consider the notion of place. But as far as we are aware, in the IS field, *place* has not received its deserved attention. Researchers have stopped short of looking at it. Instead they have focused on various types of spaces such as electronic spaces (e.g., Anders 2001; Sarker and Sahay 2004) or mobile spaces (Mennecke and Strader 2003). For our purposes, we conceive of place in such a way as to capture a person's experiences and the meanings that are given to these experiences (Harrison and Dourish 1996; Milligan 1998). The notion of place will help us to understand VWs with a novel focus on what users encounter, what they observe, what they perceive, and what their mental state is, which in turn will help us to predict users' intentions to return to VWs.

This mental state, referred to as *cognitive absorption*, is one of our main foci. The importance of this state on technology usage is well documented (Agarwal and Karahanna 2000). But whereas extant literature describes traits of technology users to influence cognitive absorption (Agarwal and Karahanna 2000; Ahn et al. 2007; Saadè and Bahli 2005), we propose a set of state predictors for it as a new theoretical contribution. These state predictors encompass various types of awareness, which have to do with what a person perceives about aspects of activities in which she is engaged in a VW. We describe how such awareness is made possible by four

[2]Internet Corporation for Assigned Names and Numbers.

[3]Second Life is an Internet-based virtual world owned by Linden Research, Inc. It was launched in 2003. A downloadable client program can be found at www.secondlife.com. Users can set up an account by registering an avatar. Paid accounts are required for buying virtual land. The application is simulated on a grid of servers. The virtual world has its own currency, called Linden dollars, which is fully convertible with the U.S. dollar, and an in-world scripting language, called Linden Scripting Language (LSL), available for user development.

[4]As of August 28, 2009, Second Life reports 15,031,025 total users of which 1,379,487 had logged on in the previous two months.

salient attributes of a VW, termed aura, focus, nimbus, and boundaries, any of which can be altered in a VW to influence a user's intention to return.

The next section describes the theoretical background of our study, highlighting the attributes of a VW that have been overlooked in the IS literature; it also describes what those attributes are related to that can predict intention to return to a VW. Thereafter, we present our research model containing the constructs intention to return to a VW, cognitive absorption, social awareness, location awareness, and task awareness. We then describe our hypotheses, which predict how these constructs relate to each other, and, in the following section, our research method. Our results and discussion, including implications for researchers and practitioners, are presented thereafter. We conclude with limitations and avenues for future research.

Theoretical Background

We rely on an overarching theory, the interactionist theory of place attachment (ITPA), to motivate and describe the constructs of our research model. We first describe the central ideas of this theory and then discuss how they apply to VWs.

The Concept of Space Versus Place

Two related concepts that underlie ITPA are space and place. Space is thought of as a not-yet-known environment or site (Milligan 1998). As a result, a space exists in the abstract. As a person gets to know it in terms of its content and what can happen in it, endowing it with value, it becomes a place. The idea of endowing a space and its content with value entails giving them meaning. A place emerges as a space is ascribed with meaning. ITPA explains that a space is transformed to a place as a person engages in an interactional process. During this process a person relies on her sensory perceptions, becomes aware of others and objects in her environment, and assigns meanings to them. These meanings give rise to what a person experiences in relation to the place.

In accord with ITPA, we define a place in a VW as a mediated space that *evolves* from users' sensory perceptions, awareness, and the meaningful interactions that can occur in the VW. Thus a place is such that some users' experiences are tied to it. Our definition of place is consistent with other definitions such as the "focus of meanings or intentions, either culturally or individually defined" (Relph 1976, p. 55) and as "entities which incarnate the experience and aspirations of people" (Tuan 1971, p. 281). Such definitions underscore the notion of place as a bounded perceptual unit that is psychologically meaningful (Buttimer and Seamon 1980).

As models of the real world, virtual worlds are able to evoke experiences that are similar to experiences in the real world. This is so because the responses of the human brain do not differ if a place, a person, or an object is represented in the form of a photograph, a "real" thing, or a sole mental image (Finke 1979, 1980). Studies in cognitive neuroscience have shown that imagining a chocolate bar, for example, activates the same regions of brain cells as does the real object (Finke 1979, 1980). This applies for places as well. Having the experience of a place, such as represented in a play, game, or movie, does not require physicality of the place; it is sufficient if humans are presented with a form that mimics a real place where they can have their experiences (Benyon et al. 2006). A place represented in a virtual environment, such as Second Life (SL), can afford positive and negative emotional experiences as in the real world (Corbett 2009). For example, an artist working in SL has noted that "the experience there was both rapid and thrilling and unlike anything else" he has had in many years of working in the real world (Corbett 2009). This kind of experience, ITPA suggests, will likely make a person become attached to a VW and motivate the person to return to it.

ITPA holds that a person becomes attached to a place because (1) she has had activities that are meaningful within its boundaries and (2) features of the place have shaped, constrained, and influenced the activities that are perceived as able to happen within it. The first reason is said to be what accounts for a place having an *interactional past* (Milligan 1998). The second reason accounts for a place having an *interactional potential* (Milligan 1998). In the sense of ITPA, interaction refers to how things that exist and occur in a space influence people in it.

Features of a place that describe interactional potential include objects and their layout in the place that favor sociability as well as visual appearances that suggest what might be acceptable behaviors in that place. Interactional past and potential are connected in the sense that experiences from the past are the bases for what happens in the present as well as what is likely to happen in the future. Hence an individual gives an unknown space meanings based on past experiences in similar spaces that were transformed into places, thus causing her to conceptualize it as a place with the potential for similar experiences. In the sense of the theory, the meaningfulness of activities is considered to be socially constructed.

There are a few ideas about how a person interacts that are the bases of place attachment. In order to interact with others and with objects in an environment, a person relies on her sensory perceptions, is aware of and attends to informational inputs that are in her environment, and attaches meanings to her interactions. We elaborate on these ideas next.

Transforming Space to Place: Formation of Place Attachment

Sensory Perceptions

Space is conceived in ways determined by our perception of it through our five senses, senses that we use to engage with people and things. At the periphery, we experience objects and people through sight. This area is primarily static space. Closer to us are our sight and hearing, which allow us to experience objects and people as they move, creating a dynamic space. Closest to us is an area of space that we can experience first by smell, then by taste and touch (Tuan 2001). Sensory perceptions provide informational inputs about the space around us and enable us to become aware. Awareness of people and objects may also be affected by past experiences in similar spaces (Milligan 1998). These experiences are themselves tied to past sensory perceptions. For example, when about to enter a hotel room, one cannot see the space beyond the closed door, but through past experience will likely have some awareness of what is on the other side. Hence through direct sensory perceptions, or through experiences based on prior sensory perceptions, a person becomes aware of an environment.

Awareness, Cognitive Absorption, and Meaningful Interactions

Awareness is a state in which a person processes the vague, general information acquired through sensory perceptions (Davenport and Beck 2001). This information might include cues concerning aspects of the activities in which the person is engaged, such as what is being done and where it occurs. The *what* and *where* information that a person is aware of is tied together for a given activity. For example, Waxman (2006) describes aspects of a coffee shop, such as lighting, aroma, furniture, and view of the outside,as influencing the activity of socializing, all of which can play a role in place attachment. Similarly, the position of chairs, sofas,and power outlets can affect interactions between people, influencing their attachment to the place (Waxman 2006).

Various types of awareness are at play as place attachment forms in a physical space. For example, a person could be in a state of awareness about others in the environment, where she understands whether or not another is available for interaction (Steinfield et al. 1999). A person could also be in a state of awareness about what she is to do, which is knowledge about how tasks are done in the environment (Gutwin et al. 1995). Finally, a person could be in state of awareness about where she is, or know her location in relation to artifacts in it (Baecker et al. 1993). We focus on these three types of awareness as we attempt to capture the various informational inputs that incite a person's action.

The informational inputs for these various types of awareness motivate a person to make sense of vague information of which she is aware and attend to it by ascertaining its meaning (Roche and McConkey 1990). Such information could be about what is to be done in an environment. A persistent effort to understand this information can cause a person to become deeply involved by virtue of losing track of time, which is an attribute of the state of cognitive absorption (Agarwal and Karahanna 2000; Dietrich 2004). Once meaning is assigned to such information, it can result in positive experiences being associated with the meaning of the information (Kintsch 1998). Having such experiences will also be associated with the state of cognitive absorption (Csikszentmihalyi 1988). ITPA suggests that this is so, as it explains a situation in which a person engaging in a wide range of activities in a place does not feel he spent much time there, even if he actually did (Milligan 1998). Corbett (2009) also notes that a person described the experience in a VW as one that invites the full involvement of a visitor. In keeping with these ideas about cognitive absorption, we take this factor into account in our study, and define it as a state of deep involvement that a user experiences as she performs an activity in the VW and tends to lose track of time. When we refer to *involvement*, we mean that the user's interests and emotions are engaged.

ITPA also holds that the more meaningful the interactions that occur at a place, the more meaningful the place will become (Milligan 1998). Interactions that give a place meaning do not have to be extreme. Multiple seemingly "uneventful" interactions might occur in a place such that their cumulative effect results in meanings that are enough to lead to strong place attachment (Milligan 1998) if those interactions result in positive experiences. But interactions resulting in negative experiences can also contribute to attachments because they can evoke powerful emotions that help a person to have a sense of self (Gustafson 2001) as, for example, when a negative experience makes a person aware of her dislikes (Hester 1993). When two or more people are in a common space, their interactions can create a shared interactional past through a process by which objects in that place have the same meaning to the people in it (Blumer 1969).

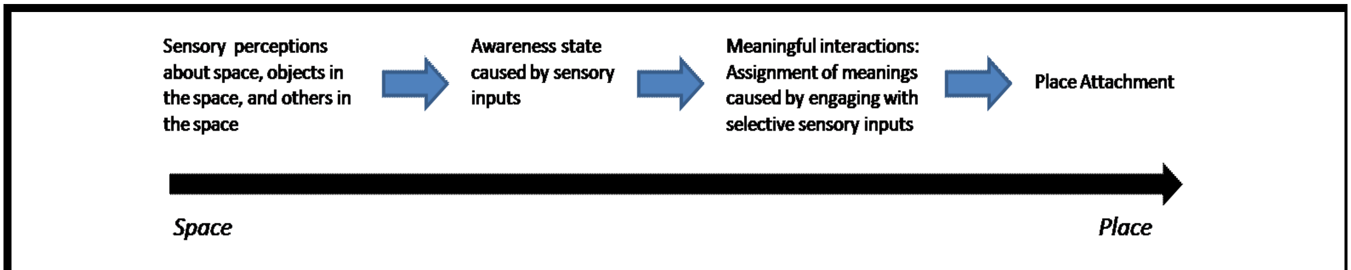

Figure 1. The Process of Place Attachment

We summarize the process of transformation of space to place in Figure 1. As shown in the figure, a space is transformed to a place as a person engages in an interactional process during which she relies on her sensory perceptions, becomes aware of others and objects in her environment, and, curiosity permitting, focuses her attention solely on these informational inputs, thus engaging and attaching meanings to her interactions in this environment. These meanings give rise to what a person experiences in relation to the place. It is through these experiences that space turns into place, thus motivating a user to return to a place for similar experiences. As relevant as these ideas are to this study, it is important to note that our work is not a test of ITPA. Our focus is on assessing some stages in the space to place transformation.

Place Attachment in VWs

The predictions of ITPA are supported in Milligan's (1998) case study about a place in which face-to-face interactions occurred. But Milligan reasons that such attachment is also possible in non–face-to-face settings. One reason is because attachment is based on the relationship between events in spaces and the passage of time. In this sense, spaces are used to categorize events over time, and meanings come from the interactional process that occurs within these spaces—even if the process occurs in cyberspace (Milligan 1998). The other reason is that place attachment is based on the meaningfulness of the interaction itself, not on the physical or virtual space in which it occurs.

Furthermore, theoretical support for the idea that it is possible to represent a place in a VW can be drawn from Reeves (1991), who notes that people form automatic perceptions of things, tend to give things that they come in touch with thoughtful attention, and engage in conscious processes in which they account for, and relate, particulars of an event in their minds.

Awareness in VWs

Sensory perceptions, awareness, and meaningful interactions can all occur in VWs to enable place attachment. Although the senses of smell, taste, and touch are currently inapplicable in a VW environment, the environment can be perceived through sight and hearing. Some features of VWs afford visual–aural perceptions to interact and gain awareness.

One feature is the support of many-to-many interactions. For instance, when an activity is underway, the space can make a person aware whether another person is available for interaction based on what her avatar is doing (Benford et al. 1994; Schroeder 2002). This is the basis for social awareness, defined as the perception a person has that she and others in the same space find it easy to understand and interact in a social sense. By *social sense* we mean what actions, such as what is said or done, are appropriate with respect to others. In the case of VWs, we consider others to be avatars since they represent users. As such, avatars convey a sense of someone's presence (Benford et al. 1994; Biocca, Harms, and Burgoon 2003; Biocca, Harms, and Gregg 2001). Social awareness is important because the meaningfulness of activities is considered to be socially constructed (Milligan 1998). Social awareness is conceptually similar to what other researchers have referred to as *availability awareness* (Steinfield et al. 1999).

A second feature is that one can interact with the objects in the virtual space. Such interactions can be associated with awareness as they can imply what and how things are to be done in that space by people in it (Benford et al. 1994; Giddens 1984). This notion is the basis for what we, like others, refer to as task awareness (Gutwin et al. 1995), defined as the perception a person has about what she is to do based on instructions, tools, or the actions of others in a given shared space. With respect to a VW, we consider what a person has to do to be a definite piece of work that can involve others, virtual tools, and some degree of difficulty. It might also involve a series of activities necessary to achieve a goal. In a VW, the instructions that a user needs to get something done can be delivered via different media, such as text, image, or audio (Benford et al. 1994). Instructions might also be situated within the space of a VW so as to give multiple users access to them.

A final feature is that virtual artifacts or objects exist in a virtual space, and the boundaries of that space can be designed to give a user a sense of where she is (Benford et al. 1994). This is the basis for location awareness, which is conceptually similar to peripheral awareness in a physical environment (Baecker et al. 1993). Location awareness is the perception a person has about where in space she is by virtue of what objects are in that space and what activities are done in it. With respect to a VW, we consider the notion of "where in space" to be what a user of the VW believes a space represents, most usually of the real world. This is in accord with the idea that the space in a VW affords a metaphorical sense of place (Ciolfi et al. 2008; Prasolova-Førland 2008; Turner et al. 2005). The user's belief is informed by what objects and activities are represented of the real world in the VW. This is so because a VW has a bounded space in which users can see virtual artifacts (Benford et al. 1994; Gutwin and Greenberg 2002).

Properties of VWs that Motivate Awareness

According to ITPA, properties of a space shape, constrain, and influence the activities that are perceived as able to happen within it. In a physical site, a person might be more easily seen than heard within a certain space (Milligan 1998). An object might be more, or less, accessible depending on its location. Similarly, depending on its location, an object might be more easily seen by a person. A physical site might have a visual appearance that represents the acceptance of specific behaviors (Milligan 1998). A physical site might also be divided into separate areas that allow for more, or less, interaction and can cause people to have certain kinds of experiences in them (Milligan 1998).

Similarly, in the context of a VW, certain properties shape, constrain, and influence awareness. The three types of awareness described previously—social, location, and task—are due to properties of the space that allow for sensory perceptions and for these types of awareness to exist. In the case of VWs, perception and awareness of virtual artifacts is restricted to the sensory inputs of sight and hearing, and properties that enable such perception and awareness are embedded in the design characteristics of the environment. We focus on four properties that are the bases for the three types of awareness within VWs: aura, focus, nimbus, and boundaries (Benford et al. 1994).

Aura is the mechanism by which the medium (audio, visual, or textual) in the VW comes into being in relation to an object (Benford et al. 1994). For example, an avatar might be more easily seen than heard. Thus, its visual aura is greater than its audio aura. Aura provides a subspace that bounds the presence of an object and within which one is more likely to be aware of it (Fahlen et al. 1993). Aura moves with an avatar (as well as with other objects) and therefore helps to define the presence of it (them) with respect to a medium (Benford et al. 1994). For example, when an individual is typing into the instant messaging text line in Second Life, her avatar makes a gesture of typing such that the avatar's aura conveys the individual's intention to communicate.

Focus is the ability to delimit an observed object's interest such that the more an object is within your focus, the more aware of it you are (Benford et al. 1994; Benford and Fahlen 1993). Focus represents the receiver's control of information. As an avatar moves away from a virtual object, this signals that it is no longer in the user's focus. The way instructions are made accessible in a VW can also provide awareness of who has these instructions in their focus (Benford et al 1994). For example, if instructions are made available in the form of a virtual whiteboard on a virtual wall, then, as an avatar approaches it, this signals that the board is in that avatar's focus. Like instructions, the use of virtual tools can send similar signals or clues.

Nimbus is the ability to represent an observed object's projection toward you (or your avatar, or another object) such that the more an object[5] is said to be within your nimbus, the more aware it is of you (Benford et al. 1994; Benford and Fahlen 1993). One can think of nimbus as a complement of focus as you are (or the avatar, or an object) the recipient of an object's focus. It represents the transmitter's control of information. For example, the properties focus and nimbus can signal an avatar's readiness for interaction. As an avatar gets closer to (or farther away from) another, the orientation and gaze of the avatar become more (or less) apparent because of focus and nimbus (Benford et al. 1994). Such cues can signal the readiness, or lack of interest, the user has in interacting (Benford et al. 1994). As in the physical world,

[5] We refer to objects as things that might represent people (such as avatars) or virtual artifacts (such as islands, doors, cars, tables, and tools) that can be apprehended by a user of a VW.

one can also signal that she does not wish to be interrupted through body posture and attention in a VW (Benford et al. 1994). An avatar can show such a signal by turning and walking away.

In sum, aura, nimbus, and focus are properties that allow us to describe interactions between users, and between users and objects, in terms of their awareness of one another. They provide more than just the perception of the presence of another; they allow for an awareness of the actions and behaviors, such that an understanding of others can develop. For example, observing an avatar's aura, nimbus, and focus while it is engaged in a task such as building a virtual structure might provide cues of the person's level of skill in that task. Similarly, watching the way in which avatars move in a virtual space such as a store (i.e., observing their aura, nimbus, and focus) may help understand that they are shopping.

Boundaries in contrast, divide space such that they provide mechanisms to mark territories, control movement, and influence interactional properties of space (Benford et al 1994). Boundaries affect aura, nimbus, and focus by obstructing or facilitating interactions. Examples of boundaries in a space may include walls, doors, windows, or symbolic boundaries, such as furniture that one needs to walk around, or other avatars in one's way who serve as intermediaries or gate keepers. Boundaries can divide the space in a virtual lab, for example, such that different activities can be done in different areas. Activities might be such that they are done with the objects in the lab, and thus the lab itself can be identified by them.

We use the properties of aura, nimbus, focus, and boundaries to describe how the three types of awareness—social, location, and task—come into play in virtual worlds.

Hypothesis Development

ITPA holds that the more meaningful the interactions that occur, the more meaningful a place will become. For this reason, a person will likely return to the place. This is the basis for our focus on users' intentions to return to a VW, which we describe next. Based on factors suggested by ITPA, we derive the research model shown in Figure 2.

Intention to Return

Intention to return to a VW refers to the idea that a user will come back to a place, as represented in the VW, for the experience it afforded to the user. Our notion of *intention to return to a VW* differs from *intention to revisit a website*, which is described by Jiang and Benbasat (2007) and Koufaris (2002). The latter concept is conceived of with a focus on online products and how these are presented to users as the basis for its prediction. For example, Jiang and Benbasat note that intention to revisit a website is partly predicted by the extent to which users believe the website is helpful for them to understand products. Thus users' cognitive responses were posited to be the main influence on this predictor. The predictor is determined by what the authors refer to as the users' online product experiences or virtual product experiences. Unlike Jiang and Benbasat, Koufaris describes the notion of intention to return to a website with a greater focus on the website itself and by taking into account not just users' cognitive responses, but also their emotional responses. Both types of responses are believed to be from influences of website attributes on the users. For example, the website design was such that it could have been perceived by a user as positively challenging in virtue.

Our notion of intention to return to a VW also takes into account users' cognitive and emotional responses. However, these responses have to do with the attributes of the VW that we described earlier and these are considerably different than those of traditional websites. Moreover, the VW allows multiple users to interact in a common space, giving rise to the potential for a wide range of responses and experiences.

The Relationship between Cognitive Absorption and Intention to Return to VW

Cognitive absorption (CA) can occur when a person processes information in a VW. Such information could be about another person as filtered through the perceived actions of her avatar. It could also be about what the person will do in the VW as well as where she is in the VW as indicated by her avatar. Understanding these things is aided by the person's heightened sense of the reality of the objects to which she is attending (Roche and McConkey 1990). Since the VW is often an attempt at a model of reality, the person also makes a judgment about the information at hand (Roche and McConkey 1990). When this kind of information is being processed, a person's attentional resources shift and focus on the activity at hand, attending less to other sensory, cognitive, or emotional demands about other activities (Dietrich 2004); a state of deep involvement results, in which a person finds herself cognitively absorbed in assigning meaning to the information. The state of CA is characterized by a loss in the sense of time passing by (Agarwal and Karahanna 2000; Csikszentmihalyi 1988, 1990, 2002; Dietrich 2004). Since

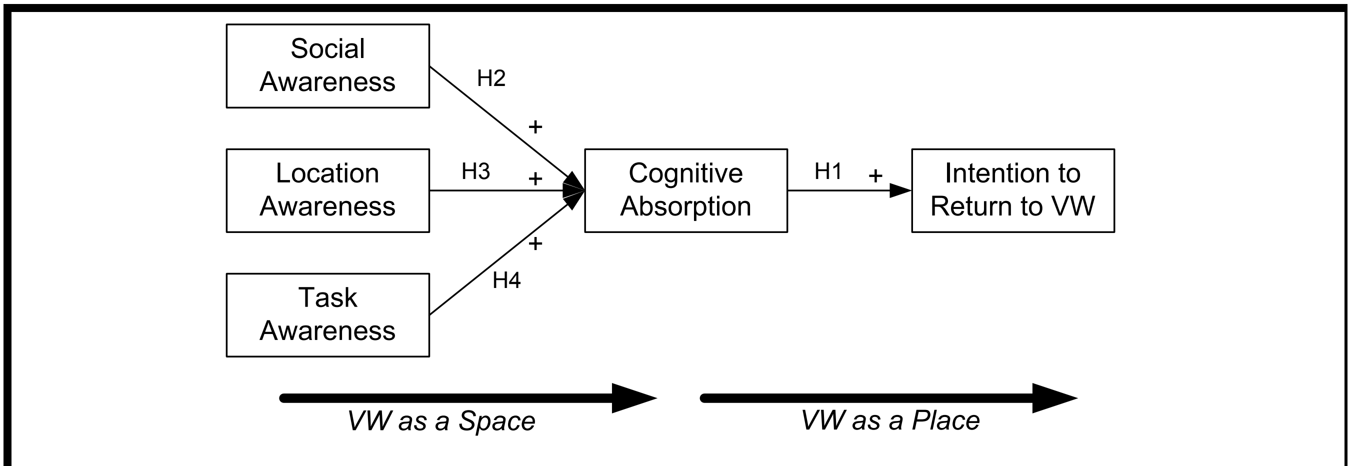

Figure 2. Proposed Research Model

any activity occurs within the boundaries of a physical or virtual space, being in a state of CA entails having an experience in that space.

Meaningful interactions shape future behavior whether they are determined by a person's own encounters or through her observations of others (Bandura 1986; Milligan 1998). What others do and what happens to them can cause a person to anticipate similar outcomes for their own behavior (Bandura 1986). For example, if a person sees that another person derives enjoyment from doing an activity in a given context, the person would also anticipate enjoyment in the same context. Since observation of other avatars and what they are doing can be made in the VW, such interactions can result there. The interactions in a VW are what will make the VW a place to a person, one to which she can be attached emotionally (Milligan 1998; Ponzetti 2003). In accordance with the ITPA theory, the more meaningful these interactions are, the more meaningful the VW as a place will be to a person (Milligan 1998). A person will also want to come back to such a place because of their experiences in it and its associations to their experiences in similar places (Bandura 1986; Milligan 1998). Thus, the person will have what we refer to as the intention to return to the VW. As long as the place retains its features, such experiences can be recaptured (Milligan 1998). Similarly, as long a VW's features persist through time, the potential to relive experiences in it also persists. Since CA is the state that underlies such experiences in a VW, we hypothesize the following about its relationship to intention to return to a VW:

Hypothesis 1: Cognitive absorption will be positively related to intention to return to a VW.

The Relationship between Social Awareness and Cognitive Absorption in VW

Being able to understand others is central to the notion of social awareness (Gutwin et al. 1995; Harvey and Weary 1984; Mizerski et al. 1979). What it takes to have this understanding is the recognition of social cues. These cues include body posture, eye contact, and other actions that can affect interactions (Sproull and Kiesler 1986). Such cues must be provided in the space where interactions are possible.

In a VW, many of these cues can occur concurrently as an avatar motions in different ways. These motions might depend on what other avatars are doing and where they are. Through the properties of aura, nimbus, and focus, an understanding of those motions develops. Meanings are assigned to them based on the user's memories of social situations. In assigning such meanings, there will be points in time when the user begins to focus on a few select social cues about others in the social situation. This is when a person's attention is triggered and the person engages in a selective, cognitive process through which she absorbs selected information. screens out (in a mental sense) inputs, and is curious about the selected information (Davenport and Beck 2001). It is said to happen when a person is driven to learn about another person in a social situation, which the focal information might be about (Fernandez-Berrocal and Santamaria 2006; Oakhill and Garnham 1996). We noted that this type of information processing is what occurs in the state of CA. Hence, we expect social awareness to be related to CA as follows:

Hypothesis 2: Social awareness will be positively related to cognitive absorption in a VW.

The Relationship between Location Awareness and Cognitive Absorption in a VW

To be aware of one's location in a VW, a person has to recognize aspects of its space such as virtual artifacts or objects and boundaries (Gutwin and Greenberg 2002). For example, an avatar in a VW can perceive, through the visual or haptic aura of objects in a room, that the room might represent a computer lab. As the avatar moves toward, or away from, the objects in the room, the properties of focus and nimbus enable more interaction with the objects such that the individual can get a further sense of "where" she is and where things are. For example, a person can distinguish a virtual lab from a meeting room based on the visible virtual objects. These objects can be in or out of focus, depending on the distance from the avatar, providing a cue about the size of the lab. The lab's virtual walls can indicate its boundaries.

While receiving concurrent cues as inputs about where she is in a space, a person assigns meanings to them based on memories of past interactions in similar settings (Clark 2003; Dartnall 2005). When assigning meanings, the person focuses on only a few select cues that have to do where she is, and this focus triggers her attention (Davenport and Beck 2001). The selective information processed ties cognition to the context in which the person is situated (Baecker et al. 1993; Collins et al. 1990; Pea 1988). With respect to our example of a virtual lab, a person who acts as if she is in this lab through her avatar will assign meanings to the virtual artifacts (e.g., network routers, computers, lab room, walls), based on information she perceives. In this way, the person recognizes that she is in a virtual representation of a computer lab. The more information on which to focus, the more the person has to engage in a cognitive process of screening and assigning meanings (Davenport and Beck 2001). This occurs when the individual is curious about aspects of the location in her focus, causing her to be involved or immersed in the process. Since these are precisely the attributes of what we refer to as the state of cognitive absorption, we make the following prediction concerning its relationship with location awareness:

> *Hypothesis 3: Location awareness will be positively related to cognitive absorption in a VW.*

The Relationship between Task Awareness and Cognitive Absorption in a VW

Like instructions, the use of virtual tools can send similar signals or clues. For example, an avatar might be able to connect a virtual network router to a virtual network hub. By observing an avatar's use of such tools, one can tell who knows what about a given tool. Tools might also be used together and be equipped with functions such that the property of their aura helps awareness. For example, a virtual bulb might light up to signal that something is working. As an avatar moves away from a virtual object, this signals that it is no longer in the user's focus, and available for use by someone else. In using these tools, cues will also be created about how they work (Gutwin et al. 1995).

As many varieties of cues are made available to a person, she must eventually decide to focus on a select few in order to get a task done (Davenport and Beck 2001). Meanings are assigned to these cues, as was the case for social cues, based on what the person performing the task knows about it (Bandura 1986). For example, interaction with virtual objects (i.e., being able to manipulate virtual objects) has been found to evoke corresponding vivid mental images (Schlosser 2003). Again, in assigning meanings to task-related cues, there will be points in time when a person begins to focus on just a few of these, and becomes aware of these informational inputs (Davenport and Beck 2001). The person whose attention is thus triggered will engage in a selective, cognitive process through which she focuses on select information about the task (Davenport and Beck 2001). Some of this information might induce feelings of satisfaction and enjoyment with the task itself (Csikszentmihalyi 1988). Attention is often triggered for challenging tasks, and the person whose attention is triggered will be focused on, and curious about, the task (Davenport and Beck 2001). Indeed, these attributes are what one can associate with the state of CA. Hence, we would expect task awareness to be related to CA as follows:

> *H4: Task awareness will be positively related to cognitive absorption in a VW.*

Research Method

The research model was tested through a quasi-experiment conducted within Second Life (SL). We chose Second Life because of our decision to focus on non-gaming virtual worlds. Gaming virtual worlds, such as World of Warcraft, introduce different factors, such as addiction or social pressure, which may play a role in users' intentions to return. However, in non-gaming virtual worlds such as Second Life, such factors are mitigated as activities and content are user-defined rather than predetermined by aspects of a game. The user-defined flexibility of Second Life allowed us to control the settings as well as the experimental task.

The site for our experiment was a physical lab in which subjects had access to a set of computers running the same version of SL. The activity to be performed within this physical site was restricted to the use of the computer. Hence, subjects could hardly have developed a sense of place for the physical site itself or much of an attachment to it, in particular because such a sense of place and attachment would have required that subjects be allowed to engage in interactions that could be meaningful to them within the physical site (Milligan 1998). Such interactions were not allowed within the physical lab.

In contrast, most activities related to testing our research model were done in a simulated or virtual lab in SL. This "Telecommunication Lab" was exclusively built for the purpose of this study on ITWorld, a private island in SL. The lab was designed to induce a sense of SL as a place for subjects. This was done by following three approaches established in the literature.

The first approach was to make the virtual environment look like, and objects in it respond as in, the real world such that subjects experience a sense of being there (Lombard and Ditton 1997). In designing the virtual lab in SL, three areas, representing a welcome room, a foyer and the networking lab, were demarcated. Virtual walls constrained the avatars' activities to the virtual space, just as walls in a room would constrain people in a physical space, and separated the different areas. Artifacts in each area helped identify the purpose of the area. For example, the network lab had virtual computers, cables, and routers, which resembled the real world objects.

The second approach was to make the virtual environment support subjects' involvement with specific activities such that their senses were engaged to heighten their perception and awareness of others and of objects in the virtual environment (Jacobson 1999). As part of the laboratory setup, five avatars were created in advance to represent subjects. A number of avatars equal to the number of subjects were active at a given time. Each avatar was unique in appearance and had a default male or female "look." This allowed each avatar to a have a distinct aura so that subjects could uniquely identify each. The embodiment of a subject in the form of an avatar transformed the space in SL into a sense of place for that subject as subjects engaged each other via their avatars (Thomas and Brown 2009). Also, visual and haptic cues, such as informational notecards, pictures, and virtual tables with networking hardware, placed in the virtual lab drew attention to the activity for which the lab was designed.

The third approach was to allow for meanings to evolve in the virtual environment (Schubert et al. 2001). The sense of place develops through such engagement and is not unlike a sense of real places (Relph 2007). The space becomes a place that is imagined and the practices of the subjects, their actions, conversations, movements, and exchanges, infuse the place with new meanings (Thomas and Brown 2009). Stimulating interactions between avatars and with objects in the virtual environment as part of the activity allowed for development of meanings as interactions occurred.

Measurements

We measured social awareness using items from Harms and Biocca's (2004) instrument which focused on perceived message understanding. These items were selected in accordance with our definition of the social awareness concept. Measures of task awareness, location awareness, and intentions to return were developed as part of our pre-studies, based on procedures suggested by Moore and Benbasat (1991). Our measure of intention to return to a VW consists of items that are similar in some sense to those used by Coyle and Thorson (2001) and Jiang and Benbasat (2007) in that they relate to what users were able to do in the VW and their intention to return to it for such purposes by choice.

Items for cognitive absorption were adapted from Agarwal and Karahanna (2000), who measured cognitive absorption as a reflective higher order construct, consisting of four dimensions. We included all four dimensions as part of our experimental setup, but for analytic purposes, we focused on one dimension: temporal disassociation. We made this choice for two reasons. The first reason is that the lower order reflective constructs of cognitive absorption correlate with one another, thus measuring any one of them is approximately equivalent to measuring the others. For this reason, Burton-Jones and Straub (2006) also measured cognitive absorption along a single dimension. The second reason is that we conceive of cognitive absorption with a focus on the user's experience and the temporal disassociation dimension. This focus has been substantiated by prior studies on subjective time loss experiences of video game players, which demonstrate a correlation with positive experiences and immersion (Wood et al. 2007). A person loses track of time when she directs all her cognitive attentional resources to a particular activity such that it becomes the exclusive content in her working memory buffer: all distractions are excluded from her consciousness such that her awareness is limited to the here and now (Dietrich 2004).

All items for our constructs were measured on a seven-point Likert scale with anchors ranging from "strongly disagree" (1) to "strongly agree" (7). The items can be found in Appendix A. The scales were tested and fine-tuned in eight months of qualitative and quantitative pilot studies (see detailed description in Appendix B).

Sample

The subjects were 190 students enrolled in an introductory IS course at a large, public university located in the south central United States. The sample of students is considered representative of the target population—the generation of IT workers most likely to use VW technologies in the next few years. Subjects received extra credit for participating. They averaged 21 years of age, almost evenly split between males and females. More than 93 percent considered themselves very or extremely familiar with computers ($\mu = 6.22$); 58 percent considered themselves familiar or extremely familiar with 3D computer games such as SIMS, World of Warcraft, or Play Station ($\mu = 4.67$); 15 percent had used SL before the experiment.

Data collection was done over three months from teams that varied in sizes of three, four, and five subjects. Subjects were randomly assigned to a team based on time slots available. Each team worked on the same task.

Task

The task chosen for data collection is characterized as a complex cognitive one. Unlike simple tasks with a single solution, complex tasks can have multiple solutions and multiple ways to achieve a solution (Campbell 1988). Our task involved a team working inside a virtual Telecommunications Lab to design and build a network typology that conformed to prespecified rules (see the detailed task description in Appendix C). The task was chosen so that interactions between participants were salient to all involved. Further, the task was designed to match the subject matter expertise of a typical IS undergraduate student.

Procedure

The physical lab was 320 square feet in size and equipped with 20 desktop computers. Each computer was equipped with two 21-inch monitors. Five computers were labeled as experimental. These were the furthest apart and would not grant a visual view on any of the other experimental machines.

When subjects arrived, each was told to choose one of the five assigned computers and administered a questionnaire. As part of the initial questionnaire, subjects were asked if they were friends or acquaintances of other subjects in the lab, so as to detect any influence on the construct of social awareness; this measure was shown to be nonsignificant. As subjects completed the questionnaire, the researcher discretely assigned a gender-matched avatar to each.

Subjects then logged into SL, where all communications were done in-world. A subject's assigned avatar appeared in the virtual "welcome room." In order to confirm that the subjects knew their avatar, each subject had to identify their own avatar by using arrow keys on their keyboard to move around. Subjects were told that they could use the text box in the SL application to communicate with other avatars. Voice interaction was not permitted. As noted previously, nimbus and focus are properties built into the design of Second Life. Mechanisms such as foreshadowing of a chat message by the movement of avatars hands and the perception of "depth" of a space based on how big or clear objects seem are illustrative.

Subjects were allowed to spend as much time as they needed, typically 15 to 20 minutes, to interact with others and to get comfortable with in-world behaviors, such as moving around, communicating via chat, and changing their avatars' appearances. In this initial period, those without prior experience with the VW interface were made familiar with the aura of the avatar, those of others, and of the objects in the virtual space, as well as with nimbus and focus properties that helped them interact in the virtual space. All subjects, without exception, were able to walk and chat within the first 10 to 15 minutes of logging onto SL. Flying was disabled during the experiment.

After the familiarization phase in the welcome room, subjects' avatars were led by the researcher's avatar into the foyer of the Telecommunications Lab. Subjects were then presented with their task in the form of notecards[6] that had been prestored in their SL inventory.[7] One notecard contained the actual task description; its narrative can be found in Appendix C. Other notecards contained necessary definitions and some textual cues regarding different types of network typologies. Additional cues, in the form of text and virtual objects, were also part of the room. For example, the foyer of the Telecommunications Lab contained displays of network components, such as virtual routers and cables, and pictorial representations of the various network topologies (see Figure 3).

[6]Notecards are simple text documents that one can create and share in Second Life. Notecards are accessible in an avatar's inventory.

[7]Inventories are virtual storage areas, where avatars can store things, such as clothing items, notecards, or objects that the avatar owns. The inventory can be organized using folders and it is virtually unlimited in size. Items are automatically placed in folders based on type.

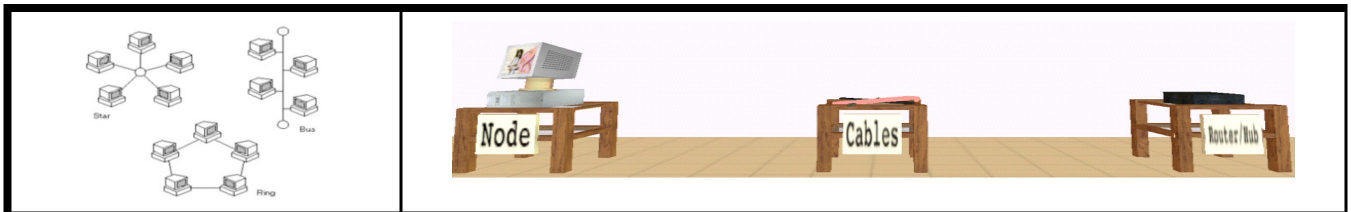

Figure 3. Visual and Textual Cues about Virtual Objects in the Virtual Lab's Foyer

After the subjects had been allowed some time to interact with one another, to check out the foyer of the lab, and to read the notecards, the researcher's avatar led them to the virtual lab. At the center of this virtual room, there was a big virtual table that held all of the technical components to solve the task, including five virtual computers (one laptop and four desktops), virtual peripherals such as keyboards, and two virtual hub devices that were on the virtual floor. Adjacent to the table were three "connection switchboards" that allowed subjects, through their avatars, to connect (or disconnect) cables between various devices with the press of a button. By pressing a button on the connection switchboard, with the hands of an avatar, a virtual cable would appear (or disappear) between the components specified. This mechanism was implemented to make it easy for users to manage their avatar and do the task that was required.

When designing the virtual artifacts or objects for the telecommunications lab, auras of the objects were kept as close as is possible, in terms of features, to what they would be in reality. For example, the size and proportion of each object with respect to the avatars and the virtual space were kept as realistic as possible; visual aids were added to clarify the nature of the objects; computer screens showed displays as real computers would; buttons on the connection switchboard needed to be clicked to be activated; "lights" on the connection switchboards changed color when buttons were clicked to indicate whether a particular connection was established or not. A screenshot of subjects performing the task is shown in Figure 4.

During task execution, one researcher stayed in the room, in real-life and in-world, but stayed out of view and was therefore not easily seen, if at all, by subjects. The researcher avoided communication to ensure that she had no influence on the study. The researcher's avatar was also far enough away from the subjects that (1) her aura, nimbus, and focus could not have had any bearing on the subjects and (2) subjects' interaction with the researcher was prohibitively difficult. Figure 5 shows another screenshot of the virtual lab from the researcher's perspective. After a group of subjects completed its task, their avatars were led back to the "welcome room" by the researcher's avatar, and they were instructed to quit SL and complete a survey based on their experience with SL.

Throughout the task, it was apparent that the subjects were aware of the boundaries in the virtual space. This could be inferred from the recorded conversations between the subjects. In the simulated lab room in SL, conversations were structured and about the actual task, while in the simulated welcome room or foyer, conversations were casual and about arbitrary topics.

By explicitly considering aura, nimbus, focus, and boundaries in the design of the telecommunications lab, we sought to highlight the awareness that the users had of each other through their respective avatars, the instructions they were given, and the virtual artifacts in the virtual space.

Analysis

We gathered usable data from 171 subjects. Invalid data resulting from technological failures or incomplete responses were discarded. The data were analyzed using structural equation modeling—specifically, a variance-based method using AMOS 7.0. AMOS, as every structural equation modeling technique, differentiates between a measurement and a structural model. Whereas the measurement model analyzes the relationship between the latent constructs and their associated items by scrutinizing their internal, convergent and discriminant validity, the structural model estimates the strengths of the relationship between latent constructs by providing estimates for path coefficients, variance explained, and fit indices.

Measurement Model

To assess the internal validity of the constructs, represented by each of their loadings, each item was examined to ensure it was measuring the constructs it was designed to measure (Chin and Newsted 1999). As Table 1 shows, each item loads above 0.7 on its respective construct. Convergent validity is established if the average variance extracted (AVE) is above a suggested level of 0.5 (Fornell and Larcker 1981); all con-

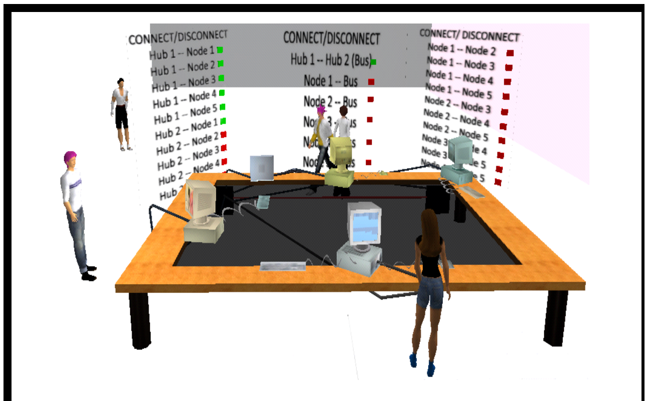

Figure 4. Inside the Experimental Lab

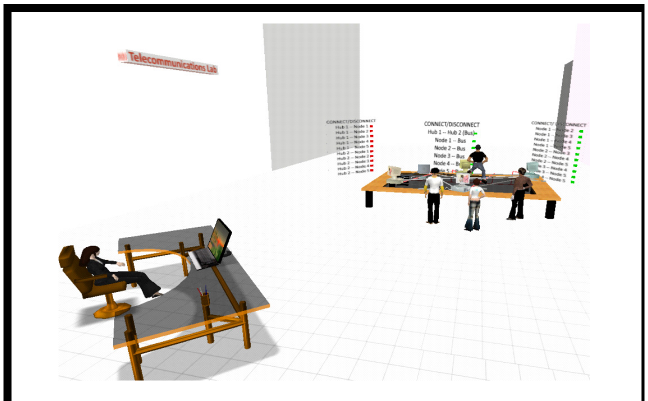

Figure 5. The Researcher's Perspective

structs surpass this criterion. In order to establish discriminant validity, the AVE also has to be greater than the squared correlations (i.e., shared variance) for each construct (Chin 1998) (see Appendix D), and constructs should load higher on their respective constructs than on others, as illustrated through cross-loadings (see Appendix E). Finally, scale reliability was assessed through composite reliabilities. As Table 1 shows, reliabilities were higher than 0.7 and adequate (Gefen et al. 2000).

Structural Model

The test of structural model results includes estimates of the path coefficients, which indicate the strengths of the relationships between the variables. As Figure 6 shows, the model explains 22 percent of the variance in the intention to return to SL. Cognitive absorption was a significant predictor of intention to return; and social, location, and task awareness were each found to significantly influence an individual's cognitive absorption (explaining 21 percent of its variance). Hence each of our four research hypotheses received empirical support.

We then examined the model's fit. Over the last decade, a plethora of fit indices has emerged to demonstrate the goodness of fit between observed sample data and a specified model in structural equation modeling (Marsh, Balla, and Hau 1996; Marsh, Balla, and McDonald 1988). Marsh, Hau, and Grayson (2005) discuss these various fit indices, including their advantages and disadvantages with regard to their approximation and estimation technique, sampling fluctuations, model parsimony in relation to complexity, the independence from sample size, and their propensity to result in a type 1 or 2 error. Besides pointing out that "the relentless quest by GOF [goodness-of-fit] researchers for a 'golden rule'… remains as elusive as the even more widely celebrated quest for the fountain of youth" (p. 311), they also demonstrate that some indices are better suited for certain applications than others. We have thus chosen some exemplary indices based on the classification scheme provided by Marsh, Hau, and Grayson. Specifically, we report on the chi-square degrees of freedom ratio (CHI/DF) as part of the fit–function-based indices, the root mean square error of approximation (RMSEA) (Steiger 1989; Steiger and Lind 1980) as part of the error of approximation indices, the unbiased goodness-of-fit index (GFI) (Steiger 1989) as part of the goodness-of-fit indices, the normed comparative fit index (GFI) (Bentler 1990) as part of the incremental indices excluding model complexity, and the non-normed Tucker-Lewis index (Tucker and Lewis 1973) as part of the incremental indices that adjust for model complexity. The values are presented in Table 2. Taking into account the tenets of our theoretical model, the values of the statistical model indicate a good model fit (e.g., Bentler and Bonett 1980; Browne and Cudeck 1993).

Discussion

We set out to answer one important research question: What factors predict users' intentions to return to a VW in an environment like Second Life? We conceive of VWs as a space that becomes a place for users as a result of their experiences in them. Thus, returning to a VW is tantamount to returning to the place, as perceived by these users. This viewpoint is guided by the theory of ITPA. The theory of ITPA helps us to identify social awareness, task awareness, location awareness, and cognitive absorption as factors that could influence users' intentions to return to a VW. Our data analysis confirms that they do, and that there are relationships between these factors. We will now elaborate on the meanings of our results and their implications for theory and practice. This is followed by a description of the limitations of our study and the opportunities they offer for future research.

Table 1. Measurement Model Results

Construct	Variable Name	Factor Loadings	Items per Construct	Composite Reliability	Mean	Standard Deviation
Social Awareness	SA1	0.71	4	0.89	4.99	1.25
	SA2	0.73				
	SA3	0.79				
	SA4	0.82				
Location Awareness	LA1	0.86	3	0.93	5.17	1.41
	LA2	0.95				
	LA3	0.77				
Task Awareness	TA1	0.84	5	0.95	4.28	1.57
	TA2	0.86				
	TA3	0.82				
	TA4	0.87				
	TA5	0.85				
Cognitive Absorption	CA1	0.91	3	0.95	5.11	1.65
	CA2	0.84				
	CA3	0.93				
Intention to Return	INT1	0.74	3	0.93	4.40	1.71
	INT2	0.92				
	INT3	0.90				

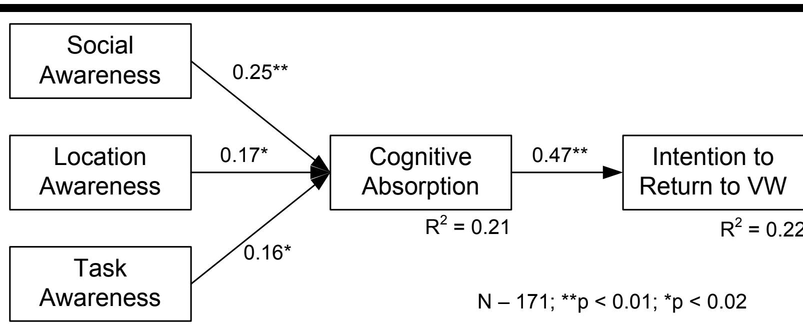

Figure 6. Structural Model Results

Table 2. Fit Indices

Exemplar Fit Index Chosen	Classification (according to Marsh, Hau, and Grayson 2005)	Value
CHI/df	Fit–function-based index	2.736
RMSEA	Error of approximation index	0.072
GFI	Goodness-of-fit index	0.903
CFI	Incremental index with no correction for model complexity	0.949
TLI	Incremental index with adjustment for model complexity	0.939

Theoretical Implications

From Space to Place

Eight years ago, Weill and Vitale (2001) wrote a book on eBusiness models that was partially titled "Place to Space." The book was intended for managers who had to lead their firms from a focus on place (e.g., physical stores) to space (e.g., websites). Perhaps because early websites were mainly textual with some pictures, the notion that they could be a viewed as a place for users had to be discarded. The dominant perspective in IS at the time was to abstract from any temporal and spatial constraints as much as possible based on the interconnectivity that the Internet afforded. But with the advent of VWs, we can begin to virtually model things that were once prohibitively difficult and expensive. It would, therefore, seem that the new charge for managers will be to return the electronic commerce efforts of their firms from a focus on space to one on place, as can be defined in VWs.

An understanding of whether a user will come back to the "place" modeled in a virtual world is not yet provided by traditional IS adoption models. One explanation is that IS research has focused on the abstract notion of *space* rather than the meaningful, contextual notion of *place*. Another is that traditional models end in their explanatory power with the formation of intentions to use a technology prior to usage or on only their initial actual use (Bagozzi 2007). While current models have been applied to explain continued use (or a user's intention to *reuse* a technology), the beliefs upon these models are based exclude those beliefs associated with the users' actual experiences with the technology. In fact, when these theories are applied to situations in which technology is used over a protracted period of time, the influences of the various belief constructs cease to exist (e.g., Compeau and Higgins 1999; Karahanna et al. 1999; Venkatesh and Davis 2000). Our work provides the basis for understanding what guides users' actions to return to a VW because of our focus on their experiences.

Cognitive Absorption and its Predictors in VWs

Based on what is suggested by ITPA, and on the work of Agarwal and Karahanna (2000), we identified cognitive absorption as a factor that captures a user's experience that is embedded in the technological medium of virtual worlds. Our result concerning cognitive absorption is interesting because this construct has been used in prior adoption research. However, by finding it to be a predictor of users' intentions to return to a VW, our work not only provides a basis for the extension of traditional models that go beyond initial use, but also a possible basis for the reconceptualization of the construct itself. For example, Burton-Jones and Straub (2006) assert that the construct of usage has habitually been under-conceptualized in the IS field and, as a consequence, usage measures have been applied unsystematically, mostly ignoring the context in which they are measured. Depending on the context, they argue, the relevance of various aspects of usage may differ, and the selection of a proper usage measure has to be reexamined every time. Thus, researchers have a choice between capturing usage in a "lean fashion" by simply measuring its frequency or duration, and a "rich fashion" by incorporating the nature and context of the usage activity (Burton-Jones and Gallivan 2007). We believe our work captures the notion of cognitive absorption and nature of usage in a more encompassing fashion since we explicitly consider various notions of awareness provided in a VW.

Prior research has identified only individual traits, such as playfulness and innovativeness (Agarwal and Karahanna 2000; Ahn et al. 2007; Saadè and Bahli 2005), as predictors of cognitive absorption. In contrast, our work identifies, and empirically supports the existence of, three state variables of awareness as predictors (i.e., social, location, and task awareness) of cognitive absorption. In addition, our work also contributes to research by showing that these types of awareness each have a positive influence on cognitive absorption. Future theoretical models can, therefore, be based on state as well as trait predictors of cognitive absorption in light of our results.

Understanding social awareness in the present context also has some implications for the testing of how other theories might apply to VWs. For example, social awareness in a VW can provide a basis for testing a theory such as social facilitation theory (Zajonc 1965) in the context of VWs so as to determine the limits of its applicability. Social facilitation theory posits that different behavioral outcomes occur in the presence of others, as compared to when a person is isolated. It has been successfully applied to consumer behavior, in real life situations, wherein shopping behaviors are predicted based on just the presence of others in the environment (e.g., Gaumer and LaFief 2005). Thus far, testing this theory in a virtual setting has been limited, since many-to-many interactions were unusual in online settings, but easy to create in an experimental VW shopping environment. It would be interesting to assess how "presence" might be experienced in such a VW, and what would be its influence.

There are two ways in which presence in this VW will likely be different than it is in real life and that might affect its influence. One way is the absence of involuntary expressions in VWs that will result in a reduction in that form of communication (Benford et al. 1994). The other way is a separation between mind and virtual body that could result in social embarrassment when someone tries to interact with a body when the mind of the person that should be attending to the body is attending to something else (Benford et al. 1994).

Location awareness is another state that can lead to a person perceiving space as a meaningful and contextual place to which she can become attached. We are not aware of any prior study that has theorized this notion of location awareness in the manner that we have done, let alone in a VW. Location awareness is the basis for a heightened level of cognitive absorption at two levels. At an individual level, users are immersed by being in their virtual place (e.g., home, office, or training facility); at a group level, users are immersed by being socially engaged with others in a virtual place. By clarifying this type of awareness, our work can provide a basis for others to use this concept in the testing of theories that have to do with location-specific activities. For example, situated cognition theory (Collins et al. 1990) advocates the notion of *situatedness*, or the immersion of learners in an environment that closely approximates the context in which the new knowledge will be applied. Location awareness might yield some insight as to the validity of this claim.

Task awareness can be a useful extension to the literature on boundary objects. Boundary objects are artifacts that possess symbolic adequacy by enabling conversation without enforcing a prior common language or prior shared meaning (Carlile 2002; Star and Griesemer 1989), yet enabling groups to arrive at a shared mental model (Klimoski and Mohammed 1994) which has been linked to better decision making, coordination, and learning (Kraiger and Wenzel 1997; Mathieu et al. 2000). Boundary objects may well transform into task-related cues that are associated with task awareness.

Empirical Implications

One of the main challenges for research in VW is whether constructs that are conceived for real life situations are generalizable to this environment (Benford et al. 1994). The three types of awareness states—social, location, and task—exist in the real world, and in other computer-mediated contexts. That their measures are validated in our study demonstrate their applicability to the context of VWs. The awareness measures demonstrated construct validity, discriminant and convergent validity, and reliability.

In measuring cognitive absorption, we used only one of its dimensions: temporal dissociation. This dimension proved robust enough to capture and measure cognitive absorption, lending parsimony to its empirical testing in the context of VW. We also find that the states of awareness influence cognitive absorption, each having a positive influence on it. But social awareness shows the greatest influence, while location awareness and task awareness are about equal. We speculate that this difference might be due to users' tendency to focus on the social aspect of their interactions in a VW (Schroeder 2002).

It is important to note that our VW in SL can be thought of as a website, albeit a particularly rich one. We found that users' intentions to return to this VW was directly and positively influenced by cognitive absorption, but prior research suggests that the influence of cognitive absorption on users' intentions to return to a traditional website is a fully mediated relationship (Agarwal and Karahanna 2000). Our parsimonious measure of cognitive absorption might explain this difference, but further empirical examination is required. Still, our results demonstrate a minimum level of measure for cognitive absorption that researchers can use in the context of VW.

Implications for Practice

Cognitive absorption has been shown to be an important factor for IS outcomes, but traits cannot be manipulated. State predictors, on the other hand, can help practitioners design environments to maximize cognitive absorption. This can be done by influencing a user's state of awareness in VWs. The challenge is to keep a person from losing attention. One way in which attention can be held is to continually introduce change in the informational input (i.e., social, location, and task related cues) such that users have to go through the process of filtering unfamiliar inputs to add meaning, and hence bring to attention things in the environment. It is not enough to build a store in a virtual world and expect people to be engaged in it.

A second way is to design realistic environments such that it is easy for users to associate and assign meanings based on informational inputs. If the "cost" of associating meaning is too high, or if the social, location, and task cues are too difficult to make sense of, then it is likely that users will reduce their attentiveness, and hence not be cognitively absorbed. A third way of engaging users' awareness is to keep the inputs consistent in their message. If a user's social, location, and task awareness all center on a particular theme (such as new product development), it is easier for the user to be cognitively absorbed. However, designers of VWs with business purposes must also ensure that the attention gathering aspects of the design do not distract from the business purpose of the site.

There are practical steps that can be taken to influence awareness. We considered awareness that is exhibited in three different forms: social, location, and task. These forms of awareness are influenced by the properties of aura, nimbus, focus, and boundaries. All can be altered to bring about different levels of awareness. For example, objects can be strategically arranged in a VW to act as boundaries so as to guide a visitor's progress through a virtual store.

Limitations and Future Research Opportunities

This limitations of this study, while cautionary, can also be a wellspring of future research. Scientific inquiry involves balancing the conflicting goals of external validity, internal validity, and realism without being able "to maximize all three conflicting desiderata of the research strategy domain" (McGrath 1981, p. 186). In our effort to maximize internal validity by controlling for task and procedure, we have chosen a quasi-experiment at the expense of external validity.

Web-based virtual worlds may be considered similar to websites in that they are both experienced via electronic displays. Prior research has looked at attributes of websites such as search functionality (Koufaris 2002), presentation formats (e.g., text, video, images) (Jiang and Benbasat 2007), and website diagnosticity or helpfulness (Jiang and Benbasat 2005). However, what users perceive in virtual worlds goes beyond 2D content. By considering aura, nimbus, focus, and boundaries as attributes of the virtual world environment, we provide a basis for shifting the focus from content on 2D websites to objects and artifacts in 3D virtual worlds. For example, in a 2D environment, two books advertised on the same website would likely be at the same level of focus for a user. In a 3D environment, placing the books away from each other would cause one to be more in focus than the other. This difference can be leveraged by engaging the attention of the user in a way that is not possible in a 2D environment. Aura, nimbus, focus, and boundaries give us a new language in which to describe and empirically test attributes of virtual worlds that influence users' perceptions.

Since testing VW features such as aura, nimbus, focus, and boundaries was beyond the scope of our study, we relied on their random existence in our modeled VW environment as would be discerned by our experimental subjects, and thus their degree of influence on user perceptions. Future experiments should attempt to control these factors and determine their varying effects. Specifically, such future research should test the strength of relationship between each property and the different types of awareness. It is conceivable that, for example, boundaries influence location awareness to a greater degree than do nimbus and focus. Such research could also have design implications for VW environments for use in different contexts of business.

Another limitation relates to our focus on a complex cognitive task. When we conceived of this task, we felt we could generalize its findings to group learning or training activities conducted in VWs. Hence this study would predict employees' intention to return to the environment if they were initially introduced to virtual worlds for such activities. Unlike in our setup, training tasks are often simple in nature, having a single possible outcome or involving less activity. On the other hand, other real world activities may be of considerably greater complexity. The predictions of our model should be reexamined across a range of complexity. For instance, in a simple task, there may be a diminished level of task awareness. But there could be a simultaneous increase in the level of social awareness as users' interests are diverted toward each other. However, it is not clear if these changes in levels of awareness would offset each other. Similarly, other task characteristics such as group size and duration of the task may be examined.

With respect to the nature of the task itself, our focus was on decision making when multiple "correct" options existed. But companies that are interested in using a VW might want to know about what happens in the case of a user who is to purchase a product in a VW. Depending on the design of their virtual stores and the kind of activities that are permitted to happen in it, we would expect users to have more complex awareness. The intention to return to such a store would also be affected by what material gains a user derives from a purchase. Hence, another avenue for future research could involve testing and extending our model to other tasks, such as those involved in shopping in virtual worlds.

The variances explained in the study, while statistically significant, seem relatively low. A possible explanation could be the nature of our experimental condition. Our model is predicated on place attachment that arises from subjects' experiences. The amount of variance explained might have been greater if subjects spent more time in the experimental condition. This might increase the opportunity for experiences that would influence their intention to return. The effects of longer and more frequent experiences in virtual worlds are worth exploring from the perspective of place attachment. One possibility is the nature of place attachment in relation to intention to return to similar places. For low degrees of place attachment, it is unlikely that an individual will want to return to a similar place, because of the low levels of meaningful interactions she experienced. When the level of place attachment increases, the individual is more likely to want to revisit similar places for similar experiences due to the interactional potential of the similar places. When the level of place attachment is very high, it is possible that the degree of substitutability of that particular place with other places is low, that is, the individual may want to return to that specific place, but not necessarily similar places (Milligan 1998). This suggests a curvilinear relationship between place attachment and intention to return to similar places. A longitudinal study would further inform our understanding of place attachment.

Still, it should be noted that the levels of explained variances, or R-squared values, that we found are common in behavioral research (Winston and Albright 2009). The levels that we find suggest that there are other factors at play that will likely influence the constructs, cognitive absorption, and user's intentions to return to a VW. But each R-squared value does not tell us what these factors could be, given that it is a statistic not based on theory. In addition, it tends to be lower when there are fewer variables, and higher when there are relatively more variables that make up a model (King 1986). This might explain why, compared to the models posited by Agarwal and Karahanna (2000) and Jiang and Benbasat (2007), our explained variances seem low. Nevertheless, our reference theory does suggest a couple of possible variables. For example, meaningful experiences and attention are important variables that are not measured in our study. Similarly, other dimensions of cognitive absorption can be explored as antecedents to intention to return. Also, awareness and attention are notions important to place attachment that can be defined and measured.

More than half (58 percent) of our participating subjects were previously exposed to 3D gaming environments, while only 15 percent were familiar with Second Life. One might question whether the relationship that is described by our research model is the same for these categories of subjects. In a *post hoc* analysis, we investigated whether there were significant differences between the responses of subjects who were familiar with 3D games and those who were familiar with Second Life in particular. We did not find any significant differences in the relationships hypothesized between these groups. Apparently, for the factors that we considered, users' experiences in 3D gaming environments are similar to those in non-gaming virtual worlds like Second Life. Thus, in terms of the constructs of our model, it appears that one can transfer insights from experiences in the gaming environment to virtual worlds in the business context. Still, there may be differences in other factors, which future research might address.

There is also much more that can be examined in terms of users' experiences than what we have described. Although we did not elaborate on the notion of experience, we implied that we conceived of it in the sense of being subjective, a state that comes about when users think, perceive, and process information with a subjective aspect (Chalmers 1995; Nagel 1974; Searle 1994). For example, when users see objects in a VW, they experience visual sensations; when they are able to make sense of information, they experience a felt quality of emotion. It is well established that subjective experience has some amount of value to a person in some specific terms (Heeter 1992; Moneta and Csikszentmihalyi 1996; Unger and Kernan 1983). For example, subjective experience could be about leisure (Unger and Kernan 1983), or about challenges and skills (Moneta and Csikszentmihalyi 1996; Unger and Kernan 1983). A precondition for a subjective leisure experience is a perceived freedom to act (Bregha 1980; Unger and Kernan 1983). In contrast, the experience that comes from challenges and skills is motivated by a drive to act (Moneta and Csikszentmihalyi 1996). How VWs are designed and what they are designed for will likely promote each of these experiences to varying degree. Hence, there is much to be gained from future research that examines the nature of relationships between the design of VWs, their purposes, and specific users' experiences. One of the assumptions we make in this study is that users' actions are driven by attributes of the virtual worlds. Since users' experiences are subjective, these experiences could vary (Chalmers 1995; Nagel 1974; Searle 1994). It is possible that the same environment can produce different experiences due to users' preexisting affective states. Affective influences occur because social thinking involves highly constructive mental operations (Bruner 1957; Heider 1958). In the course of such thinking, affect may either directly or indirectly influence the kind of information we process, and the way we process it (Forgas 2001). Since the processing of informational inputs can influence cognitive absorption, it is possible that different affective states could cause cognitive absorption to arise or not. Thus, one could find that different experiences can be had in the same environmental conditions. For example, an individual may have a positive experience when playing World of Warcraft. However, on another occasion, all factors being constant, it is possible that the same individual is "not in the mood," which could alter the influence of environmental properties on the experience that she has when playing the same game and hence intention to return to the environment.

Meaningfulness, a central concept in our explanation of users' intentions to return to a VW, was not included in our research model. We conceived of meaning to be the connection that users would have made between objects in the VW. This viewpoint is consistent with the way other scholars have thought of meaning in general (Baumeister and Vohs 2002). It seems that we could have considered the connections that users made between specific objects in the VW and what such connections meant to them. Meaning may also differ in terms of its level (Vallacher and Wegner 1987). Lower levels of meaning are more immediate and specific than higher levels of meaning (Baumeister and Vohs 2002). These different levels have different consequences and implications. People who are aware of activities at low levels of meaning are more easily influenced than those who are not (Baumeister and Vohs 2002; Vallacher and Wegner 1985, 1987). In contrast, people who are aware of activities at high levels of meaning tend to be guided by their values and principles (Vallacher and Wegner 1985, 1987). People may also shift between these levels, thus altering their experiences (Vallacher and Wegner 1985, 1987). Future research might examine the connections made between objects in VWs, the levels of meaning that are assigned, and the experiences that are tied to such meanings or shifts in them.

Also, our model for intentions shaped by actual experiences in VWs was derived by a focus on features peculiar to VWs. However, usage of information systems in general may be predicted by other factors such as habit formation (Limayem and Hirt 2003; Limayem et al. 2007). Such factors should be considered in future models intended to predict intention to return.

Conclusion

This study was motivated by the need to predict the return of users to a virtual world, a compelling problem for emerging real world firms and organizations seeking to harness VWs. We considered users' intentions to return to a VW as a proxy for actual return. Our explanation as to what factors influence users' intentions to return was based on what we conceived VWs to be: places that come about as a result of users' experiences in space. Such experiences give rise to a state of cognitive absorption, which itself is predicted by social, task, and location awareness. These types of awareness are due to the properties—aura, nimbus, focus and boundaries—of a VW. These properties provide us with a means to influence a user's decision to return to a VW.

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Appendix A

Questionnaire Items

Construct	Variable Name	Questionnaire Item
Intention to Return to VW (INT)	INT1 INT2 INT3	If given the opportunity, I would like to participate in a similar learning task in Second Life. I intend to return to Second Life to learn about different topics. I intend to return to Second Life again.
Cognitive Absorption (CA)	 CA1 CA2 CA3	In the virtual environment of Second Life… time appeared to go by quickly when I was interacting with my group members. sometimes I lost track of time when I was interacting with my group members. time went by real fast when I was interacting with my group members.
Social Awareness (SA)	 SA1 SA2 SA3 SA4	In the virtual environment of Second Life… it was easy to understand my partners. my partners found it easy to understand me. understanding my partners was difficult. my partners had difficulty understanding me.
Location Awareness (LA)	 LA1 LA2 LA3	In the virtual environment of Second Life… I was aware of the location of objects related to the networking task, such as cables and computers, in the virtual environment. I was aware of the objects in the telecommunications lab in Second Life related to computer networking. I was conscious of elements in the telecommunications lab and around me.
Task Awareness (TA)	 TA1 TA2 TA3 TA4	In the virtual environment of Second Life… the textual and visual clues in the environment helped me to do the task. information in the environment, such as diagrams and labels, made it easy to figure out what to do. there were clues in the environment that made completing the task easy. the information given in the environment helped me understand, or explain to others, the task better.

Appendix B

Pilot Study Description

Two pilot studies conducted.

First Pilot

The purpose of the first pilot was to assess the feasibility of conducting an experiment in Second Life, and assessing the face validity of the constructs in the questionnaire. At this point, the purpose was not to achieve statistical support, but to conduct an overall assessment of what kind of task and experimental setup to choose, and how best to ask the questions pertaining to the constructs of interest. Two tasks were tested with the same group of subjects. There were 28 subjects in groups of 3 to 5.

The first was a learning task where the subjects were taken into a giant model of a computer tower at Dell island. In a walk-around within the tower, subjects were given information about different parts of the computer: the motherboard, the CPU, primary memory, buses, and ventilation units (fans and heat sinks). The objective was for subjects to learn about a topic normally taught in an introductory IS course through a textbook and PowerPoint, in a three-dimensional environment.

The second task was a simple decision-making task on a private island, ITWorld. The experimental setup consisted of three rooms: a welcome room, a foyer, and the telecommunications lab. The lab room had a large table with a group of computers that were preconnected in a star, ring, or bus topology. Information was given to each group member via notecards about the types of topologies. The objective was for subjects to learn about topologies, and decide as a group what kind of topology was represented.

At the end of each of the two tasks in the first pilot, questions were asked relating to social awareness, location awareness, task awareness, cognitive absorption, and intention to return. Multiple scales for each construct were tested, with some items added by the researchers. Open-ended questions about the task, the environmental setup, and the questionnaire were also asked. The researcher had multiple rounds of one-to-one and group discussions with the subjects about their perception of the experiment.

Initial results indicated that the second task, which involved decision-making, was more applicable to a group setting for the nature of constructs tested. However, the subjects reported that the task was too easy. Additionally, the level of control obtained by conducting the experiment on the private island was a lot higher. There were instances when the experiment on Dell Island was interrupted due to the appearance of outsiders' avatars, or unscheduled server maintenance down times.

Second Pilot

The purpose of the second pilot was to refine the questionnaire and assess construct validity of the scales tested. In total, 83 subjects in groups of three to five, with a total of 21 groups, participated in the second pilot.

The experimental setup was based on the second task from the first pilot—with the modification of the task to a complex one, and more functionality added to the lab room. Instead of a predefined topology where cables between computers and telecommunications devices were already connected, a script was designed such that subjects could connect the cables between any two devices they wanted with the click of a button. The script was written in Linden Scripting Language (LSL). Further controls were added such that subjects could not fly or build while in the experimental setup. Also, as subjects moved from one room to another, doors opened and closed to prevent free access to other rooms. Again LSL was used to script these boundaries.

The task was a refinement of the decision-making task used in the first pilot. The questionnaire was statistically tested in this pilot, with items that did not perform well being dropped during final data collection.

Appendix C

Task Notecards

Notecard: Task Description

In the next room is a table that has a network connected in a star layout (topology). Your task is to modify the layout based on the following conditions:

1. The modified topology should be fault tolerant (i.e., each node should be able to communication with the other computers even if one connecting cable breaks down).

2. The modified topology should be based on the information provided to you. The new topology can be a combination of two or more of the same or different topologies (i.e., any combinations of star, bus, and ring).

You can modify the existing topology using the buttons on the menu boards to connect or disconnect a cable between two particular nodes. For example, clicking on the button next to "Node 1 – Node 2" will attach a cable between Node 1 and Node 2.

After your group has finished and agreed upon a new topology that meets condition 1 and 2, please tell {name} what your new topology is as a group.

Notecard: Network Typology Definition
In networking, the term *physical topology* refers to the layout of connected devices on a network. Components of the network include the nodes (computers), routers (or hub/switch), and cables.
Notecard: Types of Typologies
Types of Topologies: 1. Star: A star network features a central connection point called a hub/switch/ or router. A failure in any star network cable will take down that node's network access. If the hub fails, the entire network fails. There is only one path connecting any two nodes. 2. Ring: In a ring network, every node has exactly two neighbors for communication purposes. A failure in any cable or device breaks the loop and can take down the entire network. There is only one path connecting any two nodes. 3. Bus: Bus networks use one common cable as a backbone to connect all devices. A failure in the cable brings down the entire network. There is only one path connecting any two nodes.

Appendix D

Correlation Matrix and AVE

	Social Awareness	**Location Awareness**	**Task Awareness**	**Cognitive Absorption**	**Intention to Return to VW**
Social Awareness	0.824				
Location Awareness	0.316	0.905			
Task Awareness	0.421	0.514	0.885		
Cognitive Absorption	0.357	0.316	0.333	0.930	
Intention to Return to VW	0.270	0.263	0.312	0.474	0.903

Note: Diagonal contains the square root of the average variance extracted (AVE).

Appendix E

Cross-Loadings

	Social Awareness	Location Awareness	Task Awareness	Cognitive Absorption	Intention to Return to VW
SA1	**0.842**	0.281	0.372	0.312	0.315
SA2	**0.811**	0.436	0.372	0.387	0.232
SA3	**0.810**	0.243	0.322	0.155	0.163
SA4	**0.820**	0.247	0.325	0.241	0.201
LA1	0.295	**0.908**	0.543	0.349	0.294
LA2	0.269	**0.935**	0.480	0.320	0.301
LA3	0.295	**0.859**	0.409	0.372	0.221
TA1	0.378	0.459	**0.887**	0.367	0.313
TA2	0.377	0.428	**0.899**	0.368	0.348
TA3	0.371	0.467	**0.884**	0.336	0.230
TA4	0.380	0.605	**0.825**	0.359	0.231
CA1	0.305	0.415	0.417	**0.943**	0.511
CA2	0.282	0.258	0.245	**0.883**	0.400
CA3	0.371	0.315	0.323	**0.961**	0.483
INT1	0.321	0.342	0.368	0.555	**0.891**
INT2	0.240	0.224	0.281	0.434	**0.916**
INT3	0.229	0.240	0.237	0.533	**0.916**