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AN ODYSSEY INTO VIRTUAL WORLDS: EXPLORING THE IMPACTS OF TECHNOLOGICAL AND SPATIAL ENVIRONMENTS ON INTENTION TO PURCHASE VIRTUAL PRODUCTS[1]

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Although research on three-dimensional virtual environments abounds, little is known about the social and business aspects of virtual worlds. Given the emergence of large-scale social virtual worlds, such as Second Life, and the dramatic growth in sales of virtual goods, it is important to understand the dynamics that govern the purchase of virtual goods in virtual worlds. Employing the stimulus–organism–response (S-O-R) framework, we investigate how technological (interactivity and sociability) and spatial (density and stability) environments in virtual worlds influence the participants' virtual experiences (telepresence, social presence, and flow), and how experiences subsequently affect their response (intention to purchase virtual goods). The results of our survey of 354 Second Life residents indicate that interactivity, which enhances the interaction with objects, has a significant positive impact on telepresence and flow. Also, sociability, which fosters interactions with participants, is significantly associated with social presence, although no such significant impact was observed on flow. Furthermore, both density and stability are found to significantly influence participants' virtual experiences; stability helps users to develop strong social bonds, thereby increasing both social presence and flow. However, contrary to our prediction of curvilinear patterns, density is linearly associated with flow and social presence. Interestingly, the results exhibit two opposing effects of density: while it reduces the extent of flow, density increases the amount of social presence. Since social presence is found to increase flow, the net impact of density on flow depends heavily on the relative strength of the associations involving these three constructs. Finally, we find that flow mediates the impacts of technological and spatial environments on intention to purchase virtual products. We conclude the paper with a discussion of the theoretical and practical contributions of our findings.

Keywords: Virtual worlds, technological environment, spatial environment, virtual experience, intention to purchase virtual products, S-O-R framework, Second Life, interactivity, sociability, density, stability, symbolic consumption

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Introduction

Three dimensional (3D) immersive virtual worlds, such as Second Life, are computer-mediated environments in which participants, in the form of avatars (digital representation of themselves), inhabit, socialize, and perform economic activities involving a wide range of virtual products and services (Hof 2006). The populations and economies of virtual worlds are rapidly growing. The total number of active users in virtual worlds is expected to grow exponentially from 136 million in 2009 to 1,899 million by year 2013.[2] Recently, shopping has become one of the most popular activities that participants do in virtual worlds. Over 70 percent of Second Life "residents" purchase virtual products (e.g., virtual clothes, accessories, furniture, house, and land) at least weekly (Repères 2006).[3]

Given the growth in sales of virtual goods and the corresponding increase in revenue generated by virtual world providers, it is important to understand the dynamics that govern and stimulate the purchase of virtual goods in such synthetic environments. To date, the extant research on this topic has focused on the individual and product-specific factors that influence the purchase of virtual goods. For instance, applying the technology acceptance model and the theory of reasoned action, Chung (2005) investigated the impact of individual beliefs and attitudes on buying behaviors. Similarly, Lehdonvirta (2009) assessed how product attributes influence the purchase of virtual goods. Interestingly, unlike physical goods, the majority of virtual goods (especially in social virtual worlds) do not fulfill any subsistence or other physical needs. Rather, virtual goods primarily satisfy an individual's social needs such as prestige, status, uniqueness, and conformity (Martin 2008). The purchase of virtual goods is related to self-expression and participants use virtual goods as a symbol to project and communicate an image through their avatars (Jung and Pawlowski 2009; Kim et al. 2009; Lehdonvirta et al. 2009; Martin 2008). Consequently, the social dimension of virtual worlds and the environmental features that affect it are likely to influence the purchasing intentions of individuals. In this paper, we draw on the symbolic consumption literature (e.g., Grubb and Grathwohl 1967) to theorize how environmental stimuli that facilitate social interactions in virtual worlds might shape purchase behaviors (Arnett et al. 2003; Simon 2004).

To provide the structure and foundation for our research model, we employ the *stimulus–organism–response* (S-O-R) framework (Bitner 1992; Williams and Dargel 2004) which suggests that the virtual world environmental stimuli influence participants' organismic experiences (i.e., virtual experiences such as telepresence, social presence, and flow), and subsequently affect response (intention to purchase virtual goods). Given that virtual worlds are technological artifacts (Jäkälä and Pekkola 2007), we examine the technological features of virtual worlds (i.e., the characteristics of the virtual artifacts and the environment of a given virtual location) as environmental stimuli in our S-O-R framework. Specifically, we suggest that the technological features of virtual worlds can act as important environmental stimuli in shaping the behaviors of participants (Ma and Agarwal 2007). Therefore, two aspects of the technological characteristics (interactivity and sociability) are examined to comprehend how these environmental stimuli influence the participants' virtual experiences and their intention to purchase virtual goods.

Underscoring the fact that 3D immersive virtual worlds are social and dynamic environments (Jäkälä and Pekkola 2007), our research approach combines the technological and the non-technological facets of virtual worlds. We integrate the spatial features of a 3D virtual world (i.e., the characteristics of the population of a given virtual location) as environmental stimuli in our S-O-R framework, arguing that it would play a critical role in determining social interactions and hence intention to purchase virtual goods. Participants in a 3D virtual world can not only get into and out of defined space, but also can move around virtual objects (Herring et al. 2003). The embodiments of other participants causes complex shifts in the participants' perspectives, socially significant spatial positioning, and noncongruent "hearing" and "seeing" ranges (Herring et al. 2003). In the real world, such spatial dynamics shape social interactions and individual behavior (Nasar and Julian 1995; Wilson and Baldassare 1996). Similarly, in a 3D virtual world, such spatial dynamics may determine who sees and talks to whom (Bray and Konsynski 2007). However, due to the lack of empirical evidence on the topic, it is not clear how these spatial forces would influence the social interactions and buying intention in the virtual world. It is possible that due to almost complete absence of either cost or constraint in physical transportation (e.g., avatars can usually fly or teleport instantly to any location in the virtual world) as well as the ability to use text-based chat to socialize with other participants (whose avatars are not necessarily collocated in the virtual world), spatial dynamic may not be as

[2]"Active VW User Forecast: 2009–2013," KZER Worldwide (http://www.kzero.co.uk/blog/?p=3836#more-3836).

[3]In March 2010 alone, 201,707 residents in Second Life spent between L$1 and L$500; 17,128 residents spent between L$50,000 and L$100,000, and 2,581 spent over L$500,000 (i.e., US$2,000) (http://secondlife.com/statistics/economy-data.php).

important for social interactions in the virtual world as they are in the real world.

Given the potential significance of the spatial features in 3D virtual worlds (Bray and Konsynski 2007; Constable 2006; Keller 2008) and the lack of theoretical and empirical insights on the issue, this paper explores the effects of such spatial factors on virtual experiences and behaviors of participants. Specifically, we suggest that the spatial characteristics of the virtual world (i.e., density and stability), acting as environmental stimuli in our S-O-R framework, will influence the participants' intention to purchase virtual goods (Arnett et al. 2003; Simon 2004).

We extend the literature on virtual goods buying behavior by examining how virtual world environmental features can shape an individual's intention to purchase virtual goods. We also extend the virtual world research that focuses primarily on technological features of the virtual environment by examining the influence of non-technological factors (i.e., spatial features of 3D virtual worlds) on participant behaviors. Our findings, based on primary survey data collected from 354 users of Second Life, support our theoretical model and suggest that both the technological and the spatial features affect the virtual experiences of individuals and their intention to purchase virtual goods.

The rest of the paper is structured as follows. The second section presents the theoretical background of the paper and the research hypotheses. The third section details the method and the fourth describes the results of the study. The final section concludes with a discussion of the results, contributions, and limitations, as well as avenues for future research.

Theory and Hypotheses Development

Boss (2007) reports that participants in a virtual world do not need to change the clothes of their avatars, fix their hair, buy and furnish a home, or have drinks in their hands in a virtual bar, but many do, just to look right and feel comfortable. Nerad (2010) also notes that the consumption of virtual goods is related to self-expression, and participants are driven by the need to project and communicate an image for their avatar that is fulfilled by investing in virtual skins/clothes, voices, animations, and virtual housing/furnishings, among other things.

Due to the primarily symbolic nature of virtual product consumption (Lehdonvirta et al. 2009; Martin 2008), we draw on the symbolic consumption literature (e.g., Grubb and Grathwohl 1967) to develop theoretical arguments supporting our hypotheses. The symbolic consumption literature considers consumption as an act of communication and as a tool for building social bonds or distinctions. Research on symbolic consumption suggests that the factors that affect the quality and quantity of social interactions may influence salience of identity and the value of investing in constructing and enhancing one's identity (Arnett et al. 2003; Simon 2004). Research also suggests that individuals engage in vicarious consumption whereby they consume through those who are part of an individual's extended self (Belk 1988). These theoretical arguments form the core logic for our hypotheses development. Specifically, the technological and spatial characteristics of the virtual environment included in the research model are expected to play a role in determining the value of investing time and money in creating an identity in the virtual world.

The S-O-R framework (Bitner 1992; Williams and Dargel 2004) also lays the foundations for our research model and offers a structured view of the factors that influence the intention to purchase virtual goods. The S-O-R framework suggests that various aspects of the environment, such as ambient conditions, symbols, artifacts, architecture, and spatial arrangement, act as stimuli that cause changes to people's (i.e., participants in the virtual world) internal or organismic experiences. These experiences, in turn, shape their behavioral responses to the stimuli. In this study, we focus on two broad categories of environmental *stimuli* (e.g., technological and spatial features of virtual worlds) that may influence the virtual experience of participants (cognitive and emotional states of *organism* such as telepresence, social presence, and flow), which lead to participants' positive *response* (e.g., intention to purchase virtual goods).

The *technological* environmental stimuli are typically created or modified by the designer(s) of the virtual world, while the *spatial* environmental stimuli are formed by the navigation of the avatars within the virtual world. Specifically, the technological stimuli are primarily concerned with the virtual artifacts and surroundings that exist within virtual worlds, such as lands, shops, buildings, and meeting places, which stimulate the avatar's interaction with virtual objects as well as with other avatars. The ambient conditions and the aesthetic quality of virtual surroundings shape the degree of social contact and interaction among avatars. In this study, we pay particular attention to the interactivity and sociability features. Interactivity features allow participants to interact with virtual objects in the virtual environment by acting through the body of their avatar. Control over the virtual environment through the actions of the avatar enhances the vicarious experience of the participants and makes them feel that they are themselves present in the virtual world. The avatar becomes an extended self and the participant would find it valuable to engage in the vicarious consumption that enhances this extended self (Belk 1988; Lehdonvirta et al. 2009; Martin 2008). Sociability features embedded in the layout of virtual world areas make it easier to socialize and engage in rich social relationships, thus enhancing the value of consuming virtual products for building social self-image, that is, the projection of how one appears to others (Sweeney and Soutar 2001).

While the extant 2D and 3D computer-mediated communication literature has focused heavily on technological stimuli (Hoffman and Novak 1996; Ma and Agarwal 2007; Qiu and Benbasat 2005; Steuer 1992), the uniqueness of the virtual world (vis-à-vis other text-based virtual communities), stemming from the coupling of real time (primarily synchronous) communication with navigability in the virtual space, suggests that the spatial environmental stimuli will also play a significant role in shaping participants' social interactions with other avatars (Börner and Penumarthy 2003). For example, a virtual place crowded with many avatars might induce psychological stress and result in socially maladaptive behavior (Calhoun 1971). Similarly, spatial instability arising from frequent member changes might disrupt avatars' social bonds and weaken a sense of community, thereby affecting avatars' social behavior and virtual experience. These spatial impediments such as density and instability, might prevent avatars from developing a sense of belonging, shared values, and understanding through community-based social interaction within specific, spatially bounded virtual locations (Porter 2004).

Further, since the S-O-R framework suggests that the effects of these technological and spatial environmental stimuli on a participant's intention to purchase would be mediated through organismic experiences, we include virtual world experiences as the mediators in our research model. Researchers have found that virtual experiences mediate the effects of various variables of interest such as features of the interface, illusions of reality, attitudes toward the mediated others, etc., on motivation, satisfaction, and usage behavior (Hoffman and Novak 1996; Qiu and Benbasat 2005; Yoo and Alavi 2001). We focus primarily on three types of virtual experience, namely telepresence (Hoffman and Novak 1996; Qiu and Benbasat 2005; Steuer 1992), social presence (Biocca et al. 2003; Kreijns et al. 2007), and flow (Hoffman and Novak 1996; Koufaris 2002) because they are likely to be influenced by the spatial and technological environmental stimuli included in the model and they tend to influence the social and emotional motives of virtual product purchase.

Telepresence, which is one of the widely studied constructs, is defined as the experience of seeming to be present in a remote environment by means of a communication medium (Steuer 1992). *Social presence,* which has been conceptualized in a variety of ways (Biocca et al. 2003), is defined here as the extent to which a medium allows an individual to establish a personal connection with others (such that interaction with another person is judged as warm, social, sensitive, and personal) and enables an individual to experience others as being psychologically present (Short et al. 1976; Yoo and Alavi 2001). *Flow*, which is defined as the sense of intrinsic enjoyment obtained from an activity (Csikszentmihalyi 1990; Qiu and Benbasat 2005), is a third construct vital to understanding the impact of a virtual medium.

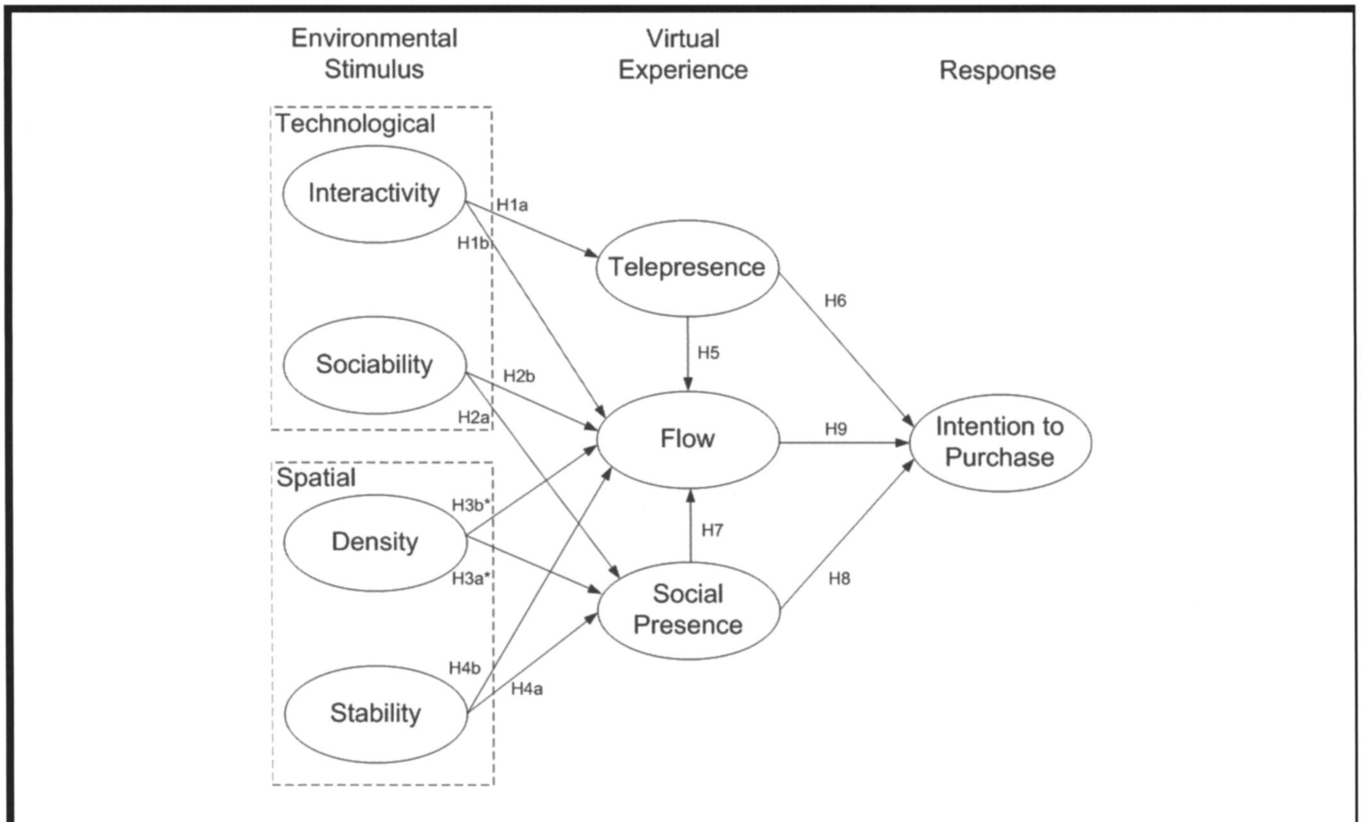
Based on these theoretical building blocks, we develop several hypotheses that elaborate the specific associations among virtual environmental stimuli (technological and spatial features of virtual worlds), virtual experiences (telepresence, social presence, and flow), and response (intention to purchase virtual goods). The research model depicting these relationships is illustrated in Figure 1.

Technological Environment and Virtual Experience

Interactivity

The technological features of an immersive virtual world can enhance or inhibit participants' interactions with virtual objects and thus influence their virtual experiences (Hoffman and Novak 1996; Steuer 1992). The extent to which users can interact with virtual objects and participate in modifying the landscape or content of a mediated environment in real time has been referred to as the *interactivity* of the medium (Steuer 1992).

Participants' interaction with a virtual world is enacted through the actions of their avatars. Participants can modify the environment and manipulate various virtual objects by acting through their avatar. It is through the avatars that the participants inhabit the virtual world, embody themselves, and make their engagement with the virtual world real (Taylor 2002). The more opportunities that the participants have to interact with the virtual environment and objects via their avatar, the more rooted the participants will be in the virtual world (Taylor 2002). Control over the virtual environment afforded by interactivity makes the brain adapt itself to the virtual world environment and the avatar become part of the participant's extended self (IJsselsteijn 2005). Thus, the interactivity experienced vicariously through the avatar distorts



*H3a and H3b are hypothesized as curvilinear (inverse-U shaped relationships).

Figure 1. A Research Model Based on the S-O-R Framework

participants' sense of reality by transporting them to the virtual world and creating a sense of telepresense (Steuer 1992).

Similarly, a high level of interactivity in a virtual world creates a sense of autonomy and control in the participant's mind, which can instill and reinforce a sense of enjoyment (Jiang and Benbasat 2007). The ability to vicariously interact with and control the virtual environment makes the role of avatar as an extended-self salient (Belk 1988) and thus enhances the value that a participant obtains from using the avatar to define who they are or who they wish to be in the virtual world. For example, virtual good purchases offer ways to extend the self through a wide variety of possessions such as virtual clothes, accessories, houses, etc., and can be used by the participants as a way to work toward the development of their ideal self (Martin 2008). However, such investments in self-identity development will be more enjoyable and involving if the participant believes the avatar to be an extension of herself. The salience of extended-self facilitated by the interactivity encourages deep engagement of the participant in the virtual world. Such captivating involvement in virtual world interactions and explorations leads to loss of self-consciousness (Coyle and Thorson 2001), makes the virtual experience playful, and increases the sense of flow (Hoffman and Novak 1996; Novak et al. 2000; Webster et al. 1993). Therefore, we posit that

H1a: *Perceived interactivity is positively related to the sense of telepresence.*

H1b: *Perceived interactivity is positively related to the sense of flow.*

Sociability

Similar to the role of technology in enhancing the interactivity (i.e., interactions with the virtual objects) of the virtual world, technology can also be designed to promote the *sociability* of the virtual world (i.e., social interactions among avatars). Sociability, defined as "the extent to which the computer-mediated communication (CMC) environment is able to facilitate the emergence of social space by allowing social affordances" (Kreijns et al. 2007, p. 179), is a feature that focuses primarily on participant–participant interactions (Preece 2001).

In the real world, sociopetal residential architecture (i.e., congenial physical arrangements that facilitate social interaction and enforce togetherness), building layout, and the features of public and semipublic spaces have been suggested to facilitate the formation of stronger communities (Kuo et al. 1998). Extending this idea to virtual worlds, Kreijns et al. (2007) argue that it is important to design virtual places to autonomously support the initiation and maintenance of social interaction. As mentioned earlier, most of the locations in virtual worlds such as Second Life are designed by participants and, as a result, exhibit a wide variety in terms of architecture, layout, and social spaces. Exploration of various locations in Second Life clearly shows that the design of some locations encourages more spontaneous interactions between participants than other locations.

The sociability feature of a specific location brings people together in time and space (Dimmick et al. 1994) as well as creates and maintains a sense of camaraderie among the participants. The virtual world locations that exhibit higher levels of sociability may lead to increased social interactions and create the feeling of affection, trust, belongingness, and warmth (Kreijns et al. 2007). Socialization in a virtual world takes place through the avatars (Taylor 2002). Participants use their avatar to engage in role-play activities (e.g., creating, communicating, and consuming in the virtual world) and build an identity to project how one appears to others (Sweeney and Soutar 2001). During social interactions, participants rely on these identities to choose interaction partners and form friendship cliques (Heise 2007). Virtual world locations high on sociability are thus likely to facilitate the development of close, warm, and personal relationships among participants and, therefore, influence the social affordances available to the participants and the subjective perception of social presence (Short et al. 1976).

Researchers examining multi-user online role-playing games have found that social interactions are correlated with the experience of flow (Kim et al. 2005). Since social interaction is a basic need of humans, even brief social interactions can make an experience enjoyable and the technology designed to enhance the interaction increases the level of enjoyment (Esbjörnsson et al. 2003). Increased social interactions fostered by sociability features offer greater opportunities for participants to showcase their identity as embodied in their avatar. Greater opportunities to interact with other participants and present their own virtual identity to them make the time, effort, and money spent in such identity building activities worthwhile and make virtual experiences involved in such role-play more enjoyable and engaging. The quest to build an identity in the virtual world for socialization and the resulting involvement in the virtual world make the participants unaware of the passage of time spent in the virtual world (Esbjörnsson et al. 2003). Therefore, we posit that sociability features create enjoyable virtual experience leading to sense of flow:

H2a: *Perceived sociability is positively related to the sense of social presence.*

H2b: *Perceived sociability is positively related to the sense of flow.*

Spatial Environment and Virtual Experience

Next, we examine the non-technological characteristics of the virtual world that influence interactions between avatars. As noted earlier, spatial dynamics such as density and stability in the virtual spaces that a participant visits are likely to influence his/her interaction opportunities. The ease with which a participant can travel around a particular virtual world is likely to cause fluctuations in the population dynamics of its various virtual locations (Börner and Penumarthy 2003; Porter 2004). Therefore, in order to gain some understanding of the implications of such spatial dynamics, while also assessing interaction opportunities, we focus on density (i.e., number of avatars) and stability (i.e., familiarity with the avatars) of avatars in a particular virtual location.

Density

Population density, which refers to the number of individuals living in a designated unit of space, is an important factor that impacts the perceptions and behavior of individuals (Nasar and Julian 1995). Research examining population dynamics in the physical world has shown that population density can have both positive and negative impacts on social interactions. On one hand, low density has been shown to undermine social ties (Glynn 1981; Nasar and Julian 1995) and on the other hand, high population density has been shown to negatively affect social interactions and weaken social ties (Hutt and Vaizey 1966; Wilson and Baldassare 1996). As we suggested earlier, the 3D representation of space in virtual worlds sets them apart from other 2D virtual communities and brings them closer to the physical world (Krotoski et al. 2009; Zheng 2009). Participants, who interact with each other by controlling their avatars, are collocated in space and time which encourages social interactions based on "physical–virtual co-proximity" (Krotoski et al. 2009). To the extent that the avatar co-proximity plays an important role in social interactions in 3D virtual worlds, the quantity and quality of social interactions would depend on the number of avatars located around a focal avatar in a specific unit of space.

Given that socialization and role-play is one of the primary objectives of participants in the virtual world (Boss 2007; Lehdonvirta et al. 2009; Martin 2008), participants seek to visit those places where they can find avatars with whom they can interact. Locations in the virtual world that are sparsely populated offer fewer opportunities to engage in social interactions as compared to locations that are more populated. Increasing the density of avatars results in an exponential increase in the number of possible interactions, which in turn is likely to increase the salience of the identity that a participant has created (Arnett et al. 2003; Simon 2004). The interactions in such locations are more engaging and enjoyable, thus creating a stronger sense of flow among participants. However, after a threshold point, higher density is likely to adversely impact participants' experiences. Research in the physical world has shown that high density has negative social and psychological consequences (Christian 1961; Evans et al. 2001). High density neighborhoods may actually lead to poor social relations (Keane 1991) and increase loneliness as individuals become reserved toward one another as a defense against the sensory overload caused by too much uncontrolled contact with others (Wilson and Baldassare 1996). Similarly, in the context of virtual worlds, too many avatars in a particular virtual location could increase the possibility of sensory overload among participants and force them to engage in unwanted interactions, thus decreasing their level of engagement and involvement in the virtual world. Based on these arguments, we propose a curvilinear relationship between density and flow such that the sense of flow increases initially with increasing density and then decreases with increasing density, leading to an inverse U-shaped curve.

Similar to the relationship between density and flow, we suggest that density will have an inverse U-shaped relationship with social presence. Participants choose interaction partners to maximally confirm their sentiments (Heise 2007). In low density areas, there are only a limited number of avatars with diverse identities, which limits the probability that participants will encounter avatars with whom they would like to interact and generate close, personal, and warm relationships. As the density increases, the likelihood of getting into more satisfying and warm relationships increases as the set of potential close matches increases. Thus, higher density leads to an increase in the sense of social presence. However, after reaching a threshold, increasing density would adversely impact the social presence as the participants in a high-density environment may find meaningful conversation with other participants difficult to maintain because of interferences created by others (Jones et al. 2004). In such an environment, participants often become anxious and aggressive when their "body-buffer zone" (e.g., a personal space) is intruded upon by others (Bailenson et al. 2003). High density is likely to result in an intrusion of participants' personal territory and therefore affects their social interaction. High density hampers a participant's ability to make oneself known to others, thus lowering the salience of the virtual identity. This then prevents the development of a sense of social presence, which contributes to the sense of belonging to that community and to subsequent continued social interaction. Therefore, we propose that

H3a: *Perceived density will have an inverse-U shaped relationship with the sense of social presence.*

H3b: *Perceived density will have an inverse-U shaped relationship with the sense of flow.*

Stability

Researchers from a diverse range of fields, including geography, economics, sociology, and psychology, have studied the construct of population stability (or mobility when negatively worded).[4] Geographical stability describes the flux of residents into and out of neighborhoods over time (Ross et al. 2000). This is considered one of the most important factors in determining an individual's local social bonds and associational ties (Kang and Kwak 2003).

Research in the physical world suggests that geographical instability or mobility disrupts an individual's interpersonal relationships, their education, and their social support systems, whereas stability strengthens their network of local social ties (Ingersoll et al. 1989). *Population stability*, characterized by minimum mobility, leads to the establishment of long-term relationships and the perception among residents that their neighborhood is stable and vibrant, creating a sense of community (Randall et al. 2008). Previous research has indicated that geographical stability is associated with the depth of local knowledge and the strength of local ties (Hanson 2005). Stability increases social integration and the likelihood that neighbors will know each other and share values and norms (Ross et al. 2000). As we mentioned earlier, 3D virtual worlds have the potential to mirror the real

[4]This construct has also been labeled as population, residential, or neighborhood mobility (Dieleman 2001).

world due to the role of avatar co-proximity in social interactions. To the extent that the avatar co-proximity plays an important role in social interactions in 3D virtual worlds, the quantity and quality of social interactions would depend on the stability of the avatars in a specific unit of space. Specifically, we argue that physical world dynamics would apply to the virtual 3D world such that greater familiarity with the participants due to stability will induce warm and close personal relationships and generate a sense of social presence.

Stability increases the likelihood of potential future interactions with the same avatars, thus increasing pro-social behavior among participants (Walther 2006). The frequent, repeated interactions endorse one's role relationship with other participants as well as the associated identity and increase the salience of participants' identity (Simon 2004). Such emotional attachment to the others to whom one relates in the virtual world enhances the value of managing one's virtual identity and investing in efforts to develop warm and personal relationships. As a result of pro-social behavior exhibited by avatars in a location with high stability, participants experience a stronger sense of social presence.

In addition to the increased probability of social interactions among regular participants, stability also plays an important role in defining the character of a place. A stable population of participants at a location defines the character of a location, setting the conversational tone and establishing the general mood of the space (Oldenburg 1999). Stability also increases the likelihood of regular encounters with "familiar strangers" (i.e., individuals whom participants frequently observe, but do not interact with), thus establishing a participant's connection to the virtual place (Paulos and Goodman 2004) and increasing the value of identity creation and management activities. The close connection with the virtual place makes participants' engagement in the virtual world more enjoyable and immersive. Therefore, it can be argued that participants, who visit areas in virtual worlds with relatively stable populations, are likely to enjoy the time they spend there and to experience a state of flow. Hence, we posit that

H4a: *Perceived stability is positively related to the sense of social presence.*

H4b: *Perceived stability is positively related to the sense of flow.*

Virtual Experience and Purchase Intention

As per the S-O-R framework, the impact of environmental stimuli on behavior is mediated through the organismic experiences or virtual experiences in the virtual world context. Therefore, as described in the theory section, we include telepresence, social presence, and flow in our research model as the mediators of characteristics in the virtual world on consumers' purchase intention.

Telepresence

Hoffman and Novak (1996) argue that telepresence increases the subjective intensity of a consumers' flow state. The avatar becomes an extended-self of the participant in the virtual world during the heightened sense of telepresence, which results in a highly immersive virtual experience. Participants who experience sense of telepresence concentrate on their activities in the virtual world so acutely that there is little attention left to consider anything else. As a result, participants lose track of the time, other events occurring in the surrounding physical environment lose significance, and they reach a state of gratification (Novak et al. 2000). Empirical evidence also shows that sense of telepresence leads to flow (Novak et al. 2000). Thus, we posit that

H5: *Telepresence is positively related to flow.*

Researchers have investigated the role of telepresence in influencing consumer response to virtual product experiences (Klein 1998; Li et al. 2001). Participants who experience telepresence are less likely to sense a distinction between self and a virtual environment and thus more likely to be satisfied with the virtual environment (Novak et al. 2000) and perceive their avatar as their extended-self (Belk 1988). Such participants get immersed in the virtual world and use their avatar as they would use their physical body to satisfy the need to express themselves and vicariously socialize in virtual worlds.[5] Consequently, participants invest in purchasing virtual products to construct and enhance the identity of their avatar in the virtual world as they consider their avatar an extension and/or projection of themselves (Belk 1988; Martin 2008). Therefore, we propose that

H6: *Telepresence is positively related to intention to purchase.*

Social Presence

Social presence can create a sense of psychological closeness or proximity that leads to flow (Ryan and Grolnick 1986).

[5]"Report: Virtual Worlds Growth to Skyrocket," EngageDigital, June 15, 2008 (http://www.virtualworldsnews.com/2009/06/report-virtual-worlds-growth-to-skyrocket-.html).

Participation in social interactions increases and sustains engagement in the virtual world (Laffey et al. 2006). Participants who engage in social interactions and develop warm and personal relationships in a virtual world are likely to attain a level of absorption in their virtual activities that causes them to lose track of time and fail to notice events occurring in their physical environment. When participants experience social presence through warm and personal interactions with others, they tend to be deeply involved, absorbed, engaged, and engrossed in the interaction (Laffey et al. 2006). Such engaging interactions make the role-playing and identity management activities undertaken by the participants in the virtual world more enjoyable. Social presence is thus likely to enhance participants' concentration on their activities in the virtual world and generate a sense of flow. Therefore, we posit that

H7: *Social presence is positively related to flow.*

Participants who develop social attachments to other virtual world participants are more likely to buy virtual products to express themselves and create an identity in the virtual society, which can enhance their ability to socialize with other participants (Guo and Barnes 2007). Participants with strong sense of social presence have closer personal relationships with other participants in the virtual world. Since the identity of the participants is salient in such interactions (Simon 2004), higher social presence will be more likely to evoke identity-related behaviors. Given the importance of products in setting the stage for the multitude of social roles that people play and in building their identity (Belk 1988; Solomon 1983), participants with a stronger sense of social presence will invest more in consuming virtual goods for the avatar such as accessories, virtual houses, and decorative ornaments like furniture, digital wallpaper, etc., to represent and articulate their virtual identity to their interaction partners. Based on these arguments, we postulate that

H8: *Social presence is positively related to intention to purchase.*

Flow

The characteristics of the communication medium affect flow (Hoffman and Novak 1996; Qiu and Benbasat 2005), which, in turn, affects consumers' attitudes and behavior (Hoffman and Novak 1996). Individuals who experience flow states reported subjective experiences that were more positive and demonstrated a higher likelihood of satisfaction and loyalty (Hoffman and Novak 1996). We argue that participants who find their virtual experiences highly compelling and become intensely involved in their activities in the virtual world are likely to focus entirely on their virtual interactions (Novak et al. 2000). Thus, they are more likely to feel the need to buy products for their virtual existence. Participants who enjoy their existence in the virtual world are likely to be more inclined to invest time and money in the purchase of virtual products, such as clothes, body parts, land, houses, accessories, etc. Such participants consider their avatar as an extension and/or projection of themselves and their virtual life is important enough to them that they will invest in virtual products to ensure that their avatar looks right and feels comfortable (Guo and Barnes 2007). Research indicates that the most popular product categories in virtual worlds (e.g., Second Life) are those related to avatar customization, such as virtual clothes, body parts, and accessories (Repères 2006). The level of enjoyment obtained from the virtual world is related to the extent to which virtual events and actions affect the participant emotionally (Yee 2006). Therefore, participants who experience a sense of flow will have a greater desire to hone their virtual identity, which would require them to create and/or buy virtual possessions. Therefore, we posit that

H9: *Flow is positively related to intention to purchase.*

Research Methodology

To test the hypotheses, we conducted a Web-based survey with the residents of Second Life (www.secondlife.com), which is one of the most popular 3D immersive virtual worlds and has a very dynamic economy. Despite the recent downturns in the real world economy, the economy in Second Life is booming. As of April 2010, for example, over 3,600 virtual business companies are listed on the Second Life business directory and they sell numerous virtual products such as land, houses, clothes, and accessories.[6] Over a half-billion-dollar trade (US$567 million) in virtual products in 2009, growth of 65 percent over 2008,[7] also demonstrates that virtual goods can be a promising business in Second Life.

Measurements

Table 1 provides definitions of the constructs and key related literature. We either adopted previously validated measures or developed new scales. For all measures, we used multiple items based on a seven-point Likert scale.

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[6]SLBiz2Life business directory (http://www.slbiz2life.com/).

[7]Blog posting by T. Linden, January 19, 2010 (http://blogs.secondlife.com/community/features/blog/2010/01/19/2009-end-of-year-second-life-economy-wrap-up-including-q4-economy-in-detail).

Table 1. Definitions of Constructs

Construct (Abbreviation)	Operational Definition	Reference
Interactivity (INT)	The extent to which one can control the virtual environment in modifying the form and the content of the environment	Steuer (1992)
Sociability (SOC)	The extent to which the virtual environment can facilitate the emergence of social space	Kreijns et al. (2007)
Density (DEN)	The extent to which one perceives that the number of individuals (avatars) is relatively large compared to its accommodating space	Self developed
Stability (STA)	The extent to which one perceives that most of individuals (avatars) present in an area are regular visitors to that space	Self developed
Telepresence (TPR)	The perceived sense of being present in the virtual environment	Qiu and Benbasat (2005); Steuer (1992)
Social Presence (SPR)	The perceived sense of how personal, warm, intimate, sociable, or sensitive the social interactions are in the virtual environment	Qiu and Benbasat (2005); Short et al. (1976)
Flow (FLW)	The perceived sense of intrinsic enjoyment obtained from interacting with the virtual environment	Qiu and Benbasat (2005); Novak et al. (2000)
Intention to Purchase (PUR)	The degree to which one believes that one will buy different types of virtual products (an aggregate likelihood of purchasing virtual products)	van der Heijden and Verhagen (2004)

Intention to purchase was measured by adopting the items used by van der Heijden and Verhagen (2004). Since each item measured the likelihood to buy a different type of virtual product (e.g., virtual real estate and virtual goods) making up the overall intention, we created an aggregate likelihood of purchase construct by averaging the items (Rossiter 2002). We measured the constructs of telepresence, social presence, and flow adopting the scale used by Qiu and Benbasat (2005). Telepresence was defined as a participant's perceived sense of being present in the virtual environment (Steuer 1992). Social presence was assessed by using a participant's perception of how personal, warm, intimate, sociable, or sensitive the social interactions are in the virtual environment (Qiu and Benbasat 2005; Short et al. 1976). Flow was operationalized as the perceived level of intrinsic enjoyment obtained from interacting with the virtual environment (Novak et al. 2000).

Generally, prior research has manipulated the level of interactivity in an experimental setting and used a dummy variable to represent it (Coyle and Thorson 2001; Qiu and Benbasat 2005). We created a seven-point Likert scale that captures the user control of the virtual environment in modifying the form and the content of the environment (Steuer 1992). Sociability is a relatively new construct in the literature (Preece and Maloney-Krichmar 2003) which has recently been operationalized in the context of virtual environments (e.g., Kreijns et al. 2007). We adopted the measures developed by Kreijns et al. (2007) to assess the perceived sociability of a virtual environment. Density (i.e., the number of individuals living in a designated unit of space) and mobility (i.e., numbers of people who moved from one location to other locations as a proportion of the resident population) are concepts borrowed from population geography literature (Gause 1932; Harrell et al. 1980) where they are calculated based on the census data. Due to the unavailability of such data in the context of the virtual world that we study, we developed a perceptual scale to measure the density and stability (i.e., defined as the reverse of mobility) of the virtual space where the respondents spent most of their time. The items for each of the constructs used in the study are listed in Appendix A.

Data Collection

The survey was conducted for 10 consecutive days during the summer of 2008. Participants were solicited by using various online channels, including placing announcements on densely populated islands in Second Life (e.g., Apolon, Full Moon, Black Lion, Avaria, Live, etc.), posting a link to our online questionnaire in various Web sites or forums related to the virtual world (e.g., http://www.sluniverse.com, http://forums.secondlife.com, etc.), installing a kiosk where individuals

Table 2. Demographics of Participants (N = 354)			
Demographics		**Frequency**	**Percent (%)**
Gender	Female	186	52.5
	Male	168	47.5
Age	16 or younger	3	0.8
	17–21	67	18.9
	22–30	125	35.3
	31–45	123	34.7
	46–64	35	9.9
	65 or older	1	0.3
Occupation	Student	97	27.4
	Working	187	52.8
	Retired	15	4.2
	Unemployed	33	9.3
	Other	22	6.2
Education	High school	70	19.8
	Undergraduate	239	67.5
	Postgraduate or higher	45	12.7
Time spent in Virtual World (hours per week)	Less than 1	8	2.3
	1–3	20	5.6
	3–5	32	9.0
	5–10	69	19.5
	10–20	101	28.5
	More than 20	124	35.0

could fill out the questionnaire, and directly contacting users with active avatars in Second Life. The participants were asked to provide their Second Life ID in order to receive a reward of 1,000 Linden dollars equivalent to approximately $4 in US currency, upon completion of the study. Additionally, in order to ensure that only one response was submitted per respondent, each participant's IP (internet protocol) address and demographic information were carefully investigated. In total, 391 individual surveys were returned. However, 30 incomplete responses and 7 aberrant responses with a uniform answer to the entire set of questions were excluded (Meijer and Sijtsma 1995). We minimized missing data by using a caution message when respondents attempted to move to the next page without fully answering the survey items. Finally, a total of 354 fully answered responses were used for the analysis. Table 2 presents the demographic information of the final samples.

Results

Structural equation modeling (SEM) was adopted as the main data analysis method. In contrast to the regular regression analysis methods, SEM collectively explores a set of interrelated issues by simultaneously testing the interplay between various independent (exogenous) and dependent (endogenous) constructs (Anderson and Gerbing 1988). In addition, relative to regression analyses, SEM provides more dynamic and rigorous analyses for model fitting. For example, SEM facilitates a two step validation approach in which both the measurement model and the structural model are validated (Anderson and Gerbing 1988).

Measurement Model

To validate the measurement model, reliability and validity analyses were performed. Because curvilinear associations between density and flow/social presence are hypothesized in our model, a squared term of density (DEN*DEN) was included along with the linear term of density (Maruyama 1997). Reliability was assessed based on Cronbach's alpha and composite reliability (CR) score. As shown in Table 3, Cronbach's alpha and CR estimates of all of the constructs, except for DEN*DEN (0.647 for Cronbach's alpha),[8] exceeded

[8]Nevertheless, we decided to retain this construct (DEN*DEN) as other estimates such as CR and AVE were well above the recommended threshold (0.787 and 0.576, respectively).

Table 3. The Measurement Model Statistics

Construct	Indicator	Factor Loading[a]	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Interactivity	INT1	.736	.824	.877	.587
	INT2	.711			
	INT3	.673			
	INT4	.710			
	INT5	.651			
Sociability	SOC1	.627	.849	.896	.625
	SOC2	.799			
	SOC3	.740			
	SOC4	.794			
	SOC5	.695			
Density	DEN1	.759	.776	.814	.603
	DEN2	.817			
	DEN3	.635			
DEN*DEN	SQD1	.655	.647	.787	.576
	SQD2	.924			
	SQD3	.391			
Stability	STA1	.763	.740	.851	.657
	STA2	.835			
	STA3	.508			
Telepresence	TPR1	.833	.873	.904	.656
	TPR2	.907			
	TPR3	.754			
	TPR4	.603			
	TPR5	.686			
Social Presence	SPR1	.785	.910	.934	.740
	SPR2	.876			
	SPR3	.835			
	SPR4	.863			
	SPR5	.748			
Flow	FLW1	.727	.886	.918	.692
	FLW2	.762			
	FLW3	.833			
	FLW4	.806			
	FLW5	.790			
Intention to Purchase	PUR	1	1	1	1

[a]All factor loadings were significant at $p < 0.05$ (two-tailed).

the recommended threshold value of 0.7 (Nunnally 1978), suggesting high construct reliability. Convergent validity was confirmed by examining both the average variance extracted (AVE) and the factor loadings of the indicators associated with each construct. A confirmatory factor analysis (CFA) was employed to compute the factor loadings. Table 3 shows that AVE values ranged from 0.576 to 0.740, which are well above the threshold value of 0.5 (Fornell and Larcker 1981). The factor loadings ranged from 0.391 to 0.924 and are all statistically significant at the $p = 0.05$ levels, strongly supporting the presence of convergent validity (Bagozzi et al. 1991).

Finally, discriminant validity was assessed by two methods. First, we compared the square root of the AVE for each construct against the inter-construct correlation estimates (Fornell and Larcker 1981). As seen in Table 4, all of the diagonal elements in bold italics (the square root of AVE) were found to be greater than any other corresponding rows or column entries (inter-construct correlation coefficients). We also calculated the loadings and cross-loadings. The results shown in Appendix B demonstrate that each indicator had a higher loading on its intended construct than on any other construct (Chin 1998). Consequently, these tests combined indicate strong discriminant validity.

The overall fit of the measurement model was evaluated by using EQS 6.1 for Windows (Byrne 1994) with various fit indices, such as normed chi-square (χ^2/d.f.), normed fit index (NFI), non-normed fit index (NNFI), comparative fit index (CFI), goodness of fit index (GFI), standardized root mean-square residual (SRMR), and root mean-square error of approximation (RMSEA). Table 5 presents the fit strength for the measurement and structural models and the desirable range of fit indices. The chi-square of the measurement model and the normed chi-square (the ratio of chi-square to the degrees of freedom) were 1107.43 (d.f. = 524, $p < 0.001$) and 2.11, respectively. These results indicate a satisfactory model fitting. With the exception of NNFI (0.89), all other fit indices (NFI = 0.83; CFI = 0.90; GFI = 0.85; SRMR = 0.06; RMSEA = 0.06) met the recommended threshold criteria. Consequently, the fit to the measurement model was found to be satisfactory.

Structural Model

The hypotheses were tested by using the maximum likelihood estimation technique employed by EQS 6.1 for Windows (Byrne 1994). Following the procedures adopted to test the measurement model, we found that all of the structural model fit indices were satisfactory, albeit marginally inferior to those found in the measurement model (see Table 5). Figure 2 depicts the main path coefficients, t-values, and explained endogenous variables' variances (R^2) for the structural model.

As shown in Figure 2, eight of the thirteen paths in the research model are supported. As expected, interactivity was significantly associated with both telepresence (path coefficient = 0.165, $p < 0.01$) and flow (path coefficient = 0.260, $p < 0.001$), supporting H1a as well as H1b. Stability was also found to be significantly related to both social presence (path coefficient = 0.161, $p < 0.01$) and flow (path coefficient = 0.126, $p < 0.05$), supporting H4a and H4b, respectively. However, mixed findings were obtained with respect to sociability. Sociability had a strong impact on social presence, supporting H2a (path coefficient = 0.435, $p < 0.001$), but the hypothesis suggesting the relationship between sociability and flow (i.e., H2b) is not supported. We also did not find evidence supporting curvilinear relationships between density and social presence (i.e., H3a) and between density and flow (i.e., H3b). Instead, density showed mixed linear relationships; density was found to have a positive influence on social presence (path coefficient = 0.143, $p < 0.05$) but negative influence on flow (path coefficient = -0.169, $p < 0.01$). Using *post hoc* analyses, we provide plausible explanations for this unexpected result in the next section. As expected, telepresence and social presence were significantly associated with flow (path coefficient = 0.186, $p < 0.001$ and path coefficient = 0.329, $p < 0.001$, respectively), supporting H5 and H7. Overall, approximately 3 percent (0.027) of the variance in telepresence, 27 percent (0.268) of the variance in social presence, and 42 percent (0.417) of the variance in flow were explained by the antecedent (exogenous) variables.

Further, flow had a significant impact on intention to purchase (path coefficient = 0.550, $p < 0.001$), strongly supporting H9. However, no significant relationships were observed between telepresence and intention to purchase as well as between social presence and intention to purchase, rejecting H6 and H8. Overall, the structural model explained approximately 31 percent (0.306) of the variance in intention to purchase.

Since self-reported survey studies that rely on responses in a cross-sectional, single setting are likely to suffer from common method bias, we performed two statistical analyses as a robustness check to ensure the validity of our results. First, we carried out Harman's one-factor test as recommended by Podsakoff and Organ (1986). The factor analysis on items related to the independent as well as the dependent variables did not lead to a single factor solution, nor did a single latent factor account for most of the manifest variables. In addition, following the recommendations of Podsakoff et al. (2003) and Liang et al. (2007), we employed a technique by which we

Table 4. Construct Correlations and Discriminant Validity

Constructs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
INT (1)	***.766***								
SOC (2)	.477**	***.791***							
DEN (3)	.012	-.012	***.777***						
SQD (4)	.118	.114	.303**	***.759***					
STA (5)	.126	.152*	.222**	.216**	***.811***				
TPR (6)	.147*	.175**	.226**	.112	.248**	***.810***			
SPR (7)	.305**	.452**	.177**	.136*	.259**	.380**	***.860***		
FLW (8)	.448**	.446**	-.041	.082	.262**	.355**	.522**	***.832***	
PUR (9)	.291**	.258**	-.044	.013	.166**	.194**	.288**	.538**	***1***

*$p < 0.05$; **$p < 0.01$ (two-tailed)

The diagonal elements in ***bold italics*** are the square roots of the AVE. The off-diagonal elements are the correlations between constructs.

Table 5. Measures of the Model Fit

Fit Statistics	Measurement Model	Structural Model	Recommended Range
χ^2	1107.43	1164.39	–
Degree of Freedom (d.f.)	524	535	–
Normed χ^2 (χ^2/d.f.)	2.11	2.18	< 2.00 or 3.00*
Normed Fit Index (NFI)	.83	.82	> 0.80 (marginal fit) and > 0.90 (good fit)**
Non-Normed Fit Index (NNFI)	.89	.88	> 0.90***
Comparative Fit Index (CFI)	.90	.90	> 0.90***
Goodness of Fig Index (GFI)	.85	.84	> 0.80***
Standardized Root Mean-Square Residual (SRMR)	.06	.08	< 0.08**
Root Mean-Square Error of Approximation (RMSEA)	.06	.06	< 0.06**

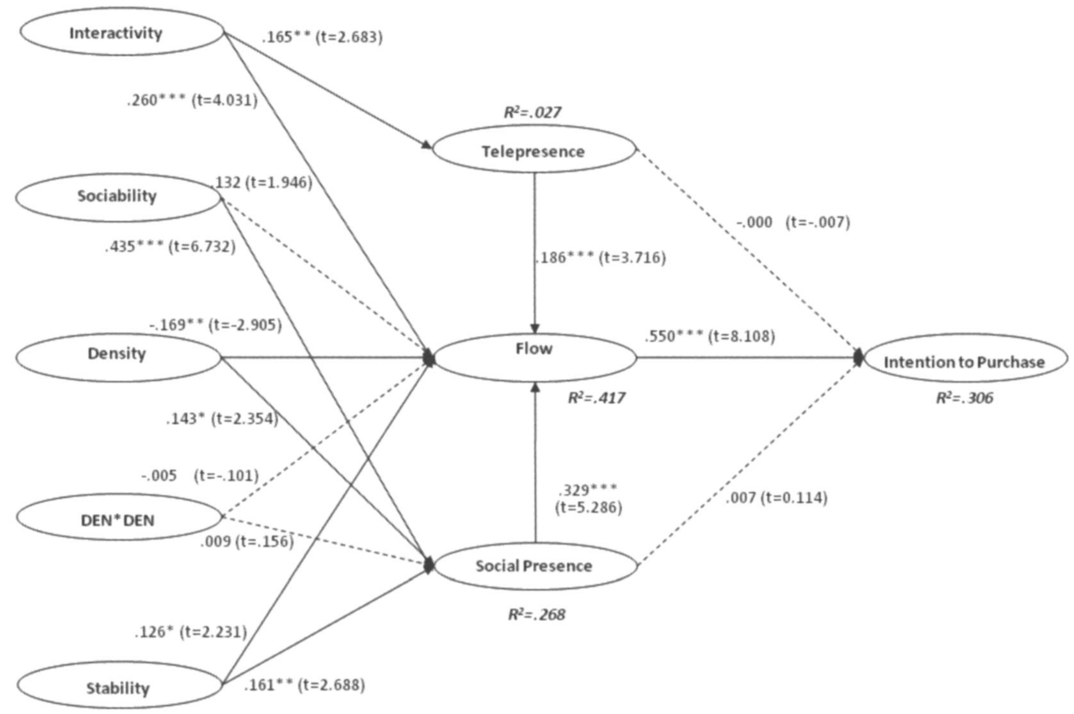
*Adopted from Carmines and McIver (1981).
**Adopted from Hu and Bentler (1999).
***Adopted from Jun et al. (2006).

could control for the possible effects of an unmeasured latent methods factor. The results indicate that the average variance explained by the initial model with the common method factor remains high (68.2 percent), but the average variance explained by the common method is almost negligible (0.4 percent). Consequently, these tests combined indicate that this present study is robust against common method biases.[9]

[9]Full results are available from the first author.

Discussion

Our results suggest that both technological and spatial environmental features influence the virtual experiences of participants in virtual worlds, which, in turn, influence their purchase intention of virtual goods. More specifically, regarding technological factors, we found that interactivity has a significant positive impact on telepresence and flow. Moreover, sociability has a strong effect on social presence, although no such significant impact was observed on flow. As for the spatial factors, both density and stability are found to significantly influence virtual experiences. Stability facili-



$^*p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$ (two-tailed)

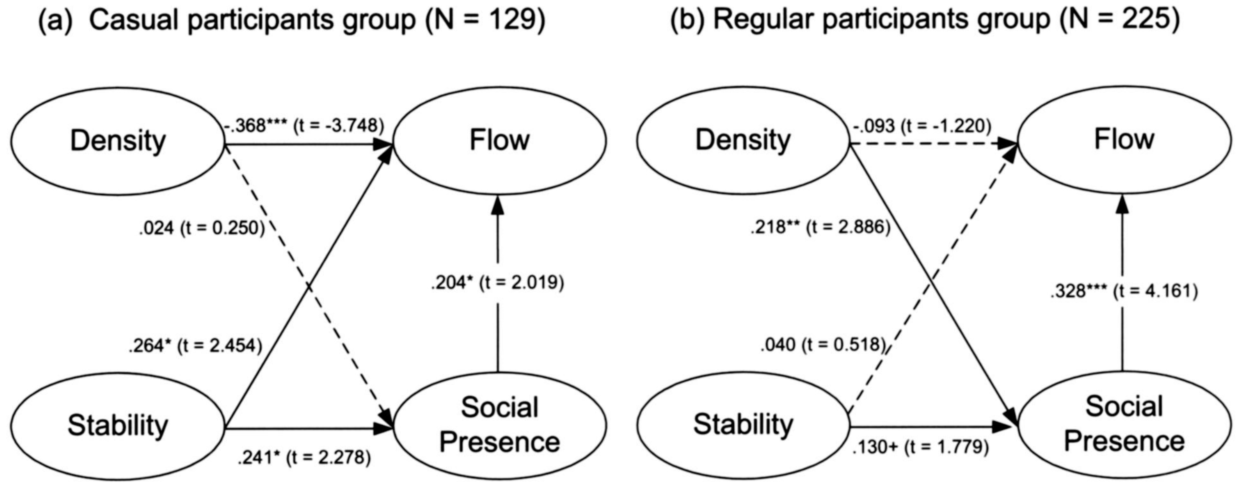
Only the main relationships are represented in the figure. Other relationships have been omitted for the sake of simplicity.

A squared term of density (DEN*DEN) is included to examine the curvilinear relationships between Density and Flow/Social Presence.

Figure 2. Results of the Structural Model

tates users to develop strong social bonds, thereby increasing both social presence and flow. However, contrary to our prediction of curvilinear patterns, density was found to be linearly associated with social presence and flow. Furthermore, our results also show two opposing effects of density on these variables reflecting participants' virtual experiences; density reduces the extent of flow, but increases the amount of social presence. Interestingly, since social presence was found to increase flow, the net impact of density on flow depends heavily on the relative strength of the associations involving these three constructs.

These results may suggest that the impact of density on virtual experiences is more complex and dynamic than our model suggests. One possible explanation for the negative relationship between density and flow is that the degradation of the virtual experience arising from sensory overload and the additional efforts required to compensate for the adverse impact of noise on the quality of interactions may play a dominant role in shaping the flow experience (i.e., the threshold at which the negative impact of density becomes dominant occurs at a very low level of density). A plausible explanation for the other unexpected result (i.e., a positive relationship between density and social presence) is that some participants have adapted to the virtual world in such a way that they can develop personal relationships with other participants despite the difficulties caused by the increasing number of participants in a given area. If this is the case, then it is more likely that the "regulars," who frequently visit the virtual world and regularly spend a substantial amount of time in it, will be able to overcome such challenges more effectively than the "casual" participants, who are relatively new and spend only a limited amount of time in the virtual world. For example, the regulars may have already become acquainted with many other participants and, therefore, feel a greater sense of social presence when the site is crowded with their friends. In contrast, the casual participants may not know many people and, therefore, may be overwhelmed by the presence of many unfamiliar participants. In order to gain insights into this moderating effect, we performed additional analyses by dividing the samples based on their participation intensity.



(a) Less than 10 hours per week. (b) More than 10 hours per week.
+$p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$ (two-tailed)
Only the focal relationships from the entire model are shown in this figure. The results on other latent constructs remain unchanged and were therefore omitted for simplicity.

Figure 3. The Comparison of Results by the Participant Groups

In order to test this explanation, we divided the samples into two groups (regulars who spend over 10 hours per week in virtual worlds and casuals who spend 10 hours or less in virtual worlds[10]) based on the amount of time that they spend in virtual worlds (see the last row in Table 2). We then ran the structural analysis described in Figure 2. Interestingly, for regular participants, density was positively associated with social presence at a 99 percent confidence level ($p < 0.01$) (see Figure 3). However, there was no such association observed for casual participants ($p > 0.1$), indicating that density does not have a significant bearing on social presence for this type of participant. The level of participation intensity also seems to moderate the relationship between density and flow. For casual participants, density was negatively associated with their flow experience ($p < 0.001$); however, this was not the case for regular participants. It appears that density is a behavioral constraint for casual participants, while it is a positive environmental stimulus for regular participants.

These *post hoc* results provide support to our explanation of the unanticipated findings. It seems that regular participants have developed an ability to have spontaneous social interactions with their neighbors, which enables them to overcome the adverse impact of density on the formation of social ties, such that the density does not adversely impact their sense of flow. The casual participants, on the other hand, lack the ability to adapt to a high-density environment, which does not allow them to develop a sense of social presence and adversely impacts their sense of flow. Although further validation is necessary, this finding suggests that participation intensity may be a likely moderator in the relationship between density and virtual experiences.

Finally, although most of our hypotheses were supported, some of the proposed relationships were found to be statistically insignificant. Specifically, we do not find support for a direct relationship between sociability and flow. Sociability, however, contributes to the flow experience through the mediating role of social presence. Further, the hypotheses suggesting a direct impact of telepresence and social presence on intention to purchase were not supported. Results suggest that flow experience mediates the impact of telepresence and social presence on intention to purchase, thus highlighting the dominant role of flow in influencing behavior in the virtual world.

[10]No public information was available for classifying regular and casual users in terms of the number of hours spent in a virtual world. However, one Web site (http://blog.webometrics.org.uk/labels/MySpace.html) reports that heavy users, on average, spend 22 hours per month (approximately, 45 minutes per day) on social networking sites. We doubled this figure and used 10 hours per week (1.5 hours per day) as a cutoff to identify regular participants.

Contributions to Research and Practice

This paper makes several contributions to research. First, we extend the literature on intention to purchase virtual goods—which has focused primarily on individual drivers of intention to buy virtual goods and product characteristics that stimulate purchasing behaviors—by studying how contextual factors influence intention to buy through mediating factors related to virtual experiences. Despite the fact that sales of virtual goods, which have only limited utilitarian value, are growing at an astonishing rate, little progress has been made in understanding the factors that impact an individual's virtual goods purchase behavior. Drawing on symbolic consumption literature and developing a research model based on the S-O-R framework, we explain and validate the significant role of environmental stimuli in influencing the intention to purchase virtual goods. Although the factors we identified in this study do not constitute an exhaustive list, they provide an initial vantage point from which to recognize other contextual variables crucial to the understanding of the intention to purchase virtual goods.

Second, recognizing the need to integrate the technological and non-technological aspects of virtual world research (Jäkälä and Pekkola 2007), we employ the S-O-R framework to investigate how the technological characteristics (i.e., interactivity and sociability) and the spatial characteristics (i.e., density and stability) of the virtual world impact virtual experiences and, subsequently, the intention to purchase virtual goods. This extends prior research on virtual worlds which has mainly focused on engineering and technological design aspects of virtual environments and provides the conceptual foundation for studying the social and economic behaviors of participants in an immersive virtual environment.

Third, we address one outstanding issue regarding the important influence of spatial features in virtual worlds. Although researchers and practitioners acknowledge the potential role of spatial features in shaping participant behavior (Bray and Konsynski 2007; Constable 2006; Keller 2008), it is an empirical question whether a lack of physical constraints in virtual worlds may make it inappropriate to extend real-world spatial dynamics to a virtual world. We identify two spatial features and develop a theoretical model to explain how these features would influence participants' intention to purchase virtual goods. The empirical validation of our research model provides valuable insight to researchers and establishes a study of spatial features in virtual worlds as a fruitful research stream.

The paper also contributes to practice. Most businesses are still in the exploration and experimentation phase and are struggling to understand the dynamics of virtual worlds and the implications for their business. This study offers insights to managers who are considering implementing virtual commerce. Specifically, our results suggest that virtual world platform creators, such as Linden Labs, and the companies that operate within the virtual world should focus not only on providing technological features that enable interactivity and sociability, but should also attempt to manage the spatial features that enhance the flow and social presence experience of participants.

Our findings also suggest that platform developers offer sociability features in order to provide the spontaneous creation of a social space, which allows interaction by participants. For example, virtual world builders should create a variety of public places to hold regular, informal gatherings for avatars and implement the "sociability by design" strategy by steering avatars to certain locations to encourage socialization. Ducheneaut et al. (2004) suggest several strategies to enhance social presence. They suggest that virtual world creators or operators promote regular use by giving frequent visitors a stake (i.e., property rights and modification privileges) in the place that they visit and reward gregariousness. They also advise that the technological features of the virtual world should partition the conversation space. For example, in Second Life, avatars can engage in public localized communication with those around them within a set distance (i.e., 60 feet) and can have private chats with specific avatars. Avatars can also shout (i.e., be audible within 300 feet) and whisper (i.e., be audible within 30 feet).[11] Since design features, such as the distance over which communication can be "heard," can influence sociability, companies should test the impact of the sociability features of the virtual world on social presence and flow before implementing them. Our findings suggest that the design of a virtual world should not be solely about the design of technologies, but should also be about the means and tools required to manipulate spatial factors that influence social behavior (Jäkälä and Pekkola 2007).

Similarly, our results suggest that companies operating in a virtual world should monitor and manage the density and stability on their virtual islands or spaces to ensure high levels of social presence and flow. Companies can expand their

[11]"Second Life for Dummies," August 25, 2007 (http://secondlifehelp.blogspot.com/2007/08/features-of-virtual-world.html).

virtual land to reduce density, and can also spread the virtual attractions evenly across the virtual land to avoid the congestion of avatars in some areas and sparse crowds in other areas of their virtual land. Companies should also increase stability by offering regular visitors incentives to remain active as suggested by Ducheneaut et al. (2004). Furthermore, companies should not only measure the traffic in their virtual real estate in terms of total number of unique visitors within a specific virtual location (i.e., track density), but should also take into account the time that visitors spend on their property as a percentage of total time spent in the virtual world (i.e., track stability).

Finally, we suggest that companies creating private virtual worlds to conduct business activities, such as employee training, corporate meetings, or customer service, should also follow the design guidelines as suggested by this study and strive to create a socially oriented community supporting virtual worlds. We find evidence that features of the virtual world like interactivity, sociability, density, and stability impact the three important virtual experiences: telepresence, social presence, and flow. Therefore, we recommend that companies that envision creating their own virtual world should consider the impact of various design alternatives on both the technological and the spatial characteristics of the virtual world so as to achieve their business goals.

Limitations and Future Research

Our study is not without its limitations. We collected the data from Second Life, the largest virtual world at the time of this study, and, therefore, we cannot fully generalize our findings to other virtual worlds, which may differ in terms of size, maturity, and culture. Future research should endeavor to include various types of virtual worlds so that the results obtained can be more comprehensive and broadly applicable. Also, the results of the study may not be generalizable if the respondents who visit an immersive virtual world are different from those who do not have sufficient virtual world experience. However, we believe that while the actual intensity of the perceived virtual world characteristics, virtual experiences, and behaviors may differ for non-adopters of the virtual world, or across visitors of different virtual worlds, the relationships between the constructs would remain. Future research can replicate this study using an experimental methodology to compare and contrast the relationships examined here in different contexts such as voluntary use and mandatory use. The experimental approach would help researchers to triangulate the results of our study by controlling the level of features such as interactivity, sociability, density, and stability and achieve high internal validity.

We examined users' intention to purchase virtual goods, which may not completely represent actual purchases. Nevertheless, to the extent that a higher likelihood to purchase is positively related to actual purchases, our findings are useful for managers. It would be useful for future research to measure and include actual purchases and to examine their relationship with virtual world characteristics and experiences. Future research can use a panel of avatars and observe their actual purchase behavior before and after measuring their perceptions and experiences in the virtual world. Future research can also study the impact of virtual world characteristics, especially the spatial features on trust formation, intention to explore, learning, creativity, and other such behavioral dimensions. Future research should also develop models to identify the differences between the purchasing behaviors for real goods versus the purchasing behaviors of virtual goods in the virtual world. As Lui et al. (2007) propose, researchers can also examine the role of "virtually experienced" product attributes in the consumption decision. Finally, we suggest that since virtual worlds provide excellent opportunities and flexibility for brand building (Barnes and Mattsson 2008), researchers should also examine the impact of virtual world characteristics on brand image for real and virtual products and services.

Conclusion

In this paper, we developed a research model to fully capture and understand the impact of the two key dimensions of immersive virtual worlds (e.g., technological and spatial) on users' virtual experiences and subsequent purchase behaviors. Given that large-scale social virtual worlds, such as Second Life, have existed only for a short period of time, very little is known about the dynamics that govern the behaviors of the participants in these immersive environments. Employing the S-O-R framework, our study aimed to provide initial insights into such dynamics. Because the phenomenon is new and has unique characteristics such as the importance of the "physical" navigation, geographical and spatial positioning, and even appearance, future research should explore and integrate fields that have been impermeable to one another up to now. For example, relevant concepts are likely to come from fields such as information systems, sociology, social psychology, and population ecology. While the present paper answers some questions about the nature of immersive virtual worlds, it raises as many questions as it answers. Hopefully, this study offers underpinnings for much further work on this topic and encourages researchers to investigate other social, behavioral, and economic issues in virtual worlds that seem as complicated as those in the real world.

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