VIRTUAL SPACE AND PLACE: THEORY AND TEST[1]

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Little is known about how individuals come to relate to settings in virtual worlds (VWs), which are defined as digital environments in which individuals, groups, and even organizations interact in virtual (that is to say, nonphysical) spaces. This research develops a theory of virtual space and place (VSP), specifically relating this to the setting of Second Life (SL), a prominent social virtual world. We explore how three-dimensional space, as perceived by users, is able to provide them with an interactive experience with virtual objects, as well as with other VW denizens. To test our theory, we build interactive work tools in SL that are designed to reflect various degrees of motion range and to influence presence. The three information technology tools are evaluated by 150 business professionals who are either familiar or unfamiliar with SL. Implications for practice and directions for future research are discussed.

Keywords: Virtual worlds, Second Life, virtual space, place, cognition, perception, familiarity, presence, social presence, focused immersion

Introduction

Virtual worlds (VWs) are digital environments in which individuals, groups, and even organizations interact in virtual,

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

nonphysical spaces. They provide untapped opportunities for current and potential users. In fact, they may be thought of as vast opportunity spaces that only become inviting when users can expect certain activities to be performed there consistently. That is, users like to go to familiar places where they interact either with other users or with virtual objects. While fascinated by such opportunities offered by space, the users still seem to yearn for more bounded places where they can go to conduct meaningful activities (Schultze and Boland 2000).

Virtual world (VW) has been defined as "an electronic environment that visually mimics complex physical spaces, where people can interact with each other and with virtual objects, and where people are represented by animated characters" (Bainbridge 2007, p. 472). In most cases, the objects and software they use have been designed to simulate physical places. Focusing on a type of VW, namely the social virtual world, and one popular application, Second Life (SL), we examine a virtual setting built and owned by its users, and thus one that provides support for manipulating an apparent three-dimensional environment. SL allows action scripting, island and object construction, and an economy supporting the creation of virtual experiences (Hobbs et al. 2006). SL is a VW "in which social and economic interactions are the main drivers" (Hendaoui et al. 2008, p. 88). Social interactivity through avatars and the performance of activities using virtual objects may allow SL users to create a sense of place (Goel et al. 2011) and to experience what we will term *presence*. While avatar–avatar interactions are also important, we focus on interaction with virtual objects in SL. We view *virtual presence* as "a psychological state in which virtual objects are experienced as actual objects in either sensory or non-sensory ways" (Lee 2004, p. 37).

Usage data show that many of the 13 million avatars registered in SL do not return after their first visit (Clark 2008). This could be because enterprises that commercialize SL islands do not provide enough of the relevant and value-added activities that visitors are seeking (Gartner Research 2007). Indeed, SL and other VWs have not yet fully matured. Seldom in SL are meetings or other work activities facilitated. SL has only limited support for meetings and other collaborative processes in its native state (Davis et al. 2009). However, more widespread use of interactive work tools may increase presence and give users a reason to return to SL.

In our research, we explore the role of apparent three-dimensional space in allowing users to interact with work tools that are virtual objects. Our theory incorporates spatial concepts that can be applied to create a "place" for users in a VW. In simple terms, *space* is for us the sum of all places (Norberg-Schulz 1971, p. 10), whereas *virtual place* is defined as *the perception of bounded space imbued with meaning*. We expand on the notion of place as the sum of associated mental representations that are created not only through social interactions in a virtual space, but also by manipulating virtual objects. Our theory of virtual space and place (VSP) distinguishes among the concepts of space, place, and presence, and seeks to explain their interrelationships.

To provide an initial, tentative test of VSP theory, we build interactive work tools to embrace aspects of virtual space and place in SL. These tools support the processes of idea generation, organization, and voting (Davis et al. 2009). They are designed to incorporate range of motion (i.e., directionality) as a characteristic of space. These types of tools are relatively well understood and described in the group support system (GSS) literature (e.g., Nunamaker et al. 1991). We used these tools to test VSP theory in meetings with 150 business professionals who were either familiar or unfamiliar with SL.

The rest of the paper is organized as follows. In the next section, we describe VSP theory and demonstrate how to create a place within virtual space—a place that is associated with *presence*. We further describe how place is created over time as a result of interactions with virtual objects. The following sections then describe the tools and study used to test the VSP theory, as well as our propositions, research model, and hypotheses. We conclude with a discussion of the results and their implications, limitations of our evaluation, and suggestions for future research. A glossary is provided in Appendix A, and main conceptual foundations about space and place and their primary contributors can be found in Appendix B.

Virtual Space and Place Theory

Space is viewed in a variety of ways across disciplines as wide-ranging as mathematics, philosophy, architecture, and sociology. It was the Greeks who first theorized about space. Plato introduced geometry as the science of space. Aristotle praised Plato because he tried to determine what place was (Lang 1998) and followed with a theory of "place" (*topos*) in which space was the sum of all places (Norberg-Schulz 1971, p. 10). For Aristotle, logic occurred as part of the world and had a locus in space, time, and objects (Lakoff and Johnson 1999). Aristotle reasoned that space was undifferentiated in the sense that two spaces are identical if they are of equal dimensions. On the other hand, Aristotle's places are differentiated in six directions (i.e., up, down, right, left, forward, and backward) (Lang 1998). Objects move in these six directions in a three-dimensional place. Thus, objects' locomotion over time is integral to Aristotle's concept of place.

Eventually, Aristotle's theories of space were supplanted by Euclidean geometry, which defined space as infinite and homogeneous. In the 17th century, the theory of Euclidean space was expanded with the introduction of Descartes' orthogonal coordinate system.[2] Further, Descartes believed that the external world of matter and motion is known only by

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[2]Newton disagreed with Descartes' view of motion within space and instead suggested that objects can have a range of motion within space.

the senses (Mazur 2007). Ultimately, Descartes' orthogonal coordinate system was supplanted by non-Euclidean geometries in the 19th century and by Einstein's theory of relativity in the 29th century. Relativity theory now substitutes the concept of matter in three-dimensional space with a series of events in four-dimensional space/time places (Norberg-Schulz 1971). This means that in order to keep track of events in space as time passes, it is necessary to have a four- dimensional address (x, y, z, t) where x, y and z are arbitrarily selected coordinates in three-dimensional space, and t represents time (Mazur 2007).

Before 1915, space and time were basically considered to be "a fixed arena in which events took place, but which was not affected by what happened in it" (Hawking 1988, p. 33). That changed in 1915 with Einstein's general theory of relativity, which viewed space and time as both related and expandable. Current theories emerging from nuclear astrophysics, for example, assert that space is growing as objects in the universe continue to move away from the originating point of the Big Bang. Therefore, today, space and time are both viewed as dynamic and they not only affect, but also are also affected by everything that happens in the universe.[3]

In addition to having an abstract characteristic which makes it possible to derive mathematical space concepts, there is also a nonmathematical spatial characteristic that describes how bodies exist and experience space (Lefebvre 1991). Couclelis and Gale (1986) elaborated on this experiential perspective when they introduced physical, cognitive, and perceptual space. In virtual worlds, physical space does not exist. What do exist, and what are very real, are perceptual space and cognitive space in the users' minds. To a great extent, space in VWs mimics physical space (Moore et al. 2007). That is why VWs are often defined as being three-dimensional, even though they are not physically three-dimensional. Rather, they are illusions that do not actually exist in the analogous physical reality. They only appear three dimensional in the mental representations of users when they navigate their

[3]The universe seems to be expanding as objects move apart from each other into space. It has been demonstrated mathematically that space is growing as objects move away from each other. Beginning this course of discovery was Edwin Hubble, an astrophysicist who measured the distance between our galaxy and nine other galaxies. He found that the distance between the galaxies is growing, a result implied in Einstein's general theory of relativity. Einstein, however, was so sure that the universe was static that he introduced an "antigravity force" into his equations to balance all matter in the universe so that it would remain static and still be consistent with his theory. Later, based on these same equations in Einstein's theory, Friedmann demonstrated mathematically that the universe is expanding, and not static. Several of Friedmann's models show that the universe is infinite in space and dynamic (Hawking 1988).

avatars in these worlds. The closer the VW is to the physical world, the easier and the less cumbersome it is for the mind to see and accept that imagined reality.

Perceptual and Cognitive Space

Perceptual space is defined as "that which can be seen or sensed at one place and at one time," while *cognitive space* is "the large-scale space beyond the sensory horizon about which information must be mentally organized, stored, and recalled" (Couclelis and Gale 1986, p. 2). While perceptual and cognitive views of space overlap, they are not the same. In developing our theory, we take both cognitions and perceptions into account, which together form mental representations of physical and virtual space. For example, we use cognitions of space when using a metaphor frequently applied in understanding spatial relations: a container. One of the first writers to use the container metaphor in describing place was Aristotle in Physics IV, in which he devoted considerable attention to what is meant by the Greek *en* (i.e., in) in relation to place. Although there are many possible definitions, the meaning of *in* used by Aristotle appears to be "as a thing is in a vessel, and, generally, in a place" (Morison 2002, p. 71).

At a most elementary level, place may be conceived of as a receptacle or container in which people have experiences and express themselves (Hartford and Leonard 2006); that is, in VW, space is the apparent three-dimensional environment within which the container (i.e., place) exists. In the container, objects are manipulated and activities occur. Space bounds and structures the world (Harrison and Dourish 1996), and the concept of *place* is formed by what people do within the boundaries of this container and by how they interact with others in it. However, when thinking of containers in virtual space, it is important to recognize that all boundaries are conceptual, and therefore mental, rather than physical (Lakoff and Johnson 1999).

Cognitive space typically is not separated from perceptual space in VSP. Initially a perceptual space is created by manipulating objects, interacting socially, and otherwise experiencing the virtual world through the senses. This perceptual space is used to build cognitive spaces in the minds of individuals who have experienced the virtual world through their senses. Individuals then try to understand a new cognitive space by building a metacognition reflecting the interactions that occurred in their minds. Thus, cognitive and perceptual spaces are both necessary to form new mental representations of place in virtual space. Further, in our VSP theory, familiarity and presence are related integrally to place, as we describe in greater detail later in the next section.

Motion in Three-Dimensional Space

Most of man's actions have a spatial aspect that requires an understanding of how he is related to other people and things (Norberg-Schultz 1971, p. 9), and of his own shape and posture (Tuan 1977, p. 34). Man construes and organizes space based on experiences with his body and his relations with others (Tuan 1977). Being able to move and interact in a range of directions is thus a core concept in understanding how and why individuals manipulate objects, as well as their own avatars, in virtual space.

When a person is standing upright, space opens up before him and can be differentiated on front–back and right–left axes in conformity with the structure of his body (Tuan 1977, p. 35). Frontal space is primarily visual[4] and because of the way people's eyes are situated in their bodies, as well as their peripheral vision, the amount individuals see ahead of them is much larger than that in rear space. Rear space is experienced primarily only through nonvisual cues (Tuan 1977, p. 40). Although individuals are aware of a visual world all around them, their actual experience is of an image in front of their eyes and not behind their backs (Rodaway 1994, p.67). As a person moves and turns, the front–back and right–left regions change as well. Further, vertical–horizontal, front–back, and right–left are embodied in various ways. They "arise from the body, depend on the body, and would not exist if we did not have" bodies (Lakoff and Johnson 1999, p. 36). Man unifies these bodily conceptions of spatial relationships into a *space concept*. Spatial relations are at the heart of each individual's conceptual system of space. Individuals use perceptual spatial relations unconsciously and impose them via their conceptual systems (Lakoff and Johnson 1999; Piaget 1954, 1985).

People must orient themselves within space. In some cultures, this cognitive concept of space is undifferentiated from the direct experience or perception of space in their language. For example, in some African languages the word for *eye* has the second meaning of "in front of." This individually based view of space "has an excellent system of directions which changes with the movements of the human body…distances and directions are fixed relative to man" (Nitschke 1968, as quoted in Norberg-Schultz 1971, p. 13).

In contrast, in this paper, directions exist independent of any one person. Thus, it is universal (Lefebvre 1991), rather than individually based. This universal space is defined as an "image of the environment" (Norberg-Schultz 1971, p. 17; also Lefebvre 1991), or a relatively stable system based on experiences with things and others.

To express the ability to move in three-dimensional space, we introduce the construct *directionality,* which is the extent to which movement is possible across a range of motion. Low directionality implies a limited range of motion, for example, one directional such as front and back. High directionality implies the ability to move in more directions, including front/back, right/left, up/down in three dimensional space.

Interaction with Objects, Adaptation, and Directionality

When first operating in a VW as avatars, users lack expertise in manipulating a range of motion in their movements. They have no preexisting perceptions or cognitions of virtual space. By moving through VWs, they can perceive virtual space, and start forming cognitions of virtual space. These spatial cognitions have to be constructed for the new virtual environment in order for users to handle objects and process spatial abstractions. Piaget (1954) demonstrated that when humans develop cognitively they need to first manipulate, test, and perceive the properties of concrete objects before they can form abstract concepts. Therefore, manipulating virtual objects in VWs requires cognitive adaptation on the part of humans to build abstract concepts of virtual space.

Adaptation is composed of two fundamental processes (Piaget 1954, 1985): (1) assimilating a new object into an old cognition (*assimilation*) and (2) accommodating an old cognition into a new object (*accommodation*). Users coordinate their avatars' movements in the VW to learn about space in VWs. By moving and manipulating objects with high directionality, they can understand how to move in VWs and thus form cognitions about three-dimensional virtual space.

When operating as avatars, users first assimilate the new experiences of virtual space by accommodating their old cognitions of physical space. They use a number of senses to explore the virtual space, and then must coordinate their sensory experiences in this seemingly three-dimensional space. While these sensory experiences are primarily visual, they may also include the touch and auditory senses. As users move their avatars in multiple directions, they experience touch through their sense of locomotion. Thus, users develop cognitions about virtual objects through their sensory experiences in manipulating them in virtual space. For example, they change their positions, move them, and even destroy virtual objects to test their properties. They must accommodate their existing cognitions to adapt to virtual space.

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[4]In contrast, individuals sense auditory phenomena all around them, the full 360 degrees. There is no front or rear space.

1 Our conceptual discussion of VW thus far allows us to
2 articulate a fundamental theoretical tenet that virtual
3 mechanisms that simulate heightened user interactions with
4 space (including objects within this space) and place lead to
5 more positive reactions to VWs. Based on this overarching
6 theoretical statement, we derive several propositions which
7 will be tested via hypotheses later in the study.
8
9 The physical body often serves as a basic frame of reference
10 when interpreting virtual space (Mennecke et al. 2009).
11 Many VWs are constructed using movements of the physical
12 body as a model for movement in virtual space. The more
13 similar the virtual space is to existing cognitions about
14 physical space, the easier the adaptation is and the faster the
15 user can master the new environment. Where there is high
16 directionality allowing a full range of motions in many dif-
17 ferent directions similar to physical space, users perceive
18 utilizing virtual objects in the virtual environment to be easier
19 (i.e., more intuitive) and more enjoyable. This is because less
20 adaptation is required.
21
22 Objects can take advantage of a range of motion in three-
23 dimensional space. On the one hand, they can show low
24 directionality by incorporating only one direction (e.g., high–
25 low or right–left). On the other hand, they may show high
26 directionality since they can incorporate a full range of motion
27 by allowing users to move and manipulate objects in many
28 directions, including right and left, front and back, and up and
29 down. Objects with high directionality have the potential of
30 providing more information and perceived enjoyment. Thus,
31 we propose
32
33   *Proposition 1a*: Objects in virtual space that have
34   high directionality are perceived to be easier to use
35   than those that have low directionality.
36
37   *Proposition 1b*: Objects in virtual space that have
38   high directionality are perceived to be more enjoy-
39   able than those that have low directionality.

40 ### *Place*
41
42 The meaning of space is often merged with that of place, and
43 they are typically used to define one another (Tuan 1977). In
44 this section, we attempt to distinguish them. We also extend
45 the concept of place (beyond that of a container) in four ways;
46 thus, we (1) suggest that the boundaries of a place are dyna-
47 mic and fluid, (2) focus on the importance of meaning in
48 creating place, (3) tie our view of place to mental represen-
49 tations formed through repeated interactions, and (4) link it to
50 the concept of presence.

Whereas space provides the opportunity for unboundedness,[5] place, to some extent, bounds that space through localized events, situated practices, and identified settings. Previously, we introduced the concept of place as a container in space. This view, however, is too simplistic because the boundaries of a container are typically static and impermeable (the concept, therefore, is more that of a *virtual* container). Unlike a container, place cannot be totally separated from the world (or space) outside its boundaries. Further, its boundaries are not static; rather, they change as meanings are continually produced and reproduced through interactions (Gustafson 2001). These interactions continually produce or alter an individual's meaning of place. Thus, the activities or inter-actions are used to produce place. Place is comprised of setting, meaning and interactions (i.e., activities). Relph (1976, p. 61) defines *place identity* as "comprised of three interrelated components, each irreducible to the other-physical features or appearance, observable activities and functions and meanings or symbols."

Often the interactions that are used to establish the meaning of place are based on moving and otherwise interacting with objects. Aristotle's definition of place also relies heavily on the movement of objects. "In place" for Aristotle means that objects can move in six directions. For him,

> motion is impossible without place because as a
> limit place renders the cosmos determinate in respect
> to the six directions, up, down, front, back, left, and
> right, and so constitutes "the where" of all things
> that are and are moved (Lang 1988, p. 102).

Moving objects are an important aspect of place for Aristotle. In VSP theory, we view VW space as three-dimensional and characterized by directionality. However, here again the concepts of space and place are hard to distinguish. Whereas both space and place can have directions, it is movement that carves a place out of the more abstract concept of space.

We believe both space and place are components of the experienced world (Tuan 1977). More succinctly stated, place = space + meaning (Harrison and Dourish 1996). *Place* is situated within a larger setting or space, and it cannot be understood in isolation of meaning (Norberg-Schulz 1971, p. 20). In contrast, *space* is a concept of openness that does not have a locally specific meaning identified with it. It may be

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[5]Our view of space differs from Aristotle's in that he views space as divisible (Mazur 2007) and having dimensionality, and he views place in terms of space, time, void and movement. We do not specifically address time or void in our theory, but we, like Aristotle, agree that the movement of objects is important in conceiving of place.

conceived as the sum of all places (Norberg-Schulz 1971, p. 10).

Place may only be found when people in these new spaces can share the "representation of action" (McCullough 2004, p. 3). For example, when users first enter SL with an avatar, it is similar to "placeless" space (Castells 1996; Meyrowitz 1985) because the users have not yet adapted to the new mental representation of the space and social situation; that is, they have not yet fully adapted and developed a perception of place, relying instead upon the imagined reality of a personal, sociable, and sensitive contact in the medium, which we define as social presence (Short et al. 1976). As users take time to interact with virtual objects or other avatars, the space becomes differentiated into an imagined place. This place represents a new setting in which behaviors, language games, and other practices are gradually and socially co-constructed through repeated interactions (Sarker and Sahay 2004). Places which are easily identified are said to be "familiar" (Gollededge 1992). Brafman and Brafman (2010) argue that familiarity leads to enjoyment. Gustafson (2001) describes familiarity with place as being meaningful because of various kinds of opportunities to perform certain activities, to feel or experience something desirable. But Gustafson does not always regard a place as being desirable. He believes that a place may also be regarded as constraining and lacking in opportunities. For example, if people are merely standing in a place and not engaged in moving and using objects, they are more likely to find the place boring, undesirable, and lacking in social interaction.

In sum, new users of a VW must repeatedly manipulate objects in virtual space, exercise the new spatial environment, and interact with the environment (and possibly others) to develop a meaningful place within the VW. These spatially related interactions support the development of a level of abstraction that is subsequently required to operate efficiently in the virtual environment. Through repetitive interactions in the virtual environment, the users become familiar with the VW as they adapt their cognitions about "what a virtual world is." Users who have never manipulated virtual objects or interacted with others in a VW do not have a mental representation of place. They are unfamiliar with it yet must adapt their cognitions to the new environment. Only users who have mental representations of an imagined place can apply their already adapted cognitions of what a virtual world is in using and evaluating virtual objects. It takes less cognitive effort for users who have mental representations of a place, imagined though it may be, to use a virtual object and enjoy its features. Further, by manipulating the virtual objects, the users have a better understanding of the space, enjoy it more, and are less likely to feel frustrated from being unable to navigate in the space. These users will like using the tool more than those users who cannot move the objects easily in the space. Thus, the virtual object is perceived as being more intuitive (i.e., easy to use) and more enjoyable. Hence, we propose

> *Proposition 2a*. Users who have a heightened experience of place when using a virtual object find it significantly easier to use than those who have a diminished experience of place when using a virtual object.

> *Proposition 2b*. Users who have a heightened experience of place when using a virtual object find it significantly more enjoyable than those who have a diminished experience of place when using a virtual object.

The left side of Figure 1 provides a macro view of VSP theory that is based on Lakoff and Johnson's (1999) container metaphor. The right side builds on the container metaphor by providing a more detailed meso view of VSP theory with theoretical units. VSP theory focuses on perceptual and cognitive space in an environment that appears to be three dimensional. Place is a container in the space and holds a mental representation of experiences that are derived from social interactions and interactions with objects. Recurring interactions within the imagined space generate familiarity (represented as drops in the figure). Familiarity further stems from experiencing directionality of what appears to be three-dimensional space in the VW and, consequently, activates the adaptation of cognitions of perceptual and cognitive space. Indeed, directionality is a familiar old cognition of what is known in the "real" physical space. The cognitions stimulate presence while fostering the illusion of place in the VW.

Familiarity, Presence, and Place

Whereas place is sometimes considered a "pause" in which transformation of location into place occurs because of activities that are being undertaken (Tuan 1977), presence is concerned with what is in the place during the pause. Recurring interactions with objects and social interactions create familiarity within the VW and stimulate the experience of presence that fosters the illusion of a place. As we discuss below, familiarity and presence are multifaceted concepts that have been interrelated in previous research (Gefen 2000).

Familiarity's complexity can be attributed to its multi-dimensionality (Gale et al. 1990; Peron et al. 1990). For example,

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Figure 1. VSP Macro and Meso Views
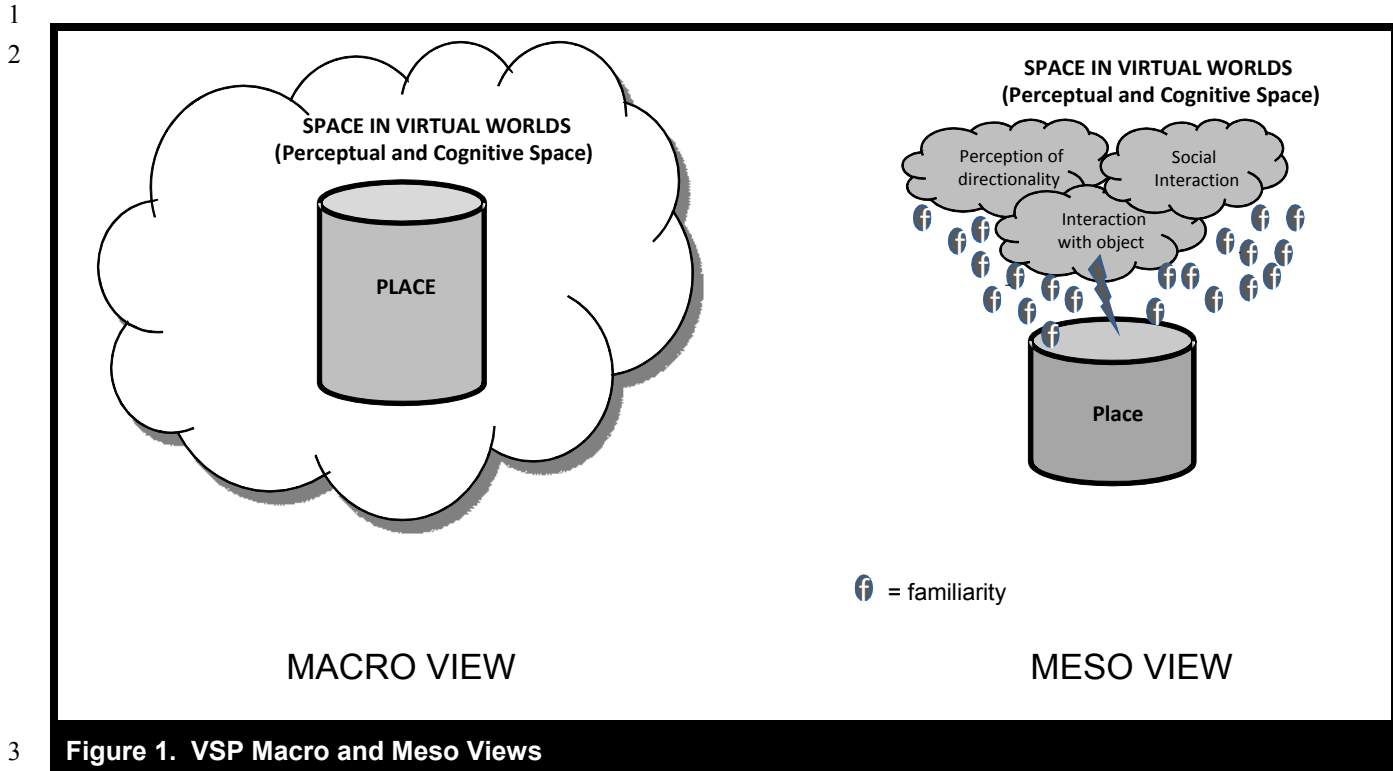
Some people claim familiarity with a place when they only know its name. Others claim familiarity if they have observed, visited, or passed by the place frequently. Yet others claim familiarity because they can identify an image of it (Golledge 1992, p. 201).

Based on Luhmann (1979), Gefen (2000, p. 727) argues that *familiarity* is "an understanding, often based on previous interactions, experiences, and learning of what, why, where and when others do what they do." Familiarity deals with an understanding and, therefore, a recognition (grounded in the past) of the current actions of other people or of objects held in memory. Gefen presents familiarity in the context of technology usage. He views it as a specific activity-based cognizance based on previous experience or learning of how to use the particular interface.

The concept of presence has been viewed in various ways. We focus on two perspectives: social presence and immersion. We define *social presence* as the perception that there is personal, sociable, and sensitive human contact *in* the medium (Short et al. 1976). Degrees of social presence (Witmer and Singer 1994) may be created when media are used for communication and interaction. Since our main focus is on interaction with virtual objects to complete a task,

we find this view to be particularly appropriate. Thus, like Lee (2004, p. 45), we think social presence is "about the technology users' experience of social virtual objects." Gefen and Straub (2004) report that "social presence theory argues that medium users assess the degree of social presence required by the task and fit it to the social presence of the medium" (p. 410). When focusing on virtual objects in the created environment, social presence theory may also focus on the social cues transmitted by the media.

Further, presence has been described as the user's compelling sense of being in (e.g., immersed in) a mediated space and not where their physical body is located[6] (Nowak and Biocca 2003, p. 482; also Lee 2004). Immersion focuses on sensory rather than social cues. As technology matures, more and more sensory cues are used. Therefore, presence also can be heightened in virtual worlds by providing as much sensory information as possible (Franceschi et al. It "involves continuous (real time) responses of the human sensory, cognitive, and affective processing systems to objects and entities in a person's environment" (Lombard and Ditton 1997, p. 77). In addition to hearing and seeing, touching has been proven to

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[6]Director James Cameron gives this a cinematic reality in the movie "Avatar" by having the physical bodies of the characters exist separately from their avatar bodies.

contribute to presence in VWs (Rheingodl 1991). Mastering the movement of objects makes it easier to manipulate them in VWs as users become more familiar with the touch, and it also facilitates the user's immersion. It can also provide a sense of control in the mediated experience which is tightly coupled with presence (Franceschi et al. 2009).

Lombard and Ditton (1997) describe six types of presence created by emerging computer technologies: *presence as social richness, realism, immersion, a social actor within a medium, medium as a social actor,* and *medium as transportation.* We find two of these as being particularly relevant to our discussion of place.

- *Presence as social richness* (based on social presence theory): the extent to which a medium is perceived as being social, warm, or personal when it is used to interact with other people (Short et al. 1976).

- *Presence as immersion*: the extent of perceptual and psychological immersion (i.e., the extent to which the person seems to be immersed or engaged in the virtual world) (Biocca and Levy 1995).[7]

These two presence constructs have surfaced in previous research (Biocca et al. 2003; Franceschi, et al. 2009; Nowak and Biocca 2003; Schultze and Leahy 2009; Witmer and Singer 1998). As an example of the first construct, Biocca et al. (2003), in writing about social presence, explain that the function of media is to collapse space and time to provide the illusion of being in other places and together with other people. As an example of the second construct, a user who is immersed when performing an activity in a virtual environment experiences presence, whereas a user who is not immersed perceives the virtual environment as a technological creation and is not psychologically transported (Franceschi et al. 2009). We address both presence constructs in our research.

Designers may want to create a place within virtual space by enhancing presence (Harrison and Dourish 1996) via social and sensory cues. Virtual objects can incorporate spatial characteristics of directionality, as well as place-oriented interactions and experiences to create social presence and immersion. Ultimately, by using such virtual objects, users can better experience their own presence in the virtual world. These real actions give users the illusion of being in a place as they become cognitively absorbed with these objects

(Argawal and Karahanna 2000). Biocca and Levy (1995) purport that the senses are immersed in virtual work in the most compelling virtual reality experiences.

Embodied social presence (ESP) theory (Mennecke et al. 2009) suggests that most, if not all, interactions in VWs are carried out in an embodied context. A combination of objects, symbols, and space helps define the context of interactions in the VW. This embodied state of interactions includes the perceptions of presence and a deep sense of engagement (i.e., immersion) with objects. Thus, we derive this last set of propositions from our theory:

> *Proposition 3a*. Users who have a heightened experience of place when using a virtual object attribute more social presence to the VW than do those who have a diminished experience of place when using a virtual object.

> *Proposition 3b*. Users who have a heightened experience of place when using a virtual object are more immersed in the VW than are those who have a diminished experience of place when using a virtual object.

Methods and Virtual Tools Used to Test VSP Theory

We tested VSP theory with a laboratory experiment in which characteristics of space and place were manipulated. In our research, we took advantage of directionality in virtual space to provide users of a SL island, Alpine Executive Center,[8] an interactive experience with virtual objects. Specifically, we built three objects (tools) to test VSP theory. In building the tools, we used a software engineering approach first described by Basili and Turner (1975), and focused on idea generation, idea organization, and voting processes. As noted by Davis et al. (2009), technologies for VWs do not directly offer support for teams, but these capabilities can be provided through tools. In particular, the authors note the need for a class of tools to support information processing in virtual worlds, and specifically identify brainstorming, organization, and voting tools as examples.

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[7]Agarwal and Karahanna (2000) talk about focused immersion and cognitive absorption as constructs related to involvement with systems in general.

[8]Alpine Executive Center is an island designed to support distributed meetings. Its visitors can meet in a variety of locations including an amphitheater, private meeting spaces, and a bar. They can also ski or skate on the island in resort-like settings.
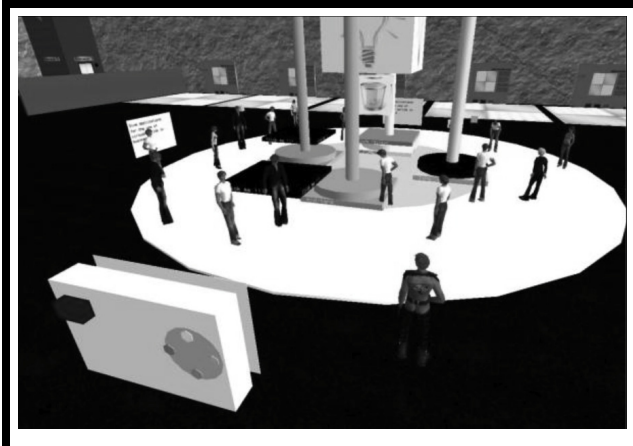
Figure 2. Brainstorming and Organizer Tools Inside Second Life

Figure 3. Voting Floor Inside Second Life

Our goal was to build tools that incorporate the different levels of directionality. The tools that we created are desirable for testing hypotheses that map directly to each of the theoretical propositions because they are relatively simple, well-understood, extensively evaluated in laboratory and field settings, and well-described in IS literature (Fjermestad and Hiltz 2000; Hollingshead and McGrath 1995). Moreover, they can promote social presence (Biocca et al. 2003).

Appendix C summarizes the iterations required to build the tools, use of space, and design documentation used. The brainstorming and organizer tools are shown in Figure 2 and the voting tool is shown in Figure 3.

The *brainstorming tool* supports idea generation. Its outer circle defines the boundary for the tool's location, and allows users to see who is present in order to encourage interaction. In the inner circle, users create idea boxes by pointing to the light bulb, refine the boxes by adding descriptive text, and delete them by putting them in the box with the picture of a trashcan. Thus, avatars do not need to walk over to the idea box. Further, since the box is at one level, moving up and down is not required. For the most part, the tools' user looks to the front, right, or left, and thus avatar body or eye movement is not required (or even desired).

The *idea organizer* organizes ideas when avatars stack the boxes generated in the brainstorming tool onto the appropriate poles in the inner circle. Thus, the poles are used to classify the generated ideas. In Figure 3, four categories are represented by the four differently colored poles. Avatars may walk around the tool area, but such movement is not required. However, the ideas must move up or down as they are placed

on poles. Hence, visually there is a greater range of motion in the virtual space that must be considered than with the brainstorming tool. The user must scan from left to right. The line of vision is typically in front of the avatar. The vertical direction is used to a limited extent in the idea organizer because categories with more ideas have higher stacks of ideas that require vertical eye movement.

The *voting floor* uses space visibly. In particular, the relative position of avatars on the voting floor's coordinate space indicates each of their positions on an issue and is a sign of embodiment. In SL, the voting floor is set up in a 10×10 grid on both the X and Y axis, each labeled with a criterion. To vote on an issue, participants position their avatar on the grid where the two criteria are reflected. The tool detects each avatar's position on the grid and computes the x/y coordinates on a 10-point scale for both axes. This is "voting with your feet" in the VW. A wall-mounted tool displays the mean location of the whole group of avatars standing on the grid; a small blue disk displays the mean and a typically larger red disk displays the standard deviation.

The coordinate space currently is two-dimensional (i.e., one dimension for each criterion). Avatars can use a range of motions to move forward, backward, right, or left on the voting floor. They indicate their preference by moving in certain directions and positioning themselves on the grid. However, the voting floor is three-dimensional to the extent that two dimensions represent preferences on the criteria; the third dimension becomes important when the body of the avatar is considered in relation to the bodies of the other avatars. Avatars are aware of their height and that of the other avatars. The third dimension, the vertical height or z-

1
2
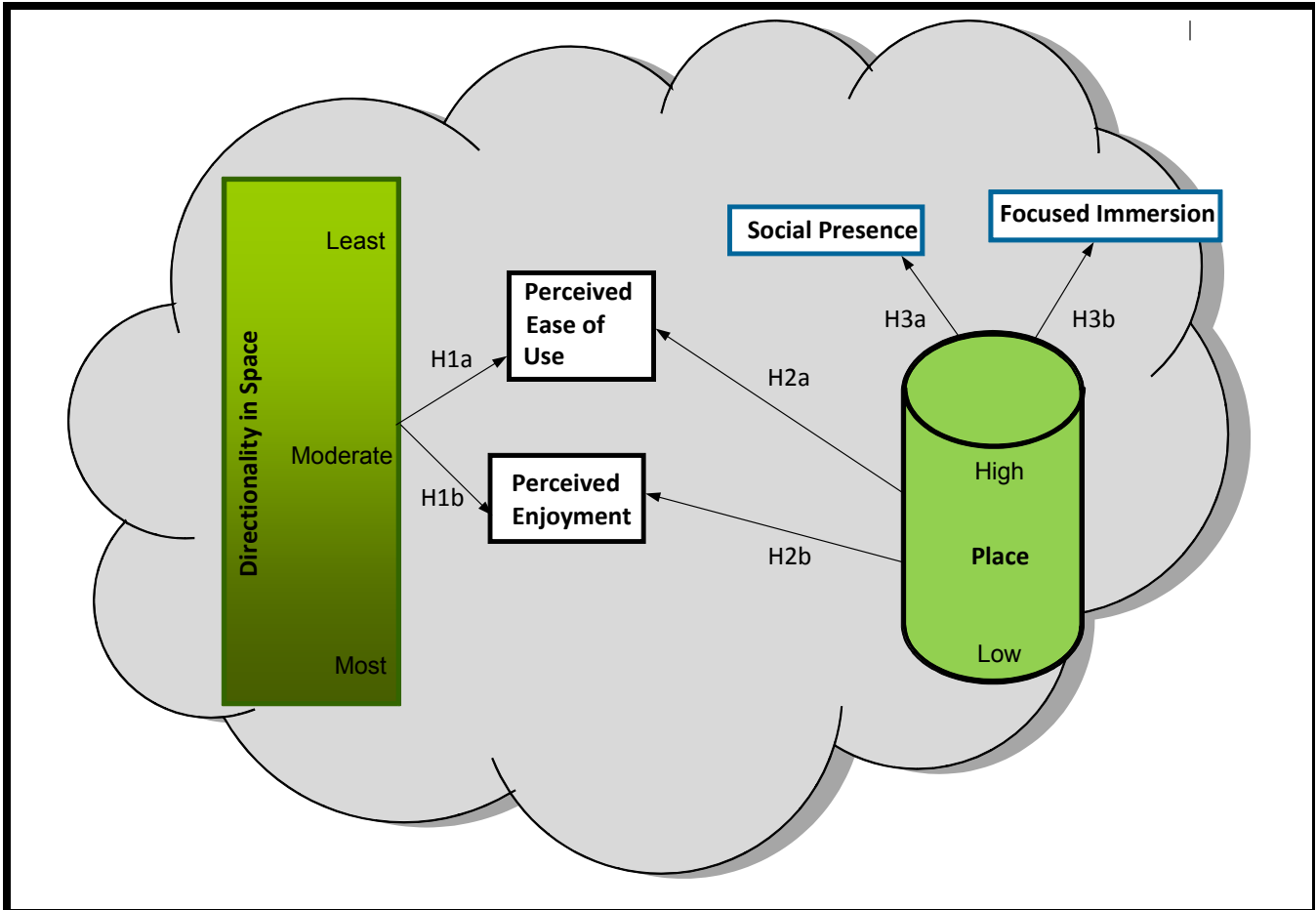
3 **Figure 4. Research Model**

4   axis, highlights presence. Avatars are also conscious of what
5   is in front of them, as well as what is to their right and left.
6   Unlike when they are using other tools, they are aware of who
7   is behind them by viewing the red and blue circles, hearing
8   them as they speak, or by turning around to see them. The
9   range of relative positions is reflected in the average and
10 standard deviation of the voting coordinates. Presence, in
11 terms of how the avatar's position relates to that of others in
12 the group, becomes obvious by placement on the voting floor.

13 **Research Model and Hypotheses** ◼◼

14
15 The hypotheses are indicated in the research model in
16 Figure 4. The relationships among the theoretical units are
17 described below. Propositions, hypotheses, direction of the
18 expected results, and rationale for using VSP theory are
19 summarized in Appendix D.

Directionality (Space) Hypotheses

We use directionality of the tools we built to explore space.
The brainstorming tool had the least amount of directionality.
It incorporated only the directions of front, right, and left.
The voting floor had the most directionality since it capita-
lized on a full range of directions (i.e., front, back, right, left,
up, and down). The idea organizer was between the others in
terms of directionality. It required use of front, right, left, up
and down, but not back. During the iterative design process,
we pilot tested the tools to ensure that the tools' users
employed the range of directions for which the tools were
designed. Because the tools have different degrees of direc-
tionality, the users perceived and experienced them differ-
ently. As discussed earlier, the more directionality is pro-
vided by a tool, the easier it is for participants to adapt their
cognition of space to the virtual environment. Hypotheses 1a
and 1b parallel propositions 1a and 1b, respectively, and
details are provided in Appendix D.

H1a: The voting floor (i.e., the tool with the most directionality) is perceived as easier to use than the idea organizer (i.e., the tool with moderate directionality), which, in turn, is perceived as easier to use than the brainstorming tool (i.e., the tool with the least directionality).

H1b: The voting floor (i.e., the tool with the most directionality) is perceived as more enjoyable to use than the idea organizer (i.e., the tool with moderate directionality), which, in turn, is perceived as more enjoyable to use than the brainstorming tool (i.e., the tool with the least directionality).

Place Condition

We also studied how the tools were used in two place conditions: low and high. We distinguished the place conditions based on (1) the participants' familiarity with the SL island where the tools were used and (2) the setting's appropriateness for using the tools.

First, the people who previously frequented the island are more likely to have a higher experience of place than are those who did not frequent it at all. In other words, a physical space becomes a place in virtual space when it becomes familiar through repeated interactions and visits (Tuan 1977, p. 73). Places easily identified are said to be familiar. We define familiarity with technology in Gefen's (2000) terms as a specific activity-based cognizance based on previous experience or learning how to use the particular interface (i.e., VW). Familiarity and recollection each reflect independent aspects of a prior encounter (Grupposo et al. 1997). In addition to designing the research to create relative experiences of place, it was anticipated that those who were less familiar or skilled in navigating in SL and in manipulating their avatars would find the setting less familiar and, hence, experience a low place condition. Locomotion is important in establishing place, and those who could not easily move their avatars would be less able to sense movement and experience place.

Second, we considered the appropriate use of the tool. That is, when participants use the tools in a face-to-face (FTF) context that intuitively is not the most appropriate or natural use of a VW tool, they are in a low place condition. In a high place condition, participants use the tools in a distributed setting where the value of the tool is more obvious. As is the case in Goel et al. (2011), we designed the low place condition to be in a physical location that was extremely unlikely to create experiences of place.

Place Hypotheses

The place hypotheses (2a, 2b, 3a, and 3b) parallel the respectively numbered propositions. They relate place with interactions.

H2a: Participants in the high place condition find each tool significantly easier to use than do participants in the low place condition.

H2b: Participants in the high place condition find each tool significantly more enjoyable to use than do participants in the low place condition.

While the relationships among the constructs that we test in our hypotheses, to our knowledge, have not been tested before, a number of similar constructs have appeared in earlier research. For example, higher levels of social presence positively impact enjoyment (Cyr et al. 2007; Mennecke et al. 2009). In another study of 3-D advertising (compared to 2-D advertising), presence was positively and significantly related to product knowledge and attitude. It is likely that the additional spatial cues enhanced immersion (as operationalized by focused immersion in Agarwal and Karahanna 2000).

Web interfaces can utilize social cues to infuse social presence into online environments (Cyr et al. 2007). The presence of objects and possible interaction with them are part of those social cues providing the idea of a sensitive environment. Witmer and Singer (1998, p. 227) report that "fully immersed observers perceive that they are interacting directly, not indirectly or remotely, with the environment. They feel that they are part of that environment." Embodiment also calls upon imagined interactions with others using the tools. Similarly, VWs can be designed to infuse presence into the places that are created from repeated interactions in the virtual space. That is, virtual space and virtual embodiment can both influence perceptions of presence (Mennecke et al. 2009).

H3a: Participants in the high place condition experience more social presence than do participants in the low place condition.

H3b: Participants in the high place condition experience more focused immersion than do participants in the low place condition.

Research Design and Operationalizations ▪▪▪▪▪▪▪

The hypotheses for directionality (H1a and H1b) on perceived ease of use and perceived enjoyment were tested using three

different tools with directionality ranging from least (brainstorming tool: front, right, left) to most (voting floor: front, back, right, left, up, down). The entire sample of 150 business professionals evaluated the tools for ease of use and enjoyment. The sample was divided into two subsets for testing the remaining hypotheses (H2a, H2b, H3a, H3b). These hypotheses tested for differences in the scores of participants who were in low place (n = 95) and high place (n = 55) conditions.

The hypotheses about place (H2a, H2b, H3a, H3b) on perceived ease of use, perceived enjoyment, social presence, and focused immersion, respectively, were tested using participants from business organizations who used the three virtual tools in a series of one-hour meetings in the two meeting contexts described above: (1) low place condition in an unfamiliar VW setting in a FTF meeting and (2) a high place condition in a familiar VW setting in a distributed online meeting. The same meeting agenda consisting of brainstorming for ideas about applications of VWs in business was used in all meetings. Examples of ideas that were generated were (1) organizing project reviews, (2) collecting early feedback from users while developing an information system, and (3) interacting with young people with the goal of interesting them in a job in the company. The generated ideas were organized into three categories based on the ability to implement them in the (1) short term (within one month), (2) mid-long term (one to twelve months), and (3) long term (more than one year). After categorization, the short-term ideas were evaluated using the voting floor. The criteria used to evaluate the ideas were "contribution to the business" and "fun."

In the setting in which the participants were expected to experience a relatively low place condition, the tools were used in a series of six FTF meetings within a large telecommunications company as part of an introductory program. This setting allowed control over participants and decision processes by the meeting facilitator. He provided help or structured processes in the first exposure of the tools to business professionals. A total of 95 participants were involved, and completed a paper and pencil survey immediately following the meetings in the low place condition. They were all new employees with various levels of experience and a range of backgrounds. None had ever visited the island or worked with one another in the organization before.

The tools were also used in a completely virtual context that was designed to create a high place condition. The same tools and processes were employed for the distributed participants within a month after the FTF sessions were conducted. Participants were previous visitors to the Alpine Executive Center island in SL who had registered to become "friends" of the island. They were invited to join a one-hour facilitated decision-making session. In total, there were 55 participants divided into 15 sessions. Immediately following their experience with the tools, they completed the same online survey as did the participants in the low place condition.

The manipulation check for the place condition was premised upon familiarity with SL, avatar use, and the appropriateness of tool three-dimensionality. Based on our manipulation checks for the place condition and directionality described in Appendix F, we concluded that conditions of high and low place were created for the participants, and that the tools did capture different levels of directionality.

Operationalizations

The operationalizations of our constructs are shown in Table 1 and the individual items are shown in Appendix E. We tested the psychometric properties of the constructs. The reliabilities are shown in Appendix E and the factor analyses in Appendix G. The Cronbach's alphas ranged from .768 to .981. The items all loaded with the other items on the scales for which they were designed and did not cross-load, providing evidence of both convergent validity and discriminant validity. Presence was operationalized as both social presence and focused immersion. Social presence addresses the extent to which SL was perceived by the participants as being sociable, warm, sensitive, personal, or intimate when it was used to interact with other people (Short et al. 1976). It was measured adapting five items from a scale developed by Gefen and Straub (2004) to reflect the use of the tools in SL. We measured immersion with three items adapted for SL from a focused immersion scale developed by Agarwal and Karahanna (2000). Focused immersion provides a feeling of deep involvement with the software. It can also be expressed as engagement, and is related to flow and perceived enjoyment (Argawal and Karahanna 2000; Csikszentmihalyi 1990; Webster and Ho 1997).

Data Analysis Approaches

Since not all dependent variables met the assumptions of normal distribution and homogeneity of error variance, we applied nonparametric tests in place of their parametric counterparts. Nonparametric tests are based on probabilities and the rank of observations, and are thus characterized as distribution-free. To be distribution-free means that neither the values obtained, nor the population from which the sample was drawn, need to have a normal distribution. The Friedman test was used in place of the parametric repeated measures

Table 1. Data Analysis Approaches and Operationalizations of Constructs				
Hypothesis (Proposition)	**Data Analysis Approach**	**Sample (n = 150)**	**VSP Theory Focus**	**Variable and Operationalization**
H1a (1a)	Friedman	Combined conditions	SPACE Proxy based on the degree of directionality of the tools. The voting floor has the *most* directionality with the greatest number or directions; the idea organizer *moderate*; the brainstorming tool the *least* with only front.	**Tool perceived ease of use** Four items for each tool adapted from Pavlou and Fygenson (2006)
H1b (1b)	Friedman	Combined conditions	SPACE Proxy based on the degree of directionality of the tools. The voting floor has the *most* directionality with the greatest number or directions; the idea organizer *moderate*; the brainstorming tool the *least* with only front.	**Tool perceived enjoyment** Four items for each tool adapted from Koufaris (2002)
H2a (2a)	Mann–Whitney U	High place: n = 55 Low place: n = 95	PLACE Condition (high or low) incorporated familiarity (four items adapted from adapted from Novak et al. 2000) with Second Life setting and appropriateness of setting (three new items)	**Tool perceived ease of use** Four items for each tool adapted from Pavlou and Fygenson (2006)
H2b (2b)	Mann–Whitney U	High place: n = 55 Low place: n = 95	PLACE Condition (high or low) incorporated familiarity (four items adapted from adapted from Novak et al. 2000) with Second Life setting and appropriateness of setting (three new items)	**Tool perceived enjoyment** Four items for each tool adapted from Koufaris (2002)
H3a (3a)	Mann–Whitney U	High place: n = 55 Low place: n = 95	PRESENCE (in PLACE)	**Social presence** Five items adapted from Gefen and Straub (2004)
H3b (3b)	Mann–Whitney U	High place: n = 55 Low place: n = 95	PRESENCE (in PLACE)	**Focused immersion** Three items adapted for SL from Agarwal and Karahanna, (2000)

ANOVA or paired-test to test Hypotheses 1a and 1b. The test statistic for the Friedman's test was Chi-square. The Mann–Whitney U test was used in place of the parametric two independent sample t-test. It was used to test Hypotheses 2a, 2b, 3a, and 3b. In addition to mean rank for the group, we reported means and standard deviations.

Results

This section describes the results of tests of the hypotheses for directionality and place. All tests were benchmarked against the community-standard alpha protection level of .05. Table 2 presents the results for directionality, perceived ease of use, and perceived enjoyment. H1a and H1b were partially supported (i.e., for the voting floor only).

Table 3 presents the results for place, perceived ease of use, perceived enjoyment, focused immersion, and social presence. The results of the Mann–Whitney test show significant differences between the group in the high place condition versus the group in the low place condition on perceived ease of use (PEOU) and perceived enjoyment (PEN) for each tool, as well as for focused immersion and social presence.[9]

Thus, H2a and H2b, as well as H3a and H3b, are supported. A summary and test results are presented in Table 4.

---

[9]The empirical test of power for differences among the three measures on PEOU was .999. However, the power for differences between the idea organizer and brainstorming tools only was .134. Similarly and respectively for H1b (PEN), the power values were of .976 and .098. Thus, the nonsignificant findings could be attributed to either inadequate sample size, inadequate manipulation of the IVs, or the fact that no significant differences actually exist.

Table 2. Results for Directionality, Perceived Ease of Use (PEOU), and Perceived Enjoyment (PEN)					
Directionality and Tool Perceived Ease of Use (PEOU)			**Directionality and Perceived Enjoyment (PEN)**		
H1a. The voting floor is perceived as easier to use than the idea organizer, which, in turn, is perceived as easier to use than the brainstorming tool.			**H1b**. The voting floor is perceived as more enjoyable than the idea organizer, which, in turn, is perceived as more enjoyable to use than the brainstorming tool.		
PEOU voting floor > PEOU idea organizer > PEOU brainstorming			PEN voting floor > PEN idea organizer > PEN brainstorming		
Friedman Chi-Square = 56.5, d.f. = 2			Friedman Chi-Square = 23.45, d.f. = 2		
Voting floor[a]	Mrank	2.5	Mrank	2.25	Voting floor
	Mean	5.3	Mean	4.6	
	SD	1.4	SD	1.45	
Idea organizer	M Rank	1.75	M Rank	1.9	Idea organizer
	Mean	4.5	Mean	4.4	
	SD	1.6	SD	1.6	
Brainstorming	MRank	1.8	MRank	1.86	Brainstorming
	Mean	4.6	Mean	4.4	
	SD	1.57	SD	1.55	
.0001			.0001		
Partially supported			Partially supported		
Voting floor was perceived as statistically easier to use than the other tools.			Voting floor was perceived as statistically easier to use than the other tools.		
The brainstorming and the idea organizer tools were, statistically, perceived as equally easy to use.			The brainstorming and the idea organizer tools were, statistically, perceived as equally enjoyable.		

[a]Range of all items was 1 to 7 where 1 was strongly disagree and 7 was strongly agree.

Table 3. Descriptive Statistics: Dependent Variables Intuitiveness, Perceived Ease of Use (PEOU), Perceived Enjoyment (PEN), Focused Immersion, and Social Presence									
Place[a]		**PEOU Brain-storming**	**PEOU Idea Organizer**	**PEOU Voting floor**	**PEN Brain-storming**	**PEN Idea Organizer**	**PEN Voting Floor**	**Focused Immersion**	**Social Presence**
Low	N	93	92	94	93	93	93	94	94
	Mean	4.00	3.90	5.00	4.00	3.90	4.25	3.65	3.00
	SD	1.45	1.5	1.5	1.6	1.6	1.5	1.5	1.4
High	N	52	52	52	52	52	53	54	53
	Mean	5.70	5.60	5.85	5.20	5.35	5.30	5.60	5.80
	SD	1.1	1.03	1.13	1.1	1.05	1.1	1.15	0.9

[a]Range of all items was 1 to 7 where 1 was strongly disagree and 7 was strongly agree.

Table 4. Summary and Test Results			
Place and Perceived Ease of Use	**Place and Perceived Enjoyment**	**Place and Social Presence**	**Place and Focused immersion**
H2a. Participants in the high place condition find each tool significantly easier to use than do participants in the low place condition.	**H2b**. Participants in the high place condition find each virtual tool significantly more enjoyable to use than do participants in the low place condition.	**H3a**. Participants in the high place condition experience more social presence than do participants in the low place condition.	**H3b**. Participants in the high place condition experience more focused immersion than do participants in the low place condition.
Perceived Ease of Use (PEOU) high place > Perceived Ease of Use (PEOU)low place	Perceived Enjoyment (PEN) high place > Perceived Enjoyment (PEN) low place	Social Presence high place > Social Presence low place	Focused immersion high place > Focused immersion low place
Mann–Whitney Brainstorming: U = 858.5, z = -6.5, p = .0001, two-tailed Idea Organizer: U = 857.5, z = -6.6, p = .0001, two-tailed Voting Floor: U = 1520, z = -4.75, p = .0001, two-tailed	Mann–Whitney Brainstorming: U = 1272, z = -4.8, p = .0001, two-tailed Idea organizer: U = 1123, z = -5.4, p = .0001, two-tailed Voting Floor: U = 1472, z = -4, p = .0001, two-tailed	Mann–Whitney U = 822, z = -6.85, p = .0001, two-tailed	Mann–Whitney U = 276.5, z = -8.9, p = .0001, two-tailed
Supported	Supported	Supported	Supported

Discussion

This paper develops a theory of virtual space and place (VSP) and tests it using three VW tools. As summarized in Table 2, the results for Hypotheses 1a and 1b were partially supported. Consistent with our hypotheses about directionality, the voting floor was the easiest of the three VW tools to use and, accordingly, it yielded the greatest sense of perceived enjoyment. However, the hypotheses about directionality in terms of ease of use and perceived enjoyment were not supported for to the other two tools. The relatively similar reception of the brainstorming and idea organizer tools is interesting in that idea organization is typically more cognitively taxing than idea generation; traditionally, it is rated significantly lower in terms of GSS tool satisfaction (e.g., Nunamaker et al. 1997). Our results suggest that the voting tool more fully leverages directionality than do the idea organizer or brainstorming tools, as was predicted by VSP theory.

The hypotheses (H2a, H2b) derived from VSP theory about creating place by moving and using objects within a virtual space were both fully supported. In particular, users who have a heightened experience of place find it significantly more enjoyable and easier to use virtual objects than do those who have a diminished experience of place. VSP theory was also supported in tests of hypotheses about social presence (H3a, H3b). Greater presence, as operationalized by measures of social presence and focused immersion, is associated with higher experiences of place.

The results suggest that VSP theory may be applied to understand the role of space and place in a VW. Below we describe theoretical contributions and practical implications of the theory and conclude with a discussion of limitations and future research directions.

Theoretical Contributions

VSP theory is important because it clearly links space, place, and presence. Whereas previous research hints at these linkages, this research offers a major contribution by introducing a theory of VSP which clearly posits relationships among these three constructs that are so important to understanding, designing, and using VWs. A common thread is the movement of objects. Perhaps VSP theory's greatest contribution is its conceptualization of directionality in relation to the movement of objects. Designers can apply directionality in converting virtual space into places where individuals can effectively use tools for enjoyment and utilitarian reasons. Directionality can lead to the design considerations discussed in the "Practical Implications" section below.

A second contribution of this research is its focus on the role of objects in creating place and presence. VSP theory posits that through the use of objects, denizens of VWs can learn to understand the space around them and carve out a place. This place is associated with presence. Most researchers of three-dimensional space have focused on avatar-to-avatar interactions and have not studied interactions with objects. Ullrich et al. (2008, p. 281) note that

> simply building a visually impressive place is not sufficient for an attractive presence in an inherently social

1   space like a virtual world. The key to the success of an
2   island is to provide visitors an interactive experience.
3
4 A premise of VSP theory is that an interactive experience may
5 occur with a virtual object, and not necessarily with an avatar.
6 This interaction, which stimulates presence, is crucial to our
7 conception of space and place. The concrete manipulation of
8 objects allows users to build cognitions of virtual space when
9 adapting to VWs (Piaget 1954). The results of our analysis
10 demonstrate that presence is positively affected by the way
11 objects are moved in the high place condition. The parti-
12 cipants who manipulated virtual objects with their avatars
13 experienced focused immersion and social presence, and over
14 time the recurrence of interactions created place or its illusion
15 in a VW. These experiences will only be heightened as the
16 currently available technologies that perfectly simulate three
17 dimensionality become more commonplace.
18
19 In developing VSP, we became aware of different concep-
20 tualizations of presence. Most typically, the conceptuali-
21 zations draw upon interactivity with others. We view pres-
22 ence as a psychological state in which virtual objects are
23 experienced as actual objects. We operationalize this con-
24 struct with measures of social presence and focused immer-
25 sion. A third contribution of this paper is its recognition of
26 the need to refine and operationalize the conceptualization of
27 presence within VWs that allows consideration of inter-
28 activity with objects as well as attributions to the media that
29 are important in creating environments high in presence.

30 ### *Practical Implications*
31
32 Practical implications relate to spatial design considerations,
33 designing VW meeting places, and making it easier for
34 newbies to visit a VW without getting lost in space.

35 **Spatial Considerations for Designers**
36
37 This research was motivated by a desire to better understand
38 how to employ spatial considerations to make virtual worlds
39 more appealing. Moore et al. (2007) note the ever-increasing
40 focus of designers on using space in VW to increase visual
41 realism. In their search for realism, a number of designers
42 have used three-dimensional space to build places that are
43 visually impressive. Some technologies even offer perfectly
44 simulated three-dimensionality. Unfortunately, the three-
45 dimensional spaces do not offer any specific features for
46 supporting extended interactions. We created a meaningful
47 virtual place where avatars interacted with tools as well as
48 other avatars. Doing so made it easier and more enjoyable for
49 participants to use the tools. We encourage VW designers not

only to work more toward an excellent, thoroughly engrossing simulation of reality that allows VW participants to experi- ence social presence, but also toward giving them access to a warm, familiar environment that they can personalize as a function of their own cognitive preferences, as well as past interactions with objects and other participants.

Designing Meeting Places in Virtual Worlds

Our promising results may encourage designers to use the apparent three-dimensionality of VWs to augment what can be done in the traditional physical space. For example, these tools offer a presence beyond what is available with more tra- ditional online brainstorming, organization, and voting GSS tools. Take the voting floor. In traditional GSS, the texts and screen displays give users information such as totals or aver- ages based on the votes. However, only a rudimentary form of presence is possible with traditional GSS voting tools in that a voting floor cannot be visually presented, and users' avatars cannot move around the floor to visually show their preferences.

With the tools that we have created, users attribute the effects of the personal and human interactions outside the system to the system itself. These tools may be realistic enough to serve as viable alternatives in an increasingly global world where FTF meetings are not always possible or feasible. They allow a virtual re-embedding that enhances social presence and immersion, and brings virtual interactions closer to FTF com- munication (Cyr et al. 2007). The meetings supported by VW tools such as the ones that we used in our study can be designed to leverage directionality. Consequently, these tools offer capabilities unavailable with traditional GSS. Indeed, the use of the interactive tools may give users a reason to return to VWs. Further, meetings in SL (or some other virtual world) appear to offer a viable and much cheaper alternative to meeting off-site to avoid distractions found in normal work settings. The meeting participants in our study were im- mersed in the task, even though it was easy for their avatars to fly away. It appears that the enjoyment they derived from the use of the virtual tools encouraged their immersion in the task.

Design Considerations to Avoid Getting Lost in Space

Individuals can literally get lost in space while flying in SL. For example, they may find out that there is a complete stadium hidden in a small building. If it takes too much effort for them to adapt their cognition to the VW, they may conclude that the environment is useless, and never return.

The expression "walk before you run" should be changed into "walk before you fly." VWs do have some facilities to get people acquainted with them. For example, SL has a sandbox available for learning rudimentary skills. We further recommend adding sandbox features that (1) use directionality and interaction with objects as means to ground new entrants in space, (2) ensure that new entrants can get acquainted without being distracted or bullied by experienced, unfriendly users, and (3) create parallel spaces to groups of users with comparable experiences to ensure that they experience the space as a place to meet similar users.

Limitations and Future Research

As is the case with all research, our research is limited in its definiteness by various methodological, conceptual, and more general factors. First, there were some *methodological* limitations in our operationalizations, especially for familiarity. Familiarity focuses on the skill and previous use of SL. Further, high Cronbach's alphas such as the .95 for familiarity are almost always artificial and the result of common method variance (Straub et al. 2004). Future research should seek to develop operationalizations of familiarity in VW that measure cognizance based on past experience and should have placement of items that are not all in one block. A second possible methodological limitation is that the participants, especially in the FTF situation, may have been distracted by others in the room. We urge future researchers to remove this confound by making it impossible for these distractions to occur in their experimental settings. Future research may also create settings for a range of "place" rather than just the extremes of low and high place.

In studying IT artifacts, it is necessary to consider both intended and unintended consequences. In our experience, space in the idea organizer was used in ways unintended by designers. When organizing ideas within the bounded space of the idea organizer, the avatars sometimes walked to the side to have a one-on-one verbal discussion. They discussed the suggested ideas, agreed on the categorization, and then returned to their places within the circle. Further, the avatars used a different space for conducting a supplementary meeting when the idea organizer became too crowded. There was an active construction by the avatars of what was inside and outside of the tool boundaries. We studied the interaction between users and objects and, thus, we focused on the perception of the tools. In the future, it would be interesting to gather qualitative data to better grasp the role of the tools in facilitating the avatar interactions and stimulating a sense of place. We intentionally did not use the classical method of virtual ethnography (Hine 2000) that is typically used to study social interaction of avatars' activities in social VWs. How-

ever, this method would be especially useful in studying conversational interactions among avatars when they are using the tools.

Charges of a *conceptual* limitation could be levied against our attempt to theorize about (and measure) social presence on the grounds of underlying preconceptions. Often social presence is conceptualized as reflecting environments in which users interact with one another. It requires physically interacting with another user (Biocca et al. 2003). However, this may not always be the case when designing IT artifacts to work in virtual environments. We are entering an era of humankind in which intersubjectivity, previously the sole domain of human communication, now includes communications between users with objects—objects that are pieces of software and lines of codes. Scientific theory must evolve to accommodate our new reality. Consequently, we need new Information Systems theory to support this changing reality. We realized in conducting our research that a well simulated world of objects can stimulate presence and foster illusion of place in an environment that is, in fact, a vast perceptual illusion. In this environment, intersubjectivity may become a larger mirage in users' day to day life as they increasingly interact with virtual objects.

How we think about social presence affects how we measure it. If social presence is premised upon flesh-and-blood individuals, then its measures must focus on the properties of the communication interactions mediated using the media (Biocca et al. 2001). However, if the environments rely on IT artifacts to create social presence, then the measures must focus on direct attributions to the media (Cyr et al. 2007; Gefen and Straub 2004). In our research we used five items to measure direct attributions to the media. We recognize, however, that future research may measure the multidimensionality of social presence as reflected in interactions using the media. For example, the networked minds measure of social presence tested by Biocca et al. (2001) introduces a set of measures that combines copresence, isolation/aloneness, awareness, attention, empathy, mutual understanding, behavioral independence, and mutual assistance. Using these multidimensional scales developed by other disciplines may mean not only having longer questionnaires, but also basing the items on assumptions of interactions that might not reflect the new worlds emanating from IT artifacts.

Another conceptual challenge that we experienced was in thinking about space and place. Our solace is that we are in good company with philosophers and scientists over several millennia. Future research should attempt to refine and distinguish the conceptualizations of space and place and, consequently, better operationalize them.

A more *general* limitation of the research is the entangled nature of technology and behavior that is present which creates evaluation uncertainty. By privileging either the material or social aspects, we lose sight of their intermingling and the relative impact that each has on the other. As Orlikowski (2005) points out, the challenge remains "to develop a new vocabulary, a new set of understandings that may help us address the situated entanglement of the technology and the social" (p. X). We define, coordinate, and validate an object's meaning through verbal and nonverbal interactions with others (Gergen 1994), and in so doing, we construct social reality. Be it a physical or virtual world, sense is made starting with our interactions with objects (Piaget 1985). It is also made when we discuss the meanings of the tools with others or when we coordinate our actions with others in using the tools in a world of intersubjectivity.

In this study we focus only on objects. As an essential first step, we designed tools that support coordination and interactions among users. As a second step, future researchers could study the interactions among users when they employ the tools to accomplish tasks such as those described above. This second step could also include studying the use of virtual objects longitudinally in groups of students and professionals using the island and other virtual world settings. Group members could be asked in separate interviews or in focus groups to reflect on their use of the tools. In particular, they could be asked to explain how social presence and focused immersion influenced their experience with using the tools through time. Researchers could also investigate the time and processes needed to adapt newbies' perceptions and cognitions of virtual space as function of design of the environment— a more efficient sandbox. Further, they could research the time required to build familiarity with an environment as a function of its design properties and level of interaction. As a third step, future researchers could study the impacts of using the tools in VWs, such as the effect of their use on decision quality and their potential support for virtual team collaboration.

Conclusions

One could say that we are exploring the first generation of virtual worlds. Movement to the next and subsequent generations is likely to be far faster in this computer age than the growth of similar technologies has been in the last century. For example, the first experimental three-dimensional television set was built in the 1920s (Pourazad et al. 2010). It took 90 years for three-dimensional TV to go mainstream. It should not take as long to move to the next generation of VWs. We can learn much from the first generation of VWs. Using theories such as those presented in this paper should provide guidance in building subsequent generations of VWs. Even if SL loses its luster, more advanced generations of virtual environments are likely to develop and thrive in the future (Pannicke and Zarnekow 2009). Nonetheless, environments like SL offer an excellent opportunity to take a first step in exploring new places that have been created in VWs. We are at the cusp of new technology and our hope is that VSP theory can inform the development and use of other tools in VWs, and guide future efforts to encourage avatars to return. The starting point should not be what is possible with the current technologies but how to allow people to find a place for themselves in the space that is provided.

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