2-15-2013

Examination of interactive experience: Construction of physical and social presence in virtual environments

Malwina Buldys

The Rochester Institute of Technology

Department of Communication

College of Liberal Arts

Examination of Interactive Experience: Construction of Physical and Social Presence in Virtual Environments

by

Malwina A. Buldys

A Thesis submitted

in partial fulfillment of the Master of Science degree

in Communication & Media Technologies

Degree Awarded:

February 15, 2013

The members of the Committee approve the thesis of Malwina A. Buldys presented on February 15, 2013.

Ki-Young Lee, Ph.D.
Associate Professor
Department of Communication
Thesis Adviser

Brian O'Keefe, Ph.D.
Assistant Professor
Information Sciences and Technologies
Thesis Adviser

Rudy Pugliese, Ph.D.
Professor of Communication
Director, Communication & Media
Technologies Graduate Degree Program
Department of Communication

Patrick Scanlon, Ph.D.
Professor of Communication and Chairman
Department of Communication

Dedication

I would like to dedicate this master's thesis to my soulmate, Maciej, and my mother, Anna—with tremendous love and appreciation. There is no doubt in my mind that without their continued support and counsel, I could not have completed this process or discovered the following genuine maxim:

> "Every great dream begins with a dreamer. Always remember, you have within you the strength, the patience, and the passion to reach for the stars to change the world."
>
> —Harriet Tubman (1820–1913)

Acknowledgments

The pages of this thesis hold far more than the culmination of months of systematic study. Each page serves as a collective mirror reflecting the contributions of many inspiring, creative, and motivational individuals who devoted their valuable time to assisting me in the preparation and completion of my thesis. I deeply cherish and admire each individual who helped me become who I am today: a graduate, a colleague, and a better person.

First and foremost, my utmost gratitude belongs to Dr. Ki-Young Lee for his unfailing support as my thesis adviser and his kind advice to never lose “momentum” in completing my studies. To Dr. Brian O’Keefe, an altruistic mentor and thesis co-adviser who taught me that to be creative, I should always challenge my own assumptions, look at things from a clear point of view, break free of conventional thinking, and take off the blinders formed by my past experiences. To Dr. Rudy Pugliese, whose unstinting support inspired me to exercise the responsibility and courage necessary to use academic resources and accentuate my own reason and intellect—I will never forget.

I would like to express my gratitude to the senior staff assistant, Ms. Helen Adamson, who was abundantly helpful and offered support and guidance in editing, formatting, and preparing my final thesis draft.

Finally, I would also like to express my thanks to the Department of Communication; the senior associate dean of the College of Liberal Arts, M. Ann Howard, J. D.; and the lab manager of the Liberal Arts Mac Lab, Mr. Jason Intini, for providing the facilities and technical support I needed to carry out my experiments.

Table of Contents

EXAMINATION OF INTERACTIVE EXPERIENCE: CONSTRUCTION OF PHYSICAL AND SOCIAL PRESENCE IN VIRTUAL ENVIRONMENTS

Name: Malwina A. Buldys
Department: Communication
College: Liberal Arts
Degree: Master of Science in Communication & Media Technologies
Term Degree Awarded: Winter Quarter 2012 (20122)

Abstract

Interactivity seems to be a familiar concept, which partially explains its frequent use in discussions about new communication technologies and what they can bring to communication studies. However, interactivity research has yet to reach a comprehensive and concrete consensus concerning the antecedents and consequences of interactive experiences. The main objective of this research is to determine the factors responsible for fostering the interactivity experience in the multiuser virtual environments and to observe how this variance in interactivity will affect the formation of physical and social presence. The study also examines the possible relationship between physical and social presence via correlation analysis and uses a one-way ANOVA with Post-Hoc Tests to designate the effects of interactivity on physical and social presence.

Keywords: interactivity, presence, social presence, spatial presence, virtual environments, mediated communication, immersion, engagement, the user experience

Examination of the Interactive Experience: Construction of Physical and Social Presence in Virtual Environments

The ideas of participation, interactivity, and immersion, which permeate multiuser virtual environments (MUVEs) such as *Second Life* (SL), attest to the fact that a social life's center of gravity can move into a world that does not physically exist. In these synthetic worlds, the paradigm of social participation undergoes considerable change, but more profoundly, as a result of the computer-mediated communication (CMC) that these environments accommodate, users are no longer merely passive receivers and observers of actions and their results; they also can, or should, become co-authors of transmitted messages and generators of feedback.

The most direct result of this communicative freedom supports a claim that the user can experience interactive relationships in that they directly engage with the environment and other users. To a significant degree, interactivity research has recognized some of the characteristics of these experiences as being involved in a generation of interactivity. However, there is still a lack of coherent agreement about what these characteristics are in the first place. In addition, interactivity theorists debate whether interactivity is a quality of the medium or the user and catechize which of these ultimately makes it possible to constitute a rudimentary interactive experience (Tremayne, 2005; Sundar, 2004).

Consequently, questions about interactivity might appear. Is interactivity embodied in the qualities of the medium's interface features? Or is it found in the user's distinct and idiosyncratic perception and experience of the medium and its interface? It is equally relevant to ask, "Can certain qualities or interface features be counted on to consistently cultivate interactive experiences for every user each time he or she encounters them?"

Smith (1999) argued, “the word ‘interactive’ is used so frequently…[that] it has become a defining characteristic of the medium” (p. 9). Nevertheless, as Smith further asserted, “This defining characteristic seems to have no central definition. ‘Interactivity’ seems like the Supreme Court’s description of pornography: I know it when I see it” (p. 9). Accordingly, it is reasonable to assert that there is a need for more comprehensive understanding of interactivity and the scope of communication technologies to foster and intensify the user experience during participation in virtual environments (VEs).

Additionally, a deeper examination of the relationship between interactivity and physical presence—the sense of being there—should be conducted to create a more precise and empirically-evaluated model of that relationship. Although the concept of presence is one of the most intensively researched fields in virtual reality (VR) technology, Schroeder (2011) states, “It is not clear how significant the level of immersiveness is in fostering presence—compared with the level of interactivity or the manipulability of the environment…does presence depend on being there, or what you can do there?” (p. 26). Moreover, in the case of MUVEs, an additional layer of difficulty is supplemented by the extent to which presence is influenced by social presence, a phenomenon that generates “the sense of being there with other users” (Schroeder, 2011, p. 26), which is also referred to as copresence (Bailenson & Yee, 2006).

Against these backdrops, this study attempts to answer the following questions. First, it is essential to determine and specify the factors responsible for strengthening the interactivity experience, although the components of communication may vary in specific environments. The next step is to observe how this variance in interactivity will affect the formation of physical presence and social presence. Moreover, this study will investigate which factors in producing physical presence and social presence will have a stronger influence over the user experience. Finally, it is crucial to examine the nature of correlations between these sub-categories of presence and ascertain if physical presence and social presence are independent of or dependent on each other or if there is mutual dependence between both categories of presence. The summary of this study's goals and objectives is presented in Table 1.

Table 1

The Goals and Objectives of the Present Study

Title:	Examination of Interactive Experience: Construction of Physical and Social Presence in Virtual Environments
Goals:	→ To provide a more comprehensive understanding of interactivity and the scope of communication to foster and intensify the user experience during participation in MUVEs → To examine the relationship between interactivity and physical presence (the sense of being there) and to create a more precise and empirically evaluated model of that relationship
Objectives:	→ To determine and specify the factors responsible for facilitating the interactivity experience in MUVEs → To investigate how varying levels of interactivity affect the formation of physical and social presence in MUVEs → To explore which of the factors involved in producing physical and social presence have a stronger influence over the user experience → To evaluate the nature of correlation between physical and social presence → To collect empirical data on factors that affect the generation of interactive experiences in MUVEs
Activities and Tasks:	Conduct the experiment: → Manipulation of communication tools that are present to varying degrees in VEs → Formation of three experimental conditions that serve as possible avenues through which an interactive experience can be generated: (a) pre-determined with a low level of interactivity; (b) middle-determined with a mild level of interactivity; (c) open-ended with a high level of interactivity

Justification and Rationale for the Current Study

Although interactivity theorists have suggested that media technologies that facilitate interpersonal communication can also support the construction of interactive experiences more successfully than media technologies that lack these communicative tools (McMillan & Hwang, 2002; Molyneux, 2003; Lim & Reeves, 2009; Schultz, 2000), empirical studies that would confirm or provide these differences are still in the developmental stage. Thus, one of the main objectives of this study is to reduce the inconsistency in the conceptualization of interactivity in communication research.

According to Walther et al. (2005), interactivity has been epitomized as an undertheorized construct with low and poor levels of operationalization as a variable in communication studies. Bucy and Tao (2007) underlined the persistent deficiency of understanding interactivity in the absence of systematic research. The accelerated development of new media technologies increases the possibility of rendering irrelevant theories regarding interactivity. Also, the speed of change leads to the formulation of ineffectual theories based solely on existing technological features that are predominantly grounded in user interfaces (Bucy, 2004a; Bucy & Tao, 2007). Consequently, Bucy (2004a) pointed out that interactivity research should focus more on the user. Only then will concepts of interactivity revolve around the patterns of impacts on users and not only around ever-changing interface developments.

Therefore, to determine differences in the user experiences while interacting in VEs, this study will be based on the manipulation of communication tools that are present to varying degrees in VEs. Specifically, the researcher will establish three categories for constructing an interactive experience (1: pre-determined with a low level of interactivity, 2: middle-determined with a mild level of interactivity, 3: open-ended with a high level of interactivity) that will serve as possible avenues through which an interactive experience can be generated. Each category will consist of separate ways in which the user can engage and thus experience physical and social presence at various levels. Further details regarding this modus operandi will be discussed in the present study's methodology section.

This study aims to contribute empirical data on factors that affect the generation of interactive experiences and observe how these experiences relate to the physical and social presence. Although this study is focused on the context of technology provided by MUVEs, the researcher argues that the implications of the findings will be important to the technology developers, who are concerned with maximizing the potential benefits of all interactive technologies.

Literature Review

Living with Technology

Bruner (1986) once said, "As social scientists, we have long given too much weight to verbalizations at the expense of images. Lived experience, then, as thought and desire, as word and image, is the primary reality" (p. 5). Technology has significantly helped—and continues to help—society in constructing the image of our existence. We create tools that serve to manipulate natural and social processes. However, as McCarthy and Wright (2004) asserted, "We don't just use or admire technology; we live with it. Whether we are charmed by it or indifferent, technology is deeply embedded in our ordinary experience" (p. 2). The interactions with technology might evoke emotions, values, ideas, personal feelings (McCarthy &Wright,

2004), or change the way we process our own perceptions as well as perceptions of others on both social and psychological levels.

The user experience. At the same time, however, as the main objective of this study is to investigate interactive experiences—prior to elaborating in greater depth with regards to how interactive technologies might shape these experiences—it is relevant to discuss the concept of *user experience* (often abbreviated as UX; Allen & Chudley, 2012) and to describe briefly the ways in which the relationships between the user and interactive technology are investigated by this study.

From a historical point of view, the interactions between people and interactive and/or information and communication technologies, along with the formation of possible relationships between people and these technologies, have been areas of interest in disciplines such as Human-Computer Interaction (HCI) and Computer-Supported Cooperative Work (CSCW) since the late 1960s and the mid-1980s, respectively (McCarthy & Wright, 2004). As McCarthy and Wright (2004) attentively pointed out, in recent years a terminological shift has been observed; *interaction design* or *user experience design* are terms employed when referring to relationships between people and interactive technologies. Yet, there remains an evident lack of concern about what the concept of user experience means (McCarthy & Wright, 2004), which in turn, creates difficulties in defining and conceptualizing the concept.

For instance, Tullis and Albert (2008) describe the user experience as relating to “all aspects of someone’s interaction with a product, application, or system” (p. xv). In the nomenclature of Hinckley and Wigdor (2012), the user experience refers to “the broad array of outputs perceived and inputs given by a user when interacting with a user interface, as well as the higher-level goals, cognitive states, emotions, and social interactions that such experiences support and engender" (p. 101). This study promotes McCarthy and Wright's (2004) approach, arguing that the experience of technology is a matter with much larger scope than the "usability or one of its dimension such as satisfaction or attitude" (p. 6). The authors characterized the relationships between users and technology as "the felt life and the felt or emotional quality of action and interaction" (2004, p. 12). In other words, the "felt experience" reflects the emotional and sensual quality of experience (McCarthy & Wright, 2004), which in consequence, lies at the heart of "feltness" of the personal and idiosyncratic character of the experience with technology. In the context of a MUVE, such as the virtual world of *Second Life,* the combination of interactive technology and communication helps and supports the relationships and activities that substantially enrich the user's experience and emphasizes the uniqueness of VEs above other forms of mediated interaction.

Media convergence. One of the most profound trends in communication technologies in recent years is the rapid proclivity for *convergence* of different media. In particular, the expeditious synergy of digital media has resulted in profound changes in the nature and organization of contemporary mediated communication. With access to new interactive media technologies, people can organize their personal and professional activities more effectively. Therefore, new media contribute to an elevation of the adaptability and ambidexterity levels of human action within the media convergence. These higher levels of competence, in turn, produce new communication environments that not only convert already existing arrangements of interpersonal relations and multimodal representations of social interactions, but also predominantly influence the way in which our experiences might be formulated. Shneiderman (2002) spoke of these transformations as *the new computing era*,

> The old computing was about what computers could do; the new computing is about what users can do. Successful technologies are these that are in harmony with users' needs. They must support relationships and activities that enrich the users' experiences. (p. 2)

Cyberspace. Due to the inclinations that have emerged on the horizon of both information and communication technologies, the locution of *cyberspace* has been embraced in order to describe the increasing influence of these technologies, especially the influence of the computer, which serves not only as an information technology, but also as the predominant communication medium. Furthermore, it becomes reasonable to argue that any form of human-computer interaction (HCI) can be described as a distinctive form of communication, and the extent of this communication's versatility can be influenced only by the merit of the computer or the users who control it.

In that context, cyberspace offers a sybaritic form of the transportation of awareness along thin optical glass fibers in the "windows to the world," our computers. Biocca and Levy (1995a), using a communication metaphor for the transport of thoughts and ideas known as *telementation,* stated that technology makes highways of information available. We are surrounded by the consolidation of technological aggregate, which penetrates our daily lives so thoroughly that it has become almost inescapable—*in situ* and *hic et nunc*. On the other hand, this accumulation of communication technologies also completely systematizes social and cultural arrangements and joins almost all forms of human expression and self-aggrandizement.

More intensely—with time-space and cost-space convergence—we are evolving into multidimensionality.

Heim (2001) asserted that humanity's "mental marriage to technology" gives birth to the phenomenon of "connectedness" with technology as well as with human others, ultimately constituting the notion of a shared space, or *online* (virtual) *community*. All virtual communities that have been formed in cyberspace have emerged as the result of CMC applications (Zaphiris, Ang, & Laghos, 2012). However, the term online community connotes different meanings and is difficult to define (Preece, 2000). Rheingold (1993) offered the following interpretation, "[online] communities are social aggregations that emerge from the Net when enough people carry on these public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace" (p. 5).

Inhabitants of cyberspace are continuously entwined and participating in the acceleration of the absolute velocity of electronic data. Virilio (2000) called this process *dromology*—a science (or logic) of speed. Additionally, Virilio argued that the real time of "action at a distance"—telecommunication—has replaced the real speed of immediate action. In Virilio's view, "cyberspace is a new form of perspective" (2000, p. 24) that does not have to agree with "the audiovisual perspective which we already know" (2000, p. 24). Furthermore, Virilio elaborated:

> It is a fully new perspective, free of any previous reference: It is a *tactile perspective*. To see at a distance, to hear at a distance: that was the essence of the audiovisual perspective of old. But to reach at a distance, to feel at a distance, that amounts to shifting the

> perspective towards a domain it did not yet encompass: that of contact, of contact-at-a-distance: telecontact. (emphasis in original, 2001, p. 24)

However, the fact that cyberspace is a shared and collective telecontact should be underlined, and, more profoundly, in its instantaneity, it becomes "glocal," a concatenation of local and global. In other words, cyberspace has the ability to atomize or synthesize data, process large volumes of information at increasing speeds, and link users across space and time. Notwithstanding, while taking Virilio's (2001) premise into consideration, one should keep in mind Heim's (2001) assertion: "Cyberspace is more than a breakthrough in electronic media or in computer interface design. With its virtual environments and simulated words, cyberspace is a metaphysical laboratory, a tool for examining our very sense of reality" (p. 70).

Correspondingly, mediation and invisibility have become designations of an age in which cyberspace has transformed much of material culture into an ethereal "cluster" and into what Gibson (1991) described as a "neologic spasm." Ergo, Gibson (1984), in his earlier work—a cyberpunk novel called *Neuromancer*—asserted the following:

> Cyberspace. A consensual hallucination experienced daily by millions of legitimate operators…A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding. (p. 67)

Computer mediated communication (CMC). The opportunity for human-to-human communication through computer networks (CMC; Zaphiris, Ang, & Laghos, 2012) is one of the most important characteristics of cyberspace. December (1996) defined CMC as "the process by which people create, exchange, and perceive information using networked telecommunication systems (or nonnetworked computers) that facilitate encoding, transmitting, and decoding messages”. Moreover, December drew attention to the fact that this process might be viewed differently, from various interdisciplinary theoretical perspectives, which also very often draw from other fields such as HCI, computer science, human communication, media studies, information studies, and telecommunications (Zaphiris, Ang, & Laghos, 2012).

Apart from a general definition, Haklay (2010) suggested that another way to understand the relevance and impact of CMC is to consider its spatial and temporal aspects, which are reflected by the concept of *groupware*. In their discussion about groupware, Ellis, Gibbs, and Rein (1991) asserted that it demonstrates “a change in emphasis from using the computer to solve problems to using the computer to facilitate human interaction” (p. 39) and defined it as “computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment” (p. 40). In the context of communication, groupware systems can be used to elevate and improve “communication and collaboration within a real-time interaction, or an asynchronous, non- real-time interaction” (p. 41). As the major conclusion, the researchers proposed a model of groupware’s time-space matrix (see Table 2), which epitomizes the classification of possible interactions in both physical and mediated environments and consists of the four modes of interaction. For the purpose of later discussion regarding the concept of copresence, it is important to underline that Ellis, Gibbs, and Rein’s (1991) model illustrates also how differences in place (colocation)—in this context, where the user is situated—and time—the moment in which interaction is taking place—can influence modes of interpersonal communication.

Based on the groupware time-space matrix, the schema of CMC examples can include both *asynchronous* (emails, bulletin boards) and *synchronous* (chat, manipulation, retrieval, and storage of information through computers and electronic databases) communication (Ferris, 1997). Audio conferencing of the synchronous communication between the users is classified as an example of a real-time communication mechanism (Zaphiris, Ang, & Laghos, 2012). The users can also share text, chat, and pictures while communicating (data collaboration). Videoconferencing, apart from features available for audio conferencing, supplements its users with the possibility to see each other while communicating. Internet relay chat (IRC) and instant messaging (IM), which are based on a text exchange, can also support synchronous communication. Instant messaging is supplemented with a digital representation of the user—an avatar—that can communicate with others within a three-dimensional VE.

Table 2

Groupware Time-Space Matrix. Adapted from Ellis, Gibbs, & Rein (1991)

	Time	
Condition (type of place/colocation):	**Same time**	**Different time**
Same place	Face to face interaction: →The participants are at the same physical location and interact at the same time. →It is the richest mode of communication between participants (Brown & Duguid, 2000).	Asynchronous interaction: →The participants are at the same physical location, but interactions occur at different times.
Different place	Synchronous distributed interaction: →The participants are at different locations but interact at the same time. →Example: chat, videoconferencing, IM, MUVEs.	Asynchronous distributed interaction: →The most complex mode of CMC. →The participants are not at the same location, nor do they interact during the same time. →Example: electronic mail, bulletin boards.

To conclude, with the appearance of VEs, our connection with technology has been significantly articulated and thus reconstructed. People are invited to cooperate in collaborative virtual environments (CVEs) such as SL, which (a) changes the way users can express their dialogue with the medium and the message, (b) generates interactive experiences of physical presence and social presence, and (c) helps to identify types of interaction proliferated by VE technologies.

Although both phenomenon of physical presence and social presence will be discussed at greater length in the next sections of the literature review, IJsselstjein (2003) raised a relevant point regarding the interactive environment,

> The essential characteristic of any interactive system is that it will allow the user some measure of control over the media form and/or content. In this context, it is useful to distinguish between two different types of user-system interaction: navigation and manipulation. Navigation will allow the user to explore a given computer-generated or distant real environment… Although navigation allows the user to dynamically change the current view onto the environment, it leaves the environment itself essentially unaffected. Manipulation on the other hand, allows the user to affect a meaningful change in the real or virtual environment itself. (p. 31-32)

IJsselstjein's observation underlines the importance of interaction that, when applied to VE technology, includes not only the user's interaction with the environment but also with others by means of CMC.

In addition, although the concept of interactivity will be also explored later, it is important to provide some concrete distinctions between *interactivity* and *interaction* as both are very often used interchangeably. Therefore, in the context of MUVEs, interactions reflect all "perceivable actions that act as manifestations of the user-user and user-environment interaction" and are "used to convey the actions of the user to oneself and to others…[and] enable awareness of actions and social presence by offering mutually perceivable visualizations and auralisations [audio] within the environment" (Manninen, 2003, p. 296). In addition, interaction includes not only control over the environment and interactivity (Wallach et al., 2011), but also directly and indirectly influences the user's sense of presence by focusing attention and increasing involvement (Schuemie et al., 2001). On the other hand, interactivity evaluates "modes of user interaction with the objects of the virtual world. The more ways there are to interact with the environment, the higher is its level of interactivity" (Kamieth et al., 2010, p. 335).

Technology of Virtual Reality (VR)

It is important to note that the *virtual environment* (VE) technology discussed in this study, and further epitomized by *multiuser virtual environments* (MUVEs) like SL, pertains to the concept of *virtual reality* (VR). As mentioned before, the term VR embraces a wide spectrum of human-technological interactions. At first, it was only a slogan, originally coined by Jaron Lanier at the beginning of the 1980s (Pescovitz, 1999). However, with time, the term has undergone a metamorphosis into an active classification of a new cultural trend: *cyberculture*. The most popular definition of this phenomenon is any technology that allows users to "join/enter" a three-dimensional, computer-mediated environment. Heim (1998) proposed a technical definition of VR as "an immersive, interactive system based on computable information" (p. 6). According to Schroeder (1996), VR technology is "a computer-generated display that allows or compels the user (or users) to have a feeling of being present in an environment other than the one that they are actually in and to interact with that environment" (p. 25).

In this study, the following definition of MUVEs, also known as shared/collaborative virtual environments (S/CVEs) and /or systems: "[environments or systems] in which users experience other participants as being present in the same environment and interacting with them—or as 'being there together'" (Schroeder, 2011, p. 4). There are two types of systems that allow users to "be there" together while implementing technologies and environments: *immersive* (and nonimmersive) *VEs* and *immersive video-environments* (videoconferencing). A further and more specific discussion about both systems will be addressed later.

From a historical perspective, the current facets of VR technologies have been influenced by some changes, but still they remain confined to specialized niches and for presentation or research purposes, thus offering limited access to the average person. The first single user head-mounted display (HMD) system, which also is considered to be the first VR prototype—"the ultimate display"—was built by Ivan Shutherland in 1965, one of the pioneers of computer graphics in VE technology (Biocca & Levy, 1995b), who also predicted:

> A display connected to a digital computer gives us a chance to gain familiarity with concepts not realizable in the physical world. It is a looking glass into a mathematical wonderland… There is no reason why the objects displayed by a computer have to follow the ordinary rules of physical reality… The ultimate display would, of course, be a room within which the computer can control the existence of matter. (as cited in Biocca & Levy, 1995b, p.7)

Furthermore, Stephanidis et al. (2012) commented,

> Virtual reality differs significantly from the "regular" computer interaction in terms of input and output devices. As the whole paradigm resolves around the immersive experiences of being present in an artificial world, the way users interact with this world depends on these devices. (p. 1396)

Therefore, there are two main types of devices (especially popular at the beginning of the 1990s) that helped and still support construction of these immersive experiences: HMDs and Cave Automatic Virtual Environments (CAVE)-type systems. One of the most important improvements that occurred in VR technology in recent years concerns the possibility of elevating the experience of shared spaces due to networking. In general, this applies to so-called high-end immersive HMD or immersive projection technology (IPT) systems, which can be networked together (Schroeder, 2011). Yet, still using either HMDs or CAVE-type systems is expensive and often limited to only a few users (Stephanidis et al., 2012). Therefore, many design proposals have turned in the direction of Internet and other web-based solutions.

In their analysis of the web's evolution— *webvolution* (see Appendix J: Figure 1), Kapp and O'Driscoll (2010) asserted that the ways in which the web has been used have shifted from "access and find" (Web 1.0; p. 7) and "share, participate, and collaborate" (Web 2.0; p. 7) to "immersive collaboration and co-creation" (Web 3.0; p. 7). The first phase of the web, which began with the launch of the first browser—Mosaic—in 1993, changed society and business. Anyone with the access to a browser could "read" basic text and graphical information (Kapp & O'Driscoll, 2010). The next phase, Web 2.0, which was originally coined by O'Reilly (2005) to describe the trend toward user-oriented content (Huang, 2008), has moved attention away from "connecting people 'to' the web to enabling people to connect 'through' the web" (Kapp &

O'Driscoll, 2010, p. 9). The final phase, Web 3.0, is "a migration from the traditional two-dimensional web to a three-dimensional one" (Kapp & O'Driscoll, 2010, p. 12). In this last stage of webvolution, the Internet metamorphizes into: (a) *Immernet*, a combination of "immersive" and "Internet," which describes how the Internet becomes more and more immersive (Kapp & O'Driscoll, 2010), and (b) a 3D VE, where users, through their digital representations, avatars, can have synchronized moments of interaction, which, in consequence, contributed to forming many Internet-based VEs, for example, *Second Life*, *There*, *Active Worlds*, *Onverse*, *Kaneva*, and *Entropia Universe*.

Schroeder (2011) noticed that when people use software to run these VEs, they "share virtual worlds, even if they do not have the experience of an 'immersive' VE in the same way" (p. 5). Furthermore, Schroeder made an important distinction between *immersive environments* and *online/virtual worlds*. The main difference between these terms speaks to the fact that immersive environments involve space(s) that is/are constructed only for a brief period of time and used for a specific purpose, in the form of visualization and experimental work. Conversely, online/virtual worlds accommodate *large* and *persistent* places that "many users can inhabit together" (Schroeder, 2011, p. 5). Therefore, online multiuser worlds reflect one of the most well-known implementations of MUVE technology.

The age of techne: experience of virtual environment (VE). Boellstroff (2008) offered a noteworthy observation about current predilections of activity between human beings and technology in VEs. Described as participation in 'the Age of Techne,' Boellstroff underlined that the word 'technology' has its roots in the Greek word *techne*, which,

> refers to art or craft, to human action that engages with the world and thereby

> results in a different world. Techne is not just knowledge about the world, what Greek thought termed *episteme*; it is intentional action that *constitutes a gap* between the world as it was before action, and the new world it calls into being. (emphasis in original, p. 55)

Consequently, VEs offer binary construction, the space and tools for dynamic progress of engagement with technology (Schackman, 2009). Accordingly, SL creates a virtual participatory culture and fabricates an alternative identification with media technology. The users of this environment can create and expand their own creativity and imagination. Additionally, open access to the semiotic solutions used in Web 3.0 is practiced and cultivated in SL.

It is also important to recall that almost all earlier technologies have been used to only create tools from an objective point of view. However, VE technology allows a participant to experience feeling in a very subjective form. When one decides to enter this new, alternative world, he or she makes one more important choice: a new system for empirical learning. From ideological and philosophical perspectives, VE technology stands as the next milestone in the history of humankind and interacts with many interdisciplinary fields.

However, the revolution of science and technology still falls behind human sensory perception and the feeling of internal time consciousness (Husserl, 1964). They constitute the absolutes and are unable to provide us with any version of reality. While this “objective world” might be one among many possibilities, the “subjective world” of perception and awareness is a source of universal need. However, this does not confirm that the *experientia* of the world surrounding us originates only in the brain because the human mind only forms part of the empirical world.

As a result, to the attentive observer, some questions might appear. If VR is equal—or deeper—and being put on the same phenomenological base as current reality, why should there be interest in creating a VR? Is it not already problematic enough to understand *one* reality that has raised so much human doubt and distress over thousands of years? The answer to that question constitutes the main motivation behind creating SL: The reality in which we exist is compulsory, while VE is the fruit of human creativity, involvement, and the mind.

Bricken (1990) formulated this relation in his statement that "Psychology is the physics of virtual reality. Our body is our interface. Knowledge is in experience. Data is in the environment. Scale and time are explorable dimensions. One experience is worth a trillion bits. Realism is not necessary". The terminology of McLuhan's (1964) technology is created to fill the needs of the cognitive process, the sensor-motor centers such as eyesight, hearing, and deliberate reasoning (Wiener, 1961). The creation of a digital realm allows a unique, deeper understanding of the real world that surrounds us. Understanding the nature of reality permits the extension of how users perceive VE technologies, which, despite their still primitive form, are catalysts for accepting the fact that the creator of VR—mankind—for the first time has a chance for a systematized, sensible existence "being present" in VEs with the others, where a variety of interactions might take place.

Finally, Ben-Ze'ev (2004) commented:

> What is new about cyberspace is its interactive nature and this interactivity has made it a psychological as well as social reality. It is a space where real people have actual interaction with other people, while being able to shape or even create their own and other people's personalities. (p. 2)

Another scholar, Turkle (1995), explained this as “people turn to computers for experiences that they hope will change their ways of thinking or will affect their social and emotional lives” (p. 26). At the same time, however, this “move from passive imaginary reality to interactive reality of cyberspace is much more radical than the move from photographs to movies” (Ben-Ze’ev, 2004, p. 2). People are connected through technology, and in the context of VEs, the users of these environments can also construct themselves more illusively in their interactions with technology as the lines between reality and virtuality through CMC have blurred.

Consequently, each individual has a unique response to technology, and as McCarthy and Wright (2004) pointed out, “even if that response is not to use certain technologies” (p. 106), it affects one’s way of being, and “becoming a self always happens in the context of dialogue with others” (p. 106). For that reason, MUVEs serve as one of a few technological options (videoconferencing systems also have similar potential) that allow people at a distance to be together in the same environment (Schroeder, 2011). While using SL as a methodological tool, it is possible to investigate how interactive experiences that are rendered by VE technologies influence and create new implications for CMC, including physical presence and social presence.

Multiuser Virtual Environments (MUVEs)

Catalysts for the development of MUVE technology.

Military. As advocated by Schroeder (2011), “the history of MUVE technology has various stands” (p. 11). The first demonstration of networked interactive computer graphics took place in 1972 on ARPANET, the acronym for the computer network developed by the U.S. Advanced Research Project Agency (Schroeder, 2011). The main goals for this system were to lower costs and provide the time-sharing of computer processing resources, especially for military training purposes. Specifically, the ARPANET project helped to render battlefield simulations, the developmental phase of which started in the United States around the mid-1980s. Although military training and recruitment have recently appropriated the advantages of online gaming, MUVE technology still remains an important aspect of their projects (Schroeder, 2011).

Computer games. As observed by Schroeder (2011), the next important facets that drove the development of multiuser VR were networked computer games. Historically speaking, so-called tabletop role-playing games (RPGs), such as *Dungeons and Dragons*, *Runequest*, and *Traveller*, have contributed to the birth of two types of video games: text adventures (*Adventure and Zork*) and multiuser dungeons (MUDs; Egenfeldt-Nielsen, Smith, & Tosca, 2008). The former further evolved into graphic adventure games, which today might be seen in hybrid games, for example, action-adventure games. The latter type spawned graphic online worlds, known today as *massively multiplayer/multiuser online* (MMO), *massively multiplayer online games* (MMOGs), *massively multiplayer online persistent worlds* (MMOPWs), and *massively multi-player online role-playing games* (MMORPGs; Egenfeldt-Nielsen, Smith, & Tosca, 2008; Vorderer & Chan, 2006). Vorderer and Chan (2006) commented, “The somewhat broader terms ‘persistent world’ and ‘virtual world’ are also used by social scientists and humanist scholars, and computer scientists and others researching virtual reality technology have examined ‘networked virtual environments’” (p. 79).

At this point, it is important to mention that these large online games, apart from obvious play features such as “Pkill” (player kill) and/or “PvP” (player vs. player) modes over the Internet (Vorderer & Chan, 2006), capture the notion of the Internet as a location of virtual communities (Rheingold, 1993). MMOGs provide the opportunity to connect thousands of users in real-time interaction and communication (Vorderer & Chan, 2006). Therefore, these game worlds, which are similar to online/virtual "social spaces" or worlds, support the emergence of complex social dynamics and integrate both communication and entertainment in play that evolves through the user interaction with this world. Accordingly, and for terminological reasons, since one of the objectives of this study is to understand how people interact in MUVEs like SL, the term *virtual worlds* (VWs) is applied throughout the paper.

Schroeder (2008) defined VWs as "persistent online social spaces; that is, virtual environments that people experience as ongoing over time and that have large populations which they experience together with others as a world for social interaction" (p. 2). This definition echoes a classification of the aforementioned multi-user/collaborative/shared virtual environments as spaces in which users can "experience other participants as being present in the same environment and interacting with them—or 'being there together'" (Schroeder, 2011, p. 4). Therefore, as Warburton (2009) observed, it is possible to conclude that a virtual world can provide "an experience set within a technological environment that gives the user a strong sense of being there" (p. 415).

Castronova (2002) advocated that although there are various types of VWs with their own idiosyncrasies, they all share three defining features worth discussing in a wider scope: (1) *interactivity*, (2) *physicality*, and (3) *persistence*. In order for a VW to be interactive, it has to support users with the possibility of interacting with the environment and other users. Moreover, as indicated by Ivory (2012), these interactions should have the potential to influence the world and the experiences of others. The main premise for the second feature of VWs, physicality, oscillates around rendering three-dimensional simulations of the environment that provide a first-person perspective for its users (Castronova, 2002). In general, the representation of the user in a VE is influenced by his/her viewpoint selection, which might be either *endogenous* or *exogenous* (Sutcliffe, 2003). The first refers to the user seeing the world through the avatar's field of view (FOV), also known as looking "through the eyes of [an] avatar" (Ivory, 2012). Accordingly, a user's FOV is limited only to the body part that would be normally visible, meaning when looking at that part. The exogenous viewpoint allows the user to see him/herself embodied as an avatar because he or she views him/herself from an external point, moderately above and behind the avatar (Ivory, 2012). In this way, the user can have a better view of the world and control the environment from the position of the avatar (see Appendix J: Figure 2). Another important aspect of VW's physicality is its attention to preserving and executing general natural laws (Newtonian physics) in the environment. Finally, the persistence of VW is reflected in its continuous existence and maintenance, meaning the environment does not disappear but retains all modifications made by others when the user goes offline (Castronova, 2002). A list of VWs' recurrent features is presented in Table 3.

Table 3

The Recurrent Features of Virtual Worlds. Adapted from: (a) Castronova (2002); (b) Smart, Cascio, and Paffendof (2007)

Feature	Description
Persistence	A continuous existence and maintenance of VW (Castronova, 2002).
Interactivity	The users can interact with the environment and with other users (Castronova, 2002).
Physicality	The user can have a first person perspective in VWs (Castronova, 2002). Similarities to the real world: topography, movement, and physics that provide the illusion of being there (Smart, Cascio, & Paffendof, 2007).
Body embodiment	The user can have his/her virtual representation—an avatar (Smart, Cascio, & Paffendof, 2007).
Immediacy of action	Interactions occur in real time (Smart, Cascio, & Paffendof, 2007).
Shared space	A shared space that allows multiple users to participate simultaneously (Smart, Cascio, & Paffendof, 2007).

McKeown (2007) proposed another way of classifying VWs based on their narrative approach and 3D representational system, as illustrated in Table 4.

Evolution of VR technology. The final catalyst in the development of MUVEs that should be briefly described is VR technology itself. Many areas of computational research (e.g., dynamic database, real-time operating systems, three dimensional modeling, and real-time graphics) have shaped VR technology (Barfield & Furness, 1995), and the main challenge in the designing of VR has been always grounded in the difficulty of selecting and integrating appropriate technologies across these research areas. When the Virtual Environment Operating Shell (VEOS) project began in 1990, the goal of which was to "provide a comprehensive and unified management facility for generation of interaction with, and maintenance of, virtual environments" (Barfield & Furness, 1995, p. 111), the possibility of being there together was significantly supported, predominantly by omnipresent research and system designs that correspond to VE technology.

Table 4

A Typology of 3D Virtual Worlds. Adapted from McKeown (2007)

Type	Definition	Examples	Representation
Flexible narrative	The world is a setting in the user's story or narrative unfolds within the constraints of the rules and goals set by the designers.	Games (MMPORGs) and serious games: *World of Warcraft*, *NeverWinter Nights*, *Ardcalloch*.	The user is a character in a role with a defined purpose.
Social world	The world may have elements of both a fictional and physical world and exists primarily as a place for social interactions to occur.	Social platforms, 3D chat rooms and virtual world generators: *Second Life, Metaplace, Habbo Hotel, Sims Online, vSide*	The user is an extension of him or herself (digital representation—an avatar).
Simulation	The world is a close representation of the physical world and governed by the same rules.	Simulations or reflections of the 'real': The Distributed Observer Network, Google Earth	The user is him or herself
Workspace	The world provides a virtual workplace setting for collaborative activity and often includes the necessary tools.	3D realization of Computer-Supported Collaborative Workspaces (CSCWs): *Project Wonderland, Olive, Open Croquet*	The user is him or herself

Moreover, as Schroeder (2011) discerned, "The possibility of putting two or more users within the same virtual world in the form of local networks was part of the development of VR systems from the start" (p. 12). For instance, VPL Research, Inc. manufactured and introduced the first commercially-available and integrated VR system called RB_2, an acronym for "Reality Built for Two" (Barfield & Furness, 1995). Jaron Lanier, a founder of VPL, while presenting his panel paper, "Virtual Environments and Interactivity: Windows to the Future," during the SIGGRAPH 89' conference and promoting RB_2 system, compared it to:

> an experience when you are dreaming of all possibilities being there, that anything can happen, and it is just an open world where your mind is the only limitation… The thing that I think is so exciting about virtual reality is that… it gives us this sense of being able to be who we are without limitation; for our imagination to become shared with other people. (Lanier et al., 1989, p. 8)

From a technical point of view, the RB_2 system was suitable to run on a Macintosh computer and its software was based on the coordination of three dimensional modeling, real-time stereo image generation on two silicon workstations, head and hand tracking devices, all dynamics and interactions on the Macintosh, and communication over an Ethernet connection (Barfield & Furness, 1995). In response to Lanier's affirmation about VPL's VR system, Woolley (1993), who participated in the conference and had the opportunity to use RB_2 during its demonstrational panel, shared his experience and reflected on the system: "I had experienced a crudely rendered, primary coloured series of badly coordinated images. I got none of the promised sensations or liberation or even disorientation, just frustration at the unresponsiveness of the equipment" (p. 14).

Insomuch as the obvious gap between what was actually experienced and what Lanier tried to convey metaphorically, this gap could not really be taken into consideration due to the state of technology at that time (Lister, 2003). At the same time, however, initiatives such as RB_2 pioneered the presence of VR systems in the marketplace and helped define many design issues, which could be further corrected and enhanced by the next systems (Barfield & Furness, 1995), including various display and interaction devices that had been implemented in MUVE technology.

Classification of MUVEs. As mentioned before, there are two types of MUVE systems that offer the user the possibility of being inside the VE and to interact with other users: (a) immersive VEs (allow users to share the same space) and nonimmersive VEs (allow a limited degree of interacting in the same space), and (b) videoconferencing ("talking heads"). Although a focus of this study surrounds VE technology, it is important to understand the similarities and differences between these two available systems as they afford different ways to construct interactive experiences and thus combine multiple information and communication technologies.

Technologically speaking, both types encapsulate the technologies of the previously mentioned CAVE-type systems and introduce less known technologies that allow people's real and full bodies to be captured and subsequently rendered in the form of holographic, 3D video images of real scenes (Schroeder, 2011). Furthermore, the current state of MUVEs' technological development offers the users a sense of being "there" and with the others, either in the form of (a) *computer-generated 3D environments* (with representations and scenes) or (b) *video 3D environments* that capture people and scenes (Schroeder, 2011).

Both systems support a co-location of users in the same VE, who apart from access to mediated communication can also experience various interactions with each other (Schroeder, 2011). In addition, the sense of presence in both systems is generally a sensory experience, mainly accommodated by visual and/or audio stimuli. However, they differ in terms of their "affordance," which reflects the way in which a particular environment is perceived and influenced. Table 5 presents the main differences between two MUVE systems.

Table 5

Classification of Multiuser Virtual Environments (MUVEs). Adapted from Schroeder (2011)

	Multiuser Virtual Environments (MUVEs)	
System:	**Immersive** & **Nonimmersive**	**Videoconferencing**
Technology:	Computer-Generated 3D Environments	Video 3D Environments
Based on:	→ Generation of user's representation (avatars) and virtual places.	→ Capturing the appearance of real users and real places.
Characteristics:	→ Ability to manipulate the environment that is not limited by realism. → Behaviors and representations (in the form of avatars) can be programmed. → The scenarios might be realistic, fantastical, and not constrained by the laws of physics.	→ The environment looks realistic and limited by this realism; therefore the realistic representation of things captured cannot be modified and/or altered.
Examples:	→Virtual Worlds	→ The Blue-C system (Gross et al., 2003), The Office in the Future project (Raskar et al., 1998)

The components of the user's experience in MUVEs. Schroeder (2011) asserted that the main difference between the experience of MUVEs and experience in the physical world is based on how and where the users can allocate their *attention*. In the physical world, attention can be focused on various levels of the user's own existence—from the stream of sensory inputs and outputs (hearing, seeing, touching, etc.) to cognitive functions (thinking, reflecting, abstracting). In the VEs, the scope of elements that the environment consists of and on which the users can focus their attention is much more limited. Roda (2011), who developed a theoretical and computational model for attention computing, argued,

> Attention plays an essential role in task performance and interaction. It enables us to act, reason, communicate, in physical or virtual environments that offer us stimuli exceeding, probably by several orders of magnitude, what we are actually capable of processing. Attention makes it possible for us to pursue goal without being distracted by the immense variety of available alternative stimuli and actions and undeniable mediates our interaction with the world. (p. 11)

Therefore, in order to understand the user's MUVE experience, it is important to explore the user's interactions with this environment (Roda, 2011). Notwithstanding, all attentional processes operate these interactions, "which guide the allocation of cognitive and physical resources, allowing one to both perceive the environment and act upon it" (Roda, 2011, p. 12). Accordingly, the way in which the user's attention allocated in VEs serves as "the proxy that both reveals and guides interactions" (Roda, 2011, p. 12; Roda & Thomas, 2006) that might be employed also to MUVEs. Taking this into consideration, in his analysis and examination of MUVEs, Schroeder (2011) identified three components of the VE experience: *place* (where), *task* (doing what?), and *interpersonal interaction and communication* (how engaged with others?). The author underlined also the importance of how the user's adaptation to VEs *changes over time*, and thus affects one's experience. As MUVEs significantly differ from other media, a brief overview of each component will be provided to explain the mechanisms that contribute to the construction of the user experience in VEs and how and where this experience diverges from those generated by the physical environment.

Place. The most important aspect of VE—either 3D-video environments or computer-generated environments—is a continuous engagement with the virtual place. Garau (2003) pointed out that "it is their inherent spatiality that sets CVEs [collaborative virtual environments] apart from other systems designed for collaboration with others" (p. 31). Correspondingly, Benford, Dourish, and Rodden (2000) called attention to the novelty of CVE's nature,

> CVEs are perhaps the most radical form of spatially oriented cooperative systems. Emerging from research into real-time graphics, virtual reality, and computationally shared workspaces, CVEs are virtual environments which can be simultaneously occupied by distributed individuals, who come together to achieve some collective activity as much as, in the everyday world, we gather to work in meeting rooms, in offices, in hallways, or around the coffee machine. (p. 1)

There are a few possible foci that may capture the user's attention in VEs. Firstly, "automatically—one is preoccupied with being in another place" (Schroeder, 2011, p. 46) and only a disruption known as a break in presence can interfere with the user's attention flow. According to Slater, Brogni, and Steed (2003),

> A participant in an immersive virtual environment (VE) is subject to two streams of sensory data, the first from the real world in which the experience is taking place, and the second from the virtual world displayed by the virtual reality system. A ‘break in presence’ (BIP) occurs when the participant stops responding to the virtual stream and instead responds to the real sensory stream. (p. 1)

Secondly, the focus on place can be strengthened when the user’s attention is centralized on the task or another person that is also present in the environment.

Task. Another important aspect of the way in which the user’s attention can be distributed involves tasks, which allow the user to act and perform in the VE. In their analysis of cyber-game addiction, Chou and Ting (2003) argued that when the user plays a computer game, she or he can be affected by five factors. Firstly, the user typically remains strongly focused on the game. Secondly, while playing, the user has a clear and well-defined agenda of goals that he or she seeks to fulfill. Thirdly, when dealing with obstacles or difficulties, the user usually receives immediate feedback from the environment to resolve these issues. Also, the user holds a strong sense of control over the environment and thus his or her actions. Finally, an altered duration of time can also be a part of the experience. The user can be involved in playing a video game to such a degree that he or she loses track of time and, as discussed earlier, the feeling of internal time consciousness (Husserl, 1964).

Consequently, as commented by Piwek (2008), such experiences might be seen as characteristics of the cognitive state known as the flow. In Csikszentmihalyi’s (2002) nomenclature, *the flow* can be defined as a “mental state of operation in which a person is fully immersed in what he or she is doing, characterized by a feeling of energized focus, full involvement, and success in the process of the activity" (Weibel et al., 2008, p. 2277). In accordance with Csikszentmihalyi's concept, Hoffman (2004) addressed the flow in his study of VR, underlining that "human attention has been linked to a spotlight, allowing us to select some information to process and to ignore everything else, because there is a limit to how many sources of information we can handle at one time" (p. 62). Hoffman attested to a positive correlation between spotlight attention and interactivity and argued that spotlight attention increases with the increased interactivity and richness of VEs (Piwek, 2008).

The user's attention in a VE can also be conceptualized in the context of physical presence. As Fontaine (1992) argued, the ability of a given medium to focus the user's attention serves as a central construct to foster the sense of physical presence. Taking this approach further, Witmer and Singer (1998) found that focused attention gives rudiments under a formation of two psychological states—involvement and immersion. Although more extensive and sophisticated analysis of immersion, involvement, and physical presence will be presented later, a brief discussion regarding these phenomena is needed due their direct influence on the user's experience in MUVEs.

Witmer and Singer (1998) defined involvement as "the psychological state experienced as consequence of focusing one's energy and attention on a coherent set of stimuli or meaningfully related activities and events" (p. 227). Tamborini and Skalski (2006) further asserted that involvement is "a form of internal mental vigilance characterized as being cognitively engrossed" (p. 229). Correspondingly, if the VE is coherent and the objects in the environment are well aligned with each other, the user's attention is focused on one meaningful set of stimuli (McGreevy, 1992). Moreover, the user's ability to apply his or her existing models to the objects and events that built this environment allows the user to try and make sense of the environment. Consequently, the user can experience a sense of physical presence (Wirth et al., 2007; Witmer & Singer, 1998). For example, the ability of a game to arrange objects and scenery, which are consistent and logically aligned with the user's expectations, can supplement and enhance the construction of a physical presence (Hoffman et al., 1998). In the context of games, Tamborini and Skalski (2006) noted that these games, which "offer dynamic content and meaningful plots consistent with models from a user's actual or virtual experience, should generate a continuous flow that facilitates involvement and subsequent spatial presence" (p. 229).

On the other hand, immersion reflects the ability of technology, with the quality of interaction with tasks (Stanton, 2009) and the VE, to control environmental stimuli and isolate users from other surrounding stimuli (Tamborini & Skalski, 2006). Importantly, in a VE, interaction is based on the communication between the user and the VE, meaning, "the capacity of detecting user…actions (user inputs) and refreshing the VE, according those inputs defines interaction" (Rebelo et al., 2011, p. 383). One of the main attributes of immersion manifests itself in the possibility of interacting with the environment and the user's sense of being embraced by the environment "that provides a continuous stream of stimuli" (Witmer & Signer, 1998, p. 227). VE can generate immersion to such a degree that the user might be isolated from his or her physical environment, which also helps to induce a sensation of being inside the environment and the possibility of interacting with and navigating the environment in a natural manner (Tamborini & Skalski, 2006).

Witmer and Signer (1998) underlined that whereas involvement can occur in almost any type of media, immersion is typical for these environments, which either isolate the user from the environment or generate “the perception of inclusion, natural interaction, and control” (Tamborini & Skalski, 2006, p. 229). In addition, although the catalysts responsible for involvement and immersion might be different, the levels of both, while experienced in the VE, are interdependent, meaning with an increasing level of involvement; the user might experience a higher level of immersion (Witmer & Signer, 1998). Therefore, the sense of physical presence might be seen as a conjugation of factors that affect immersion as well as involvement (Rebelo et al., 2011).

For instance, spatial tasks, the most common type of tasks in VEs (Schroeder, 2011) can be further examined in relation to the user’s activity in the VE. The spatial tasks induce the possibility of modifying and monitoring the environment and thus demand continuous and self-conscious attention from the user. For instance, determination of the avatar’s orientation and/or all objects rendered by the environment, the ability to manage all possible sensory inputs, and using the interface to provide these inputs in the first place require the user’s constant attention.

Interpersonal interaction and communication. While place and task belong to the general classification of VE experience, interpersonal interaction and communication directly apply to shared VEs like MUVEs. Schroeder (2011) emphasized that sustaining awareness involves a multitude of constant and attention-demanding efforts. Specifically, “holding the other in the visual and auditory field” (p. 47) is one of the most important aspects in determining if the user is alone in the environment or shares it with others. Swinth and Blascovich (2002) commented that with a VE, “a greater variety of verbal, non-verbal, and contextual social information can be conveyed" as a result of "its immersive, interactive nature and its ability to render both auditory and visual signals" (p. 237). Accordingly, the user's attention might be enriched by implementation of VE's communicative bandwidth and engagement of communication and interaction with others, which further can help foster the VE experience.

Since VEs do not offer the same audio signals and/or peripheral awareness of bodies available in the physical environment, the user is more "sensitive" to any visuals that the environment generates. During a face-to-face conversation, "people exchange conversational turns by looking away, voice tone, small gaps in speech and explicit discourse acts to elicit a response" (Sutcliffe, 2003, p. 159). In VEs, the user can employ his or her field of vision for constant detection of visuals that resemble humans (avatars). Garau (2003) asserted that one of the main advantages of VEs, in contrast to other media, "is that participants' embodiments can be seen in spatial relation to each other and to the objects they are interacting with" (p. 33). In contrast to MUDs, where the participants' presence can be signaled by room listings or text-based messages, in CVEs, the avatar holds potential to articulate the participant's presence in the form of a graphical representation. According to Taylor (2002), "The avatar as a body is woven into the structure of life in these worlds. It is through embodied practice that selves and social life are grounded in multi-user spaces" (p. 60). In addition, while monitoring the environment, the user can also focus on any gestures that another user—through control over his or her avatar—might send. The user's avatar can be operated using simple controls (usually part of the VE's interface) for a full presence representation with typed text. For example in *Second Life*, another user might signal his or her willingness to communicate or that she or he is already sending a message through a visual gesture of typing on a keyboard. In other words, the user's avatar will “perform” a visual gesture of typing while preparing the communication. In addition, users who participate in the communication exchange can signal their attention to each other by adding small utterances to dialogue (e.g., “yep,” “OK,” “aha”), which indicate a wish to continue the conversation (Sutcliffe, 2003).

Secondly, the user concentrates his or her attention on any possible audio signals that might be sent by others. For instance, the sound of “typing” signals that a conversation is taking place between other users, and because of the spatial location of the user’s avatar, he or she can “hear” (although it is a text communication) this conversation and thus join. Also, apart from a text-based communication, many VEs allow voice communication, which more strongly articulates the presence of others within the range of the user. A more detailed discussion on communication in SL is provided later.

Finally, apart from communication clues, which help to interact and focus on others, the user needs to be self-conscious of his or her movement in relation to others (proximity) and the environment. In reality, people usually prefer an interpersonal distance of approximately 0.5 to 1 m (Sutcliffe, 2003). Hook and Dahlback (1992) demonstrated that personal space is projected onto artificial persons, and people do not like when their personal virtual space is invaded. Therefore, the user should be aware to not approach others too closely or rapidly because others might interpret these sudden movements as a threat (Sutcliffe, 2003). Schroeder (2011) also underlined the importance of this spatial-awareness, stating, “one does not want to cause embarrassment by walking through [others]” or “encroach on the other’s space while at the same wanting to be in their (others) field of awareness” (p. 48).

Changes over time. The focus of attention in VEs not only shifts over time but also when the user becomes more acclimatized with the environment. Schroeder (2011) distinguished three phases that describe the way in which the user's adaptation to the VE can migrate: (1) *short term*, reflected in the first minutes while entering the VE (novelty and excitement of experience); (2) *medium term*, the user accustoms him or herself to what he or she should focus and concentrate on; and (3) *long term*, full adaptation to the VE and the ability to ignore the physical environment, except for breaks in presence (BIP), as discussed earlier.

MUVE: Second Life. As underlined previously, VWs are designated by their use of Internet networking, which provides persistent, open-ended, and shared three-dimensional environments. The users of these spaces can interact with each other and control some aspects of their virtual participation. SL in particular received special attention as one of the most prominent and celebrated "social" virtual worlds (Malaby, 2009). As noted by Johnson (2010),

> *Second Life* is a digital culture that competes increasingly with real life media and society and challenges the way we participate in media making and all forms of mediated entertainment… *Second Life* provides an alternate space of communication within a mediated environment, one that nearly mirrors the real world in almost every way. (p. XII)

Overview. SL is a three dimensional, multiuser virtual world, launched by Linden Lab, the designer and creator of operating systems (viewer) for SL, in 2003. In contrast to many other VWs (e.g., *Everquest* or *World of Warcraft*), SL is characterized by the lack of universal objectives (Malaby, 2009). Ivory (2012) offered the following comments on this characteristic:

> While most virtual worlds provided game environments with clear play mechanics, general plotlines, and overreaching objectives, the environment provided by *Second Life* included very little content and infrastructure and instead allowed its users to interact with each other and environment with whatever objective they choose. (p. 12)

In other words, the user (resident) is given a model of a VE where content is almost fully created by other SL residents. This world is built from digital representations of the users, called *avatars*, which resemble their creators (mostly in physical terms of appearance), and *prims*, which are objects ranging from everyday things in the physical world to objects created in the user's mind. The users can control almost every aspect of their existence, from the shape of their avatars to the design of houses and spend their free time with the groups to which they belong. Accordingly, apart from its remarkable growth (at the time of this study, October 2012, 31,116,236 users have created SL accounts), SL provides its users with in world "tools" that support the creation of interactive objects and other content to which they own the intellectual property rights (Malaby, 2009). Therefore, the users hold the right to control how their creations are distributed to the other users, including attributes to modify, copy, or sell through the official SL market transactions using in-world currency—Linden dollars (US$ 1= L$ 248).

The deliberate existence in SL is available using free software that stimulates perceptions and experiences and allows user participation. Moreover, Linden Lab recognized the importance of media and their potential in reconfiguring the users' possible actions while entering SL, thus providing distinct affordances for SL users who can experience their presence and see the products of their imagination in the form of images, videos, and sounds.

Communication and technology. More than 40 years of network games and digital worlds have shown that many tools implemented in SL have been borrowed from earlier technologies; these include text, hyperlinks, and graphical simulation (application of OpenGL). Nova Spivack, a pioneer of semantic solutions in the technology of communication and founder of Networks Radar (Spivack, 2007), suggested using the term *Web 3.0* to classify tools that also appear in the VW of SL.

The technology of VWs represents an example of electronic space in which users can create and cooperate, communicate, and have mutual interactions with avatars in a three-dimensional space. This is similar to many fields in the contemporary world as well: spending free time (gaming and socialization), business projects (Toyota, IBM, Dell), or social and educational cooperation. It is important to underline that the communication in the SL environment is being generated in joined, synchronous places, with users distant from each other and represented through the electronic representation of their avatars.

SL's platform offers a few methods of communication for its users (see Appendix J: Figure 3). The interface in SL allows synchronous and asynchronous communication. Irrespective of distance, the exchange of information occurs fluidly and actively in real time (RT). On the left side of the screen, a description of how text can be used during a chat conversation is presented. Users can employ the communications window, which (1) offers a personal IM among chosen participants of the session (a) or in the form of group chat with all users logged in at that time and belonging to a particular group (b). It is an example of synchronous transport of agents with different locations in electronic space (simulator). In the same temporary allocation, the participant can lead a synchronous conversation with others (avatars or embodied agents) in the same space—normal distance for a text chat has a range of 20m, shouted 100m, and whispered 10m (2). Moreover, users can use notecards, resembling e-mail (3), to send textual information as well as attachments such as pictures and hyperlinks. Sending a group notification is a popular method of announcing events (4), a function located on the upper-right corner of the application window. Additionally, irrespective of the mode of presence (online or offline) of an individual or group, the notecard and group notification are written and saved automatically; participants will receive it the moment they login. This feature demonstrates the power of the semiotic solution used in this environment.

The fastest-growing form of communication in SL is realistic voice chat (5) among participants (technology of Voice-Over-Internet Protocol, VOIP), which features a 3D-mapped voice with audio focusing and speech gestures (Linden, 2007). For example, when the receiver moves around the sender, his or her voice will also "move" in 3D, meaning when the receiver changes his or her distance from the sender, the voice becomes either louder (when the receiver moves closer to the sender) or quieter (when the receiver moves away from the sender). Another important aspect of voice chat is that since the volume of each speaker (used by the user) can be attenuated from the user's camera position in SL, the camera controls can be used to create audio focus on a given speaker (Boulos et al., 2007). Finally, speech gestures, which "are customizable head, arm/hand and body movements, that animate an avatar while speaking, and are triggered by different speech intensity levels" (Boulos et al., 2007, p. 234), can also increase the believability of CMC in SL. Using voice chat allows for fully synchronous vocal conferencing among participants. Additionally, these conferences can be held on private or public channels. It is a helpful option during lectures, business meetings, or live musical concerts; it becomes a modern form of expression and source for podcasts.

Logistically speaking, SL uses the rules of global topology from real life. The principles of free fall and passage (awareness) of time are preserved: The sun rises and sets according to Pacific Daylight Time (PDT). The system's platform is founded on a grid of computers, each one simulating about 64, 750 m2 of land as well as the aerospace above it. Additionally, to increase the semiotics of nature, one finds the implications of Navier-Stokes equations, which grant full visualization for all participants at the same time and includes streaming media. Moreover, every server (part of grid) is connected with edges to four others, which allows it to insert 3D objects (present and generated to all participants at the same time). Everything is done to create a *metaverse*— fully immersive, three-dimensional space where the user can interact with the environment and others.

Interactivity

General overview. The concept of *interactivity* is not a new phenomenon and has been investigated from the perspective of human communication as well as from various types of technological systems. Moreover, one can encounter the term interactivity while differentiating traditional and innovative media as an explanatory construct (Rafaeli & Ariel, 2007). Unfortunately, as noticed by Gane and Beer (2008), "Interactivity is a concept that tends to be used to bypass descriptions of the workings of media technologies, and as result all too often escapes sustained analytical and critical attention" (p. 97).

Furthermore, despite the absence of ultimate constructs of interactivity, Stephanidis et al. (2012) proposed two dominant views that can be taken into consideration while approaching the conceptualization of the interactivity: (a) the expansion of technology and (b) the social impact of technology.

Firstly, an accelerating development of technology has contributed to new ways in which an average person can utilize technology. Kovalchick and Dawson (2004) emphasized that “technology and communication theory are explicitly linked in numerous ways” (p. 133), and as endorsement of technology increases in daily life, it is important to investigate which innovations are adopted by their users and how these innovations might work as methods of communication.

Secondly, “the social impact of these technologies” (Stephanidis et al., 2012, p. 1374) has an enormous influence on the users of these technologies. Specifically, with increasing access to communication technologies, one can observe an emerging new landscape for the user’s experience. In consequence, “not only these powerful tools of transformation inform and influence humanity’s understanding of itself, they can also aid in the evolution of society by inspiring visions, disseminating information, and catalyzing actions” (Glenn et al., 2011, p. 61).

At the same moment, however, as noticed by Rafaeli and Ariel (2007), an examination of interactivity should not only be restricted to an analysis of interactivity from the perspective of computerized and new media technologies. Furthermore, they asserted that such an approach presents problems in comparison with traditional media. The researchers cautioned: “If we study only ‘new media,’ we are constrained in our ability to build a cumulative theory based on evidence, because the domain of ‘New Media” itself changes rapidly” (2007, p. 71).

Therefore, the main objectives of this section are to understand the concept of interactivity and to highlight the primary development of interactivity’s conceptualization, including the ways in which interactivity has evolved in domains of human communication and human-computer interaction (HCI). Equally important to discuss is an extension of interaction and how it contributes to the creation of new, interactive experiences. Finally, in the light of VE technology, theoretical perspectives on the concept of physical and social presence and their role in generating interactive experiences will be further examined.

Taxonomy of terminology. One of the most difficult challenges in defining the term interactivity is grounded in the fact that scholars from opposite sides of the research spectrum (e.g., communication research, linguistics, semiotics, philosophy, informatics, and computer science) implement the term using various approaches and methodological practices (Bucy, 2004a; Johnson, Bruner II, & Kumar, 2006; Rafaeli & Ariel, 2007).

Communication researchers understand interactivity, which originated from *social interaction* in sociology and social psychology (Goffman, 1963), as being involved in the process of communication between two persons and “the degree to which participants in a communication process have control over, and can exchange roles in, their mutual discourse” (Williams, Rice, & Rogers, 1988, p. 10). As advocated by Murschetz (2011),

> communication theory sees the interaction as mutually interdependent social action between individuals who exchange symbols and meaning in the communication process which itself is supposed to be sequential, that is actions of one person result in reactions of another person. (p. 389)

From the sociological perspective, the interaction involves the mutual orientation of different people in a social context and thus in relationships between people (Vorderer, 2000). Taking this approach further, the interaction is different from a regular action, which is based on the premise that when a person interacts, she or he always aims toward others (Vorderer, 2000). In other words, during the interaction, one keeps in mind that she or he might be perceived by another person or can perceive oneself. Therefore, interaction serves as a principal form of the social action, a form that is guided by the presence of others (Jaeckel, 1995; Weber, 1984). The deeper examination of the social interaction will be devoted in the later portion of the study while discussing the concept of social presence.

Taking a communication's perspective on interactivity, Murschetz (2011) observed, "This type of non-computer-based or reciprocal interaction between humans has been adopting significantly contradictory meaning within competing scientific discourses" (p. 389). Accordingly, the scientists in HCI research advocate that interactivity "refers to the ability of users to communicate directly with the computer and to have a consequential impact on whatever message is being created" (Dillon & Leonard, 1998, p. 144). This definition of interactivity designates the software, which accepts and responds to inputs from humans in an interactive human-computer dialogue. Moreover, the interactivity is understood as interaction between humans, the computer, and the human-technology interfaces (McMillan, 2002) and possible relationships between all three (Murschetz, 2011).

As attentively observed by Murschetz (2011), HCI is a multiparadigmatic discipline and has a rather extensive perspective on the concept of interactivity. Inasmuch as a more detailed analysis of the HCI literature devoted to interactivity is beyond the scope of this study, Hewett (1992) claimed that interface hardware and software architecture, computer graphics, dialogue architecture, and design might be taken into consideration as a focal lens for technological aspects of HCI in the discussion about interactivity (Murschetz, 2011). Table 6 exemplifies studies in which some conceptualizations of interactivity have been further examined, some of which will be discussed in the following section.

Theoretical frameworks on interactivity. Bucy and Tao (2007) claimed that an enduring question and major inconsistency in the interactivity research relates to the question of how to most effectively isolate the concept for systematic investigation. Researchers asserted that various definitions and multidimensional models have been proposed by interactivity researchers; however, the current approaches seem to either mix the functional characteristics of media technologies, a process-related variable (in the message exchange), and user perceptions into a single multidimensional construct or identify one of these factors as the central locus of interactivity. Bucy and Tao (2007) further emphasized that uncertainty over the conceptual definition of interactivity arises from the lack of shared agreement about the concept's unit of measure.

Therefore, in his analysis of the ways in which the concept of interactivity has been described, Rafaeli and Ariel (2007) identified three "qualitatively distinct literature-based frameworks" in which interactivity is defined either as *an invariable medium characteristic* (technology), *a process related variable* (communication), or *a perception-related variable* (the user). Moreover, while investigating previous attempts to divide interactivity into categories and/or the topology of its components, Rafaeli and Ariel (2007) concluded that while addressing interactivity, these frameworks might belong to one or more of the four categories. The first group, *the user to user,* discusses the interpersonal communicative dimension of the interactivity and consists of the following terminological alternatives: user to users, person-to-person, and human-to-human. Accordingly, the more communication in a computer-mediated environment that reflects human interpersonal communication, the more “interactive” such an environment is (Ha & James, 1998). When discussing the Internet, Stephanidis et al. (2012) pointed out that users no longer have to occupy the same spatial and temporal space. For example, Flaherty, Pearce, and Rubin (1998) emphasized the fact that CMC and face-to-face communication (F2F) are no longer functional alternatives since “each has distinctive characteristics and addresses different needs” (Stephanidis et al., 2012, p. 1377).

Table 6

The Conceptualization of Interactivity across Social Disciplines and HCI.

Conceptualization:	Studies:
Bandwidth	Burke & Chidambaram (1999)
Choice variety	Ha & James (1998); Liu (2003)
Connectedness	Ha & James (1998)
Control	Coyle & Thorson (2001); Dholakia et al. (2000); Jensen (1998); Lieb (1998); Liu (2003); Lombard & Snyder-Dutch (2001); Neuman (1991); Rogers (1995); Sicilia et al. (2005); Shin (1998); Steuer (1992); Stromer-Galley & Foot (2002); Sundar (2004)
Customization	Holland & Baker (2001)
Directionality	Markus (1990); McMillian & Downes (2000); Van Dijk (1999)
Experience	Bucy (2004a; 2004b); Burgoon et al. (2000); Wu (2000)
Hypertextuality	Amichai-Hamburger et al. (2004); Sundar et al. (2003)
Participation	Dyson (1993)
Rapidity and speed	Lombard & Ditton (1997); Novak et al. (2000); Zeltzer (1992)
Responsiveness	Alba et al. (1997); Heeter (1989); Miles (1992); Rafaeli (1988); Rafaeli & Sudweeks (1997); Stewart & Pavlou (2002); Sundar et al. (2003); Wu (1999)
Speed of response:	
→ Timeliness	Hanssen & Jankowski & Etienne (1996)
→ Synchronicity	Burgoon et al. (2000); Dennis & Valachich (1999); Dennis & Fuller, & Valachich (2008)
Symmetry	Grunig & Grunig (1989)
Synchronicity	Kiousis (1999); Liu (2003); Liu & Shrum (2002); Mundorf & Bryant (2002); Van Dijak (1999)
Alternatives:	
→ Machine interactivity	Sicilia et al. (2005)
→ Real-time interaction	Dholakia et al. (2000)
→ No delay	McMillan & Hwang (2002)
Two-way communication	Rogers (1995)
Alternatives:	
→ Direction of communication	McMillan (2002); McMillan & Hwang (2002)
→ Reciprocity	Huang (2003)
→ Reciprocal communication	Ha & James (1998)
→ Bi-directionality	Yoo, Lee, & Park (2010)

The next group, *the user to medium* (or human to machine, and the user to system), considers the interaction between a human and the 'machine' (meaning any type of new media system) the main locus of interactivity research. For example Jensen's (1998) claim about interactivity, which reflects "a measure of a media's potential ability to let the user exert and influence…on the mediated communication" (p. 201), might be taken into consideration while addressing this category. Classification of interactivity as the user to system was the focus of early definitions of interactivity that highlighted the importance of human interaction with a machine (specifically speaking, computers) and the machine's responsiveness to the user's actions. As underlined earlier, the interactivity was seen in terms of inputs and outputs, for example, the number of "point-and-click" possibilities on the computer screen (Shneiderman, 1998). Norman (1998) advocated, "The interactive process is a repeated loop of decision sequences of a user's action and the environment's reaction" (quoted in Stephanidis et al., 2012, p. 1377).

The third group, *the user to the content* (or the user to document or the user to message), encapsulates the distinction between the user and media interaction (Bezjian-Avery at el., 1998; Schultz, 2000; Williams & Rice & Rogers, 1988) and interprets the interactivity as the ability of the user to control and modify messages (Steuer, 1992). In contrast to traditional media, new media redefine the ways in which messages are received and sent. For instance, the Internet opens the possibility of customizing and personalizing the needs of its users. According to Liu and Shrum (2002) interactivity might be defined as "the degree to which two or more communication parties can act on each other, on the communication medium and on the messages and the degree to which such influences are synchronized" (Rafaeli & Ariel, 2007, p. 73).

Finally, the fourth dyad, *the medium/agent to medium/agent*, examines interactivity as "compatible and conductive for non-human actors" (Rafaeli & Ariel, 2007). This distinction is particularly important while investigating machine-generated messages, synthetic actors, or AI agents (like bots) that mimic a human response. Also, the outcomes that encounters with non-human participants might bring to the discourse about interactivity (especially from a communication's perspective) are acknowledged as the research objective.

Interactivity as invariable medium characteristic. The first literary framework concerning interactivity examines the function of features and emphasizes the technological attributes of a given medium/technology. Supporters (Ahern & Stromer-Galley, 2000; Durlak, 1987; Heeter, 1989; Massey & Levy, 1999; Sundar et al., 1998) of this approach believe that the technological attributes of a given medium have the potential for activity generation.

The core element of this approach recognizes the interaction between the user and the medium as the most elementary form of interactivity. As asserted by Murschetz (2011), this perspective is grounded in the tradition of HCI research (Baecker & Buxton, 1987; Carroll, 2009; Landay & Myers, 1995; Nielsen, 2010; Rosson & Carroll, 2002; Shneiderman & Plaisant, 2010).

Steuer (1992) applied interactivity as a characteristic of the medium and addressed its relation to *sense of presence* in VEs. According to Steuer (1992), presence is the subjective experience "in an environment by means of a communication medium" (p. 76). Steuer (1992) examined the human experience of presence in conjunction with the technological variables of *vividness* and *interactivity* that predestine the extent of the experienced presence (Schorr et al., 2003). Vividness designates the ability of a technology to produce a sensory-rich mediated environment. Interactivity, on the other hand, refers to "the extent to which users can participate in modifying the form and content of a mediated environment in real time" (p. 84). The subjective aspect of technology, such as the experience of presence, is part of interactivity, whereas vividness reflects the objective dimensions of technology (Schorr et al., 2003). Roehm and Haughtvedt (1999) emphasized that interactivity allows "consumers to participate in the formation of the content of the communication and its presentation (p. 32).

According to Steuer (1992), this "extent" might be further analyzed by three components of interactivity—*speed*, *range*, and *mapping*. Speed "refers to the rate at which input can be assimilated into the mediated environment" (Steuer, 1992, p. 85) and epitomizes the level of the system's responsiveness to the user's actions (Stephanidis et al., 2012). The second element, range in Steuer's (1992) nomenclature, "refers to the number of possibilities for action at any given time" (p. 86) and can be understood in terms of manipulations that the user can perform in the mediated environment such as *intensity* (brightness of the graphics/video, loudness of the audio), *spatial organization* (where objects [in MUVEs known as 'prims'] are located and/or appear), and *temporal ordering* (Stephanidis et al., 2012). The final construct of interactivity, mapping, "which refers to the ability of a system to map its controls to changes in the mediated environment in a natural and predictable manner" (Steuer, 1992, p. 86) is also crucial for a generation of *sense of telepresence.* Respectively, mapping is defined as the fidelity of actions required to manipulate simulated environments to the "natural" actions that are executed in the physical environment. Thus, mapping connects actions from outside the mediated environment (real environment) to the action performed inside the mediated environment (Norman, 1986;

1998). All three components are technological elements and help to classify old and new media according to their level of interactivity, which is grounded in how speed, range, and mapping are supported by particular media.

One growing area in studies on interactivity as a characteristic of a medium centers on the Internet. Some of the functional features that might be listed for this research include hyperlinks, all possible downloads, chat rooms, email links, and search engines (Rafaeli & Ariel, 2007). Therefore, the role of these features in generating a platform that allows users to communicate and engage, manipulate, and influence the content serves as the unit of measure for interactivity and the method through which to operationalize the interactivity (Rafaeli & Ariel, 2007).

At the same moment, however, the significant limitation of this approach is related to the premise that many researchers concentrated on developing typologies of interactivity and proposed new dimensions to classify a wide range of new media. Yet, they failed to explain how specific attributes/features make one technology more interactive than another.

For example, a significant number of early researchers devoted to the examination of websites overlooked the effects of user engagement with technological attributes or users' motivations to engage in interactive behaviors in the first place. Moreover, with the exception of experimental researchers who controlled the media stimulus of a presentation or display (Bucy & Tao, 2007; Eveland & Dunwoody, 2001; Sundar, Kalyanaraman, & Brown, 2003), researchers have not shown interest in tracking which interactive attributes have actually been used. Accordingly, Heeter (1989) proposed a six-dimensional model of interactivity in new media: (a) *complexity of available choice*, which reflects the amount of choices that are available for the user; (b) *the amount of the effort that has to be exert in order to access information*; (c) *responsiveness of the medium*; (d) *information use monitoring*, meaning how the selection of information might be monitored among users; (e) *ease of adding information*—the level of customization of information by users for the others; and (f) *facilitation of interpersonal communication*, which further can be divided into two subcategories, *asynchronous* communication and *synchronous* communication (Stephanidis et al., 2012).

Despite the fact that all these scholars effectively taxonomized the type of interactivity available in a given mediated communication medium, they failed to go beyond initial classification via empirical testing and theory building (Bucy & Tao, 2007). The main conclusion that can be drawn from these studies is that, while investigating the relationship between technological attributes and media effects, researchers have embraced a conceptual model that views interactive features as the independent variable and media effects as the dependent variable (Bucy & Tao, 2007).

Moreover, although the level of interactivity in these studies is generally associated with objectivity and its effects, which are essentially uniform across users, interactive attributes can have differential effects (McMillan, 2002). Thus, it might be reasonable to argue that dependent variables are not a direct function of the independent variable (level of interactivity) in a discussion about the interactivity as an invariable medium characteristic. Instead, it is possible that a third variable might mediate or moderate the relationship between the independent and dependent variables. For example, Tremayne and Dunwoody (2001) reported that the relationship between interactivity (the number of links) and elaboration (knowledge acquisition) varies at different levels of the Web experience. Moreover, on the low-interactivity website, moderate users experienced a lower degree of elaboration than beginner users.

In another study on the relationship between interactivity (number of hyperlinks + email's function) and its manipulation on political websites, Sundar, Kalyanaraman, and Brown (2003) concluded that users' perceptions of interactivity were positively associated with the amount of hyperlinks a website offered. However, the level of web experience and individual differences among the users (like for example a degree of apathy) may vary and thus influence the relationship between interactivity and media effects (Bucy & Tao, 2007). Therefore, the relationship between interactivity and impression formation (in the context of political candidates) might be nonlinear, meaning that the users in the medium-interactivity condition gave a more favorable evaluation than users in the high-interactivity condition.

Bucy (2004b) argued that the presumed benefits of interactivity increase to a point. However, once the optimal level of engagement is achieved, its intensity overwhelms users. Thus, too much interactivity might have a negative influence on performance, impression, and interest (Bucy & Tao, 2007). In his investigation on how interactive and noninteractive tasks on websites influence user evaluations, Bucy (2004b) found that interactive conditions might offer more positive responses, but at the same time, can add "a certain degree of confusion, frustration, and disorientation" (Bucy & Tao, 2007, p. 652). Bucy (2004b) defined such a situation as the *interactivity paradox*.

In conclusion, the conceptual model implied by the structural approach does not address the question of how nonlinear patterns during an interactive experience with particular technological features emerge; consequently, it omits the possible influence of a third variable, such as the level of expertise in navigating or using a particular medium. In addition, this model ignores the mediating role of individual differences across users. Without modification, the structural model cannot accurately explain how interactivity works or predict what interactivity does.

Interactivity as a process related variable. In their study on interactivity, Rafaeli and Sudweeks (1997) suggested that message exchanges between two or more communicants serves as the unit's interactivity measurement. They operationalized interactivity as semantic relatedness and stated, "Interactivity is not a characteristic of the medium. It is a process-related construct about communication" (Rafaeli & Sudweeks, 1997, p. 3). According to the researchers, "Interactivity is an expression of the extent that is a given series of communication exchanges, any third (or later) transmission (or messages) is related to the degree to which previous exchanges referred to even earlier transmission" (p. 14). Kiousis (2002) defined this characteristic as *third-order dependency.* The messages provide not only the evidence for interactivity, which involves a series of actions represented by a message's exchange, but also "the manner in which previous messages were reactive. In this manner, interactivity forms a social reality," and "actual social actions and relations are transacted through observable behaviors, the exchange of messages" (Rafaeli & Sudweeks, 1997, para. 8). Unfortunately, as pointed out by Bucy and Tao (2007), "Rafaeli never offers a concrete example of what he considers an interactive message to be" (p. 650), and due to a lack of empirical research, the exchange of message does not equal the exchange of meaning.

Another essential construct that underlines the dimension of interactivity as a process-related variable includes the concept of reciprocal communication. Reciprocity supports the interaction by allowing a two-way flow of information, accommodates the sequential exchange of information, and provides a channel for exercising control (Rafaeli & Sudweeks, 1997).

At the same time, interactivity is assumed to be a behaviorally-oriented entity that involves a series of actions that are reflected by message exchanges, but because the framework of interactivity as a process-related variable is based on an untested hypothesis that states the exchange of messages equals the exchange of meaning, it generally omits media effects, thus making this approach incomplete (Bucy & Tao, 2007).

Interactivity as a perception-related variable. As exemplified by Rafaeli and Ariel (2007), the third approach considers interactivity as a perception-related variable. This approach uses the user's perception as the unit of measure for interactivity. Therefore, the degree of interactivity, which is presumed to have a variable effect, is reflected in the extent to which the user subjectively experiences interactivity. As Murschetz (2011) asserted that interactivity "refers back to action and, in the social sciences, whereby action is presupposed to depend on an active human subject intentionally acting upon an object or another subject" (p. 391). From a practical point of view, any interaction with objects and with the creators of these objects contributes to the modification of these actions and reactions (Murschetz, 2011).

This framework was derived from media studies of television that show that even a medium without interactive attributes can elicit a sense of interactivity through one-sided techniques employed in interpersonal communication, such as the presenter's nonverbal expressions or talents. For example, Bucy and Newhagen (1999) found that close-ups with a single actor (political candidate) on the screen induced a higher level of interactivity than medium or long shots with multiple actors on the stage. To a significant degree, it echoed the conclusions of Harton and Wohl (1956), who argued that such “production techniques” might prompt the experience of *para-social interaction* of the viewer’s illusion of social intimacy with a media persona. The researchers further stated, “We propose to call this seeming face-to-face relationship between spectator and performer a para-social relationship” (Harton & Wohl, 1956, p. 215). In other words, para-social interaction takes place when the individual interacts with persona or representations of the content in a given medium (Rafaeli & Ariel, 2007).

Some researchers (McMillan & Downes, 2000; Vorderer, 2000; Wu, 1999) in regard to para-social interaction commented that the user could perceive the interaction as real even though it might not be an interaction at all. Furthermore, recent studies have developed the concept of *perceived interactivity* with multiple dimensions. Wu (1999) asserted that perceived interactivity is “a two-component construct consisting of navigation and responsiveness” (as cited in Bucy & Tao, 2007, p. 654). The first dimension, *perceived responsiveness,* reflects “the perception of the system’s ability to react to user input” (Quiring, 2009, p. 902). The *perceived navigation* describes the navigation options offered by the system.

Therefore, it is important to note that users’ perceptions are different from each other and cannot be generalized into a single entity. Kiousis’s (2002) operational definition of interactivity refers to four indicators: (a) *proximity*, meaning the social nearness to others; (b) *sensory activation*; (c) *perceived speed*; and (d) *telepresence*. McQuail (2010), in regard to Kiousis’s definition, elucidated that the perception of the user is more influential than, for example, “any intrinsic or objective medium quality” (p. 145).

Another group of researchers, Burgoon et al. (2000), viewed interactivity as a construct that consists of three dimensions: (a) *interaction involvement*, "the degrees to which users perceive they are cognitively, affectively, and behaviorally engaged in the interaction" (p. 36); (b) *mutuality*, "the extent to which users perceive and create a sense of relational connection" (p. 36); and (c) *individuation*, "the extents to which users perceive they have a rich, detailed impression of the other's identity and personalized information" (p. 36). Burgoon et al. (2000) based their conceptualization of interactivity on the qualitative experiences that users equate with interactivity. In conjunction with Burgoon et al. (2000), Thorson and Rodgers (2006) defined perceived interactivity "as the extent to which users perceive their experience as a simulation of interpersonal interaction and sense they are in the presence of a social other".

Ha and James (1998), in their examination of business websites, concluded by defining interactivity "in terms of the extent to which the communicator and the audience respond to, or are willing to facilitate each other's" (p. 461) communication needs. They outlined five dimensions of interactivity: (a) *playfulness*, which highlights the experience of entertainment by the audience; (b) *choice*, meaning the availability of choice and unrestricted navigation in the mediated environment; (c) *connectedness* (in Kiousis's (2002) approach known as proximity), which,

> For sites visitors, hypertext in website can create a feeling of connectedness to the world by allowing the visitors to jump with little effort, from one point in cyberspace to another… Such connectedness is the feeling of being able to link to the outside world and to broaden one's experience easily. (Ha & James, 1998, p. 462);

(d) *information collection*, meaning the information that the site-owner creator/owner systematically collects and updates about his/her visitors and users; and (e) *reciprocal communication* between the site users/visitors and the website owner/creator, which, accordingly, improves the quality of service provided by the website.

Another interview-based study conducted by McMillian and Downes (2000) sees interactivity as a multidimensional construct that combines both frameworks of interactivity—as a process-related variable and a perception-related variable. Three message-based dimensions of interactivity are (a) *direction of communication*, which allows all users to communicate; (b) *time flexibility*, which reflects the possibility to meet the time demands of all users; and (c) *sense of place* in the communication environment. Importantly, the construct of sense of place has a close connection to the presence or social presence concept (Lee, 2004; Short et al., 1976). Three user-based dimensions of interactivity are (a) *level of control of the communication environment*, in other words, the perception that users have a high level of control over the communication environment; (b) *responsiveness* in the process of communication; and (c) *perceived purpose of communication*, the users perceive that the goal of communication is oriented toward the exchange of information and not an attempt to persuade. Overall, McMillian and Downes (2000) identified six main constructs of interactivity.

McMillan and Hwang (2002) established a scale-development exercise that generated three-dimensional perceived interactivity, which includes the following factors: real-time conversation, no delay, and engagement. Further, Liu (2003) emphasized the importance of achieving controlled, two-way communication and synchronicity as major factors that foster perceived interactivity in mediated experiences. O'Keefe (2003) argued that effect-based variable definitions, such as vividness, fear, and quality, examine the relationship between psychological states and media effects, but overlook individual differences and media attributes.

Unfortunately, the perceptual approach also has a few limitations. As noted by Rafaeli and Ariel (2007):

> The paradox is that even when research defines interactivity in a particular setting as high or low, users can subjectively have different feelings, experiences, or perceptions of interactivity of different levels or intensity. Therefore, subjective and objective interactivity might diverge and could confound study. (p. 82)

In other words, the framework of interactivity as a perception-related variable assumes that perceived interactivity is the independent variable and media effects is the dependent variable; however, it fails to acknowledge that functional characteristics of information technology system/medium are required to evoke a sense of perceived interactivity and should therefore be included in this framework as the independent variable. In addition, this model neglects the relationship between technological attributes and perceived interactivity.

Summary. McMillan and Hwang (2002) stated, “Interactivity has been positioned conceptually as a process, a function, and a perception, but most operational definitions have focused on the process or function” (p. 29). The concept of interactivity has been explored from the perspective of CMC (Heeter, 1986; Rafaeli, 1985; Rice, 1984; Rogers & Rafaeli, 1985), the perception of the user (McMillian & Downes, 2000; Kiousis, 2002; McMillan & Hwang, 2002), and Internet/VR technology (Biocca, 1992; Ku, 1992; Newhagen & Rafaeli, 1996; Steuer, 1992). As exemplified in the literature review, interactivity is classified as a multidimensional construct (Ha & James, 1998; Heeter, 1989; Levy, 1999). This study seeks to bridge all three ways for operationalization of the interactivity, as it is difficult to avoid the many overlaps that exist in all three ways in which interactivity is defined.

The interactivity as a process-related variable could be illustrated by Rafaeli's (1985; 1988) approach, wherein interactivity is defined in terms of the responsiveness of participants and the degree to which the act of communication mimics a human discourse (Li, Daugherty, & Biocca, 2005). Accordingly, the high relevance of later messages to earlier messages has been defined as "response contingency" (Alba et al., 1997), "message tailoring" (Rimal & Flora, 1997), or "mapping" (Steuer, 1992). Li, Daugherty, and Biocca (2005) noted that, although immediacy of response is classified as another dimension of interactivity (Rice, 1987; Ku, 1992), "it is an intrinsic attribute of responsiveness itself" (p. 151). In addition, the interactivity has been also operationalized by the ability to select content, timing, and sequence of communication acts in a mediated environment, which is a form of the user's control. In turn, the user can influence and control the abilities listed above (Li, Daugherty, & Biocca, 2005).

This observation echoes Steuer's (1992) definition of interactivity as "the extent to which users can participate in modifying the form and content of a mediated environment in real time" (p. 46), meaning that interactivity is an objective characteristic that is inherent in the medium interface and its features. As addressed earlier, Steuer (1992) examined the human experience of presence in conjunction with technological variables of vividness (also known as media richness; Li, Daugherty, & Biocca, 2005) and interactivity that predestine the extent of the experienced presence. Accordingly, the subjective aspect of technology, such as the experience of presence, is part of interactivity, whereas vividness reflects the objective dimensions of technology (Schorr, 2003) and tends to enhance a sense of presence (Li, Daugherty, & Biocca, 2005). There are two aspects of vividness worth highlighting: *sensory breadth* and *sensory depth*. Sensory breadth refers to the number of dimensions that are simultaneously presented to the user and can be understood as a function of the ability of a communication medium to present information across human senses (Li, Daugherty, & Biocca, 2005; Steuer, 1992). The sensory depth, on the other hand, epitomizes the quality of information.

In the context of SL, a greater level of sensory breadth can be elevated, as this VE provides to the participant's sensory system both the audio and visual channels. In reference to sensory depth, rendering of 3D visuals, with resolution of 1920 X 1080p on a 24" desktop (iMac computer), which was the case for the experimental conditions in this study, can significantly increase the quality for a visual representation, in comparison to a computer with smaller desktop resolutions and sizes. As Li, Daugherty, and Biocca (2005) attentively pointed out,

> The premise of media richness lies in the assumption that messages appealing to multiple perceptual systems are better perceived than these that call on single perceptual systems and that high-quality messages are more effective than low-quality messages. (p. 151)

Finally, the interactivity has been viewed as an entirely subjective manifestation that is inaccessible through objective measurements. Therefore, the interactivity is a perception-related variable that has been operationalized as an experience and defined as the perceived interactivity (Kiousis, 1999; Lee, 2000; McMillan & Downes, 2000; Newhagen & Rafaeli, 1996). As discussed previously, the perceived interactivity can be viewed "as the extent to which users perceive their experience as a simulation of interpersonal interaction and sense they are in the presence of a social other" (Thorson & Rodgers, 2006).

Thus, it can be concluded that the perceived interactivity is predominantly grounded in engagement during the interactive experience. Although the concept of engagement is frequently associated with experiencing interactivity, it has also been included in conceptualizations of presence, which mirrors the concepts of interactivity and presence in confusion between engagement and involvement. The involvement is a psychological state that is experienced as a consequence of focusing one's attention on a coherent set of stimuli or related activities and events (Witmer & Singer, 1998). Therefore, the concept of involvement might be accordingly associated with experiencing presence, as it is possible for the user to be involved without having direct interaction.

In reference to all three approaches to the study of interactivity, Bucy and Tao (2007) stated that due to their different units of measurement, the conceptual model of each approach is incomplete. Thus, they proposed the implementation of the following definition of interactivity in an attempt to merge and unify all three approaches, "technological attributes of mediated environments that enable reciprocal communication and information exchange, which afford interaction between communication technology and users, or between users through technology" (Bucy & Tao, 2007, p. 656). This definition can serve as a starting point for building the relationship between interactivity and presence, given that the latter directly depends upon the "technological attributes" of a particular mediated environment. Ultimately, Bucy and Tao's (2007) definition can open the discussion about its role in constructing physical presence and communication technologies that highlight the possibility of having "reciprocal" interactions between users, thus giving birth to social presence. However, prior to conducting a broader analysis of presence, it is important to articulate the role of human communication and how different models of communication can influence new interactive experiences.

Human Communication and Interactivity

Despite evident diversity in apprehension and addressing the concept of interactivity, it is possible to make two observations. Firstly, interactivity can be conceived as a multidimensional concept. And secondly, interactivity has emanated in the context of human communication and has been used to formulate various models that further explain and are embraced in the study of media processes and effects. Therefore, it is important to notice the ways in which interactivity has entered the discourse in communication research and thus conduct a brief overview of the basic communication models that have influenced the development of interactivity. Deutsch (1952) asserted that a model is “a structure of symbols and operating rules which is supposed to match a set of relevant points in an existing structure of process” (p. 357). In respect to communication research, a model can serve as an abstracted representation of not only how humans communicate with each other but also to explain information transmission over mechanical systems (Bettinghaus, 2004). Furthermore, a model might provide a perspective on communication processes and suggest possible relationships between “relevant points” during an act of communication.

Linear models of communication. The earliest communication model can be traced to the Greek philosopher Aristotle, who introduced a verbal and linear model of communication in *Rhetorica* over 2,300 years ago. Aristotle’s model serves as an explanation of oral communication. He called the study of communication ‘rhetoric,’ and his model consists of five quintessential elements of communication: *the speaker, the message, the audience, the occasion,* and *the effects* (Narula, 2006). Although focused on public speaking rather than interpersonal communication, this model provided an important foundation for understanding communication methods; consequently, Aristotle gave birth to a philosophy of communication adopted by subsequent generations.

In 1948, a communication theorist, Harold Lasswell, proposed a model that allowed for general applications in mass communication. Lasswell understood communication as an act that should answer five questions that make up a sequence in which communication occurs: (1) who, (2) says what, (3) in which channel, (4) to whom, (5) with what effect? (Severin, 2001). Lasswell (1948) used Aristotle's model as a foundation; however, in his model, the message did not only flow to a broad range of audiences (which was also the case in Aristotle's model), but rather predominantly through numerous *channels* (Narula, 2006b).

Independently from Lasswell's (1948) study, Norbert Wiener (1961), a mathematician at the Massachusetts Institute of Technology (MIT), in his influential book *Cybernetics: or Control and Communication in the Animal and the Machine*, argued:

> the problems of control engineering and of communications engineering were inseparable, and that they centered not around the technique of electrical engineering but around the much more fundamental notion of the message, whether this should be transmitted by electrical, mechanical, or nervous means. (1961, p. 8)

For Wiener, the unification of control engineering and communications was grounded in the notion of the message and feedback loops. According to Wiener, a human represents a "link in the chain of the transmission and of information" (1961, p. 96), ultimately defined by Wiener as *the chain of feedback*. Moreover, the mathematician proposed an analogy between the digital computer and the human nervous system, which both operate according to similar principles (Mindell, 2004). Finally, he pioneered a new science of feedback, human behavior, and the information, coined *cybernetics*, which originated from a Greek word "kybernētēs" ("steersman;" Mindell, 2004). As Watson (1998) commented, "The steersman metaphor is an apt one for examining the nature of communicative interactions" (p. 36). Wiener's research also provided the foundations for the statistical communication theory, which, consequently, contributed to the beginning of interactive communication model development.

In conjunction with Wiener's statistical communication theory, Shannon and Weaver (1949) wrote *The Mathematical Theory of Communication*, which was an essential "and influential stimulus for the development of other models and theories in communication" (Severin & Tankard, 2001, p. 49). Shannon and Weaver revised Lasswell's (1948) approach to create a model that can be adapted to various information transmissions, whether by humans, machines, or any other communicative system (Reddi, 2010). According to Shannon and Weaver, the sender selects the message, which is then sent through a communication channel and changed into signals (messages). Shannon and Weaver emphasized that in the process of transmission, various distortions are added to the message. Although these distortions are not part of the sender's original message, they also participate in communication and have been defined as *noise*.

However, Shannon and Weaver's model of communication lacks any acknowledgment of the importance of the context (e.g., social, political, or cultural) in which a particular communication process occurs. Also, it does not highlight the psychological aspects of communication or the dynamic aspects of human communication from the other possible communication systems, including the importance of feedback. Yet, a model still epitomizes a turning point in technological history (Reddi, 2010). Shannon and Weaver's research and efforts toward developing a *unified model of communication* (Narula, 2006) contributed to many technical improvements in message transmission and motivated researchers from many other disciplines to scientifically examine and study communication.

To conclude, all early linear models have a significant number of limitations. Firstly, they interpret the communication process as a one-way act—sending the message from the active sender to a passive receiver. Secondly, linear models represent communication as a sequence of actions in which each subsequent step in the communication process must be preceded by fulfilling the previous step (Wood, 2009). In practice, however, when "actual interaction" takes place, seeing, listening, and speaking can occur all at once. Also, communication has a rather two-way nature and is not only one-way. From the perspective of new media technologies, for example, users can have simultaneously a videoconference via Skype, respond to received instant messages (IM) on FaceBook, or send an email. Consequently, another way to represent human communication was developed—the interactional (West & Turner, 2011) or interactive (Wood, 2009) model.

Interactive models of communication. In order to emphasize the two-way nature of human communication, Schramm (1954) proposed the interactional model of communication. In his early stages of this model's development, Schramm moved from a simple human communication model to a more complex and advanced model. His first model shares many similarities to Shannon and Weaver's model, including terms for sources and destinations, although he substituted the terms transmitter and receiver with *encoder* and *decoder*, respectively.

Then, Schramm decided to modify his vision of the communication process and focused on forming a model that takes into consideration the experiences of two individuals during an act of communication. During this second phase of development, Schramm advocated that "only what is shared in the fields of experience of both the source and the destination is actually communicated, because only that portion of the signal is held in common by both source and destination" (Severin & Tankard, 2001, p. 58). Although the second model still preserves a rather mechanistic structure, *the fields of experience* introduced a personal dimension to the model (Watson, 1998). As Watson (1998) pointed out, "Where the encoder's field of experience overlaps with that of the decoder, communication is likely to be at its most effective" (p. 38). On the contrary, communication is the least effective in areas where fields of experience do not overlap with each other.

In the final stage of the model's development, Schramm introduced the importance of *interaction* between two individuals in human communication (Severin & Tankard, 2001), which ultimately became a theoretical foundation for the third version of his model. According to Schramm, communication is based on interactions between two individuals, who encode, interpret, decode, transmit, and receive signals while communicating with each other and thus generate the feedback loop. At this point in his research, Schramm abandoned the linearity of previous models and recognized the interactive nature of communication (Watson, 1998).

Despite the fact that the interactive model brings some improvements to the linear model, it is still based on the sequential paradigm, "in which one person is a sender and another is a receiver" (Wood, 2009, p. 18). However, like the liner model, the interactional model does not provide any answer to what occurs when nonverbal messages are sent at the same moment as verbal messages, for example, facial expressions, direction of gaze, and gestures. Furthermore, a third model of communication, the transactional model was developed.

Transactional model of communication. The transactional model implements all the elements of communication for previous models, but also emphasizes that communication is not only about transmitting a message from one individual to another or the interaction between two individuals. As Steinberg (2007) advocated, "The communication process becomes a transaction during which the meaning of a message is negotiated" (p. 56). Furthermore, the transactional model overturns the major restrictions of Schramm's model—the assumption that the "communicator and recipient take turns to express and interpret messages" (Steinberg, 2007, p. 56). The transactional model portrays the communication as an active and dynamic process during which both sender and receiver are involved in the process of encoding, transmitting, receiving, and decoding messages.

Another important difference of transactional models from previous models epitomizes the context of the relationship between the communicator and recipient, who are simultaneously in the constant process of negotiating meaning. As Figure 4 (see Appendix J) illustrates, the message (represented by both circles) might be communicated by using both verbal and nonverbal signs. The message can be influenced by, for example, participants' backgrounds, attitudes, sex, feelings, experiences, or knowledge. Consequently, the "frame of reference of the participants" (Steinberg, 2007, p. 57) can affect how meaning is expressed and interpreted.

The main result of this encounter is influenced by the mutual involvement of the participants in the process of negotiating the meaning of the messages that takes place in a particular medium of communication. Importantly, rather than depicting transmission and feedback as two separate processes as was the case in Schramm's (1954) model, the transactional model indicates that messages are constantly forwarded between the individuals. The space around the communicator and the recipient reflect the context or situation in which the process occurs. Finally, the noises that can emerge at various places in the model might as well affect the entire process. The major result of these disruptions is a decreasing chance to construct shared meaning during message exchanges.

To conclude, as underlined by Stephanidis et al. (2012), to achieve an effective process of communication, three elements have to be present: a sender, a selected message, and its recipient. In addition, a successful message exchange is obtained when both parties share a "common code or language" (Stephanidis et al., 2012, p. 1375). At the same time, however, in the case of new media technologies, neither presence nor awareness of the sender's intent is required of the recipient to communicate in real time. Thus, in contrast to older media, communication technologies implemented for new media offer both synchronous and asynchronous modes of information flow that affect the ways in which an interactive experience might be formed. As mentioned by Biocca et al. (2001), "There is one often repeated claim of communication theory: the function of media is to collapse space and time to provide the limited illusion of being there in other places and being together with other people" (p. 1). For that reason, however, it is fundamental to reconsider how that illusion—the sense of presence—is created.

Presence

Definition. Presence research, which considers the experience of developing the feeling of being someone or something else, along with other people, but without being physically in the same environment, serves as the *ne plus ultra* for a methodology of understanding technology and perception in VEs. Yet, the history of presence research is stigmatized by various definitional and methodological conflicts.

For example, according to Gibson's (1979) definition, *presence* can be understood as an experience of a physical environment. This experience is not a feeling of *surroundings* that exist in the physical world but rather a *perception* of surroundings, and an automatic and controlled mental process produces this perception. With CMC technology, a user experiences awareness of two separate environments at the same moment: the physical environment, in which the person is physically present, and the VE, which is presented through the medium itself. Presence in this second environment is defined as *telepresence*—the feeling of being inside the environment's medium of communication (Biocca & Levy, 1995). Steuer (1992) stated that telepresence establishes "the level to which [a] person feels to be more present in [the] medium of [the] environment than in physical surroundings." Further, he explained, it reflects "the experience of presence in an environment by means of [a] communication medium" (1992, p. 76). Loomis (1992) asserted that presence might be linked to the phenomenon of *distal attribution* or *externalization*, which involves attributing one's perception to "external space beyond the limits of the sensory organs" (p. 113).

However, Calleja (2011) noted a significant number of divergences in the term *telepresence*. In 1992, with the launch of the academic journal, *Presence: Teleoperators and*

Virtual Environments, Minsky (1980), who originally coined the term *telepresence*, had been confronted with a vital, academic debate in regard to his claim,

> The biggest challenge to developing telepresence is achieving that sense of 'being there.' Can telepresence be a true substitute for the real thing? Will we be able to couple our artificial devices naturally and comfortably to work together with the sensory mechanisms of human organisms? (p. 48)

For instance, Sheridan (1992) constrained the implementation of the term telepresence to be used only while referencing to teleoperators, and formulated the term *virtual presence* to address presence in VEs. Conversely, Held and Durlach (1992) suggested using the term *telepresence* for both VEs and teleoperators. The term *telepresence* was eventually "dropped" and replaced with *presence*, which is used while addressing both virtual and real environments (RE; Calleja, 2011). Accordingly, the assumed "equivalence" between a VE and RE highlights differences in all of the previously discussed definitions of presence "are not merely terminological, but ontological" (Calleja, 2011, p. 19). As IJsselsteijn, Riva, and Davide (2003) emphasized,

> Importantly, multisensory simulation arises from both the physical environment as well as the mediated. There is no intrinsic difference in stimuli arising from the medium or from the real world—the fact that we can feel present in either one or the other depends on what becomes the dominant perception at any one time. (p. 6)

Taking into consideration IJsselsteijn, Riva, and Davide's (2003) perspective, it is possible to argue that all technological features and properties offered by a particular medium are involved determining experiences that are based on interactions between the user and the medium.

However, as emphasized by Lombard and Jones (2006), "The first and most basic distinction among definitions of presence concerns the issue of technology" (p. 1). Therefore, there are two schools of thought in approaching presence: the rationalist (known as media presence) and psychological point of view (known as inner presence; Coelho et al., 2006).

Inner presence. According to this view, presence refers to a psychological phenomenon, which rather than being linked to the experience of a medium, can be predominantly elaborated on when ascertaining individuals' control and social activity (Riva et al., 2011). The main premise concerning "inner presence" is reflected in recent findings in neuroscience and its influence on understanding how humans exercise an action. Specifically, Riva (2009) suggested that presence is a missing link between the cognitive and volitional perspectives on how the user can carry out a particular action. Riva supplemented his view by defining presence as the "pre-reflexive" perception of the transformation of the user's autonomous desideratum into action. The sense of being present in a mediated system does not alter the ability to be present in the physical space in which the user is situated (Benyon et al., 2009).

To sum up, the fundamental idea of presence within a particular medium is based on the premise that reality is a product of the user's brain; people construct reality through their sensory inputs. Therefore, by taking control of someone's sensorial data stream, a program could substantially alter that person's subjective perception of reality (Ruffini, 2009). Social elements—such as other people's reactions to the user's presence in a mediated environment (e.g., immediacy and intimacy)—can provide confirmation to the user, which ultimately indicates the concreteness of the user's existence in this virtual space (IJsselsteijn, Riva, & Davide, 2003). By using new-media technologies and CMC tools, a person could become immersed in VEs with others in real-time modes.

Media presence. This approach serves as an alternative paradigm for presence researchers. According to supporters of this approach, presence is the function of the user's experience with a given medium (Riva et al., 2011). Moreover, presence might be interpreted as "the subjective experience of being in one place or environment even when one is physically situated in another" (Witmer & Singer, 1998, p. 225).

Riva et al. (2011) highlighted that the major advantage of the media presence approach centers on its prognostication dimension. The level of presence is respectively abbreviated by the experience of mediation during the action. According to the International Society for Presence Research (ISPR; 2000),

> Presence (a shortened version of the term "telepresence") is a psychological state or subjective perception in which even though part or all of an individual's current experience is generated by and/or filtered through human-made technology, part or all of the individual's perception fails to accurately acknowledge the role of the technology in the experience... Experience is defined as a person's observation of and/or interaction with objects, entities, and/or events in her/his environment; perception, the result of perceiving, is defined as a meaningful interpretation of experience. (International Society for Presence Research, 2000)

ISPR's definition of presence consists of two types of mediation, first- and second-order mediation (Pinchbeck & Stevens, 2005). First-order mediation is grounded in the natural process of choosing information from the environment that occurs through the mediating processes of perception. Second-order mediation is subject to a series of actions that are carried through some form of a technological artifact and are thus mediated. The main objective of a media presence researcher is to further investigate the illusion of non-mediation that manifests itself in second-order mediation.

Immersion and presence. It is also important to highlight the fact that the terms "immersion" and "presence," although often used interchangeably, are not equivalent phenomena; thus, it is often difficult to discern how they are used by scholars (Konijn & Bijvank, 2009). In conjunction with Kalawsky's (2000) observation,

> The term immersion is also sometimes used erroneously to describe the experience of presence. The term immersion in fact refers to the extent of peripheral display imagery. If the display presents a full 360° information space then we are dealing with a fully immersive system. However, if the extent of the display is less than this then we have a semiimmersive system. The term non-immersive is usually reserved for desk-top VR systems. To avoid confusion it is best to associate immersion with the technology characteristics of the display. Unfortunately, these terms are not interchangeable and refer to quite different things. Presence is essentially a cognitive or perceptual parameter whilst immersion essentially refers to the physical extent of the sensory information and is a function of the enabling technology. (p. 2)

The literature devoted to the research phenomenon of immersion offers a few significantly different approaches. From the perspective of media studies and art, Grau (2003) stated that immersion is an intellectually stimulated process characterized by a mentally absorbed change from one state into another and has the potential to generate "hermetically closed-off image spaces of illusion" (p. 5). From the participant's point of view, there is a reduction in distance to what is presented and an increase of emotional participation in what is occurring (Grau, 2003).

Morse (1998) noted that the electronic realm is closely connected to immersion and the attempts to transcend, in the sense of "nonorganic rebirth" (p. 130). Another scholar and philosopher, Zhai (1998), suggested that immersion is a feeling of being completely surrounded by the electronic environment. According to Zhai, this *electronic* environment is completely separated from the perceptual experience of the *real* environment. From a technical perspective, immersion is seen as an emotional response from a virtual world (Menetta & Blade, 1998) or the ability to enter a game through its controls (Radford, 2000). Specifically, in the field of game studies, researchers (Jennett et al., 2008; King & Krzywinska, 2006; Tamborini & Skalski, 2006) argued that immersion and presence are crucial elements in constructing the user (player) experience.

All of these definitions emphasize the problematic nature of immersion and presence in their conceptualization (Slater, 2003; Waterworth & Waterworth, 2003) and utilization (Ermi & Mayra, 2005). In particular, Calleja (2011) attested to the debatable and complex definition of immersion since "it has also been applied to the experience of non-ergodic media such as painting…literature… and cinema… all of which provide forms of engagement that are qualitatively different from these of game environments" (p. 18).

For the purposes of this study and its aim to explore the attributes of physical presence and social presence in VEs, it is relevant to highlight a few approaches in which immersion and presence have been operationalized. Slater and Wilbur (1997) designated immersion as "a description of a technology that describes the extent to which the computer displays are capable of delivering an inclusive, extensive, surrounding and vivid illusion of reality to the sense of a human participant" (p. 606). Presence, on the other hand, can be conceptualized as "a state of consciousness, the (psychological) sense of being in the virtual environment" (p. 607). Later, Slater (2003) reformulated his definitions and asserted that presence reflects "a human reaction to immersion" and immersion is "simply what the technology delivers from an objective point of view" (p. 1). To paraphrase, immersion can be objectively quantifiable (Schubert et al., 2001), whereas presence is a subjective experience that can be only quantifiable by the user experiencing it.

In a different vein, as mentioned earlier, Witmer and Singer (1998) defined immersion as "a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences" (p. 227). Calleja (2011) pointed out "while Witmer and Singer use *immersion* in the same way that Slater and Wilbur use the term *presence*, they view presence as a combination of involvement and immersion" (emphasis in original, p. 21). Witmer and Singer's approach has been widely adopted, especially in game studies (Laurel, 1991; Murray, 1997) and is also promoted by this study.

Types of Presence. Lombard and Ditton (1997), in their analysis of the ways in which the term *presence* had been used in literature, distinguished six dimensions of presence: (a) *presence as social richness*; (b) *presence as realism*; (c) *presence as transportation*, further divided into three subcategories ("You are There," "It is Here," and "We are Together" [shared space]); (d) *presence as immersion*, divided into two subcategories (perceptual immersion and psychological immersion); (e) *presence as social actor within medium*; and (f) *presence as medium as social actor*. Researchers synthesized all six dimensions of presence into one and defined presence as "the perceptual illusion of non-mediation" that is generated by the instrumentality of the desertion of the medium from the user's cognizance. In other words, presence is the extent to which a person fails to perceive or acknowledge the existence of a medium during a technologically mediated experience. Lombard and Ditton's (1997) conceptualization of presence as an illusion has been further taxonomized by IJsselsteijn et al. (2000) as: (a) *physical presence* (spatial presence), which refers to the illusion of being physically located/present in the mediated environment; (b) *social presence*, which addresses the illusion of being present together with others in the mediated environment; and (c) *copresence*, which combines both illusions and highlights the sense of being together in a shared virtual environment at the same time (IJsselsteijn, 2005). Nowak (2001) commented that copresence focuses more on the psychological connection of minds. All three categories of presence are discussed in more detail below.

Physical presence. The physical presence refers to a sense of being physically located in a mediated space. Biocca et al. (2003) explained that the concept of *(tele)presence* is equivalent to the physical or *spatial presence*, including the "automatic responses to the 'spatial cues' and the mental models of mediated spaces that create illusion of place" (p. 459). During mediated interactions, physical presence becomes a matter of technology's providing realistic sensory experiences, which, in turn, contributes to the user's self-awareness becoming immersed in the mediated environment (Draper, Kaber, & Usher, 1998). Spatial presence includes the original conceptualization of presence as the sensation of being there rather than here, or the sense of being in a place other than one's current physical location, which is referred to as the idea of presence as transportation (Lombard & Ditton, 1997).

For example, Sadowski and Stanney (2002) described presence as “a sense of belief that one has left the real world and is now ‘present’ in the virtual environment” (p. 791), while in Slater and Wilbur’s (1997) nomenclature discussed earlier, presence is a “state of consciousness, the (psychological) sense of being in the virtual environment” (p. 604). In accordance with Witmer and Singer’s (1998) study, immersion and involvement are the essential components of experiences of presence. Due to the enhanced vividness and new ways of interaction that are available for the user in VE, it is possible to facilitate immersion of the user into a computer-generated environment more successfully (Van Dam et al., 2000). The starting point for analysis of the sense of presence in video games can also begin with Tamborini and Skalski’s (2006) observation that “Many games are now being designed to create a sense of ‘being there’ inside the game world, a feeling we call presence… Presence seems central in shaping the experience of electronic games” (p. 225).

This study focuses on Schubert et al.’s (1999; 2001) analysis of presence—the sense of being in a VE—from the perspective of an *embodied cognition framework* (Glenberg, 1997; Lakoff & Johnson, 1999). According to the authors, the user can experience presence when the possibilities of his or her bodily actions in the VE are mentally represented as “meshed sets of patterns of actions and that presence is experienced when these actions include the perceived possibility to navigate and move the own body in the VE” (1999, p. 1). Apart from the bodily actions in regard to the VE and navigation, other examples involve manipulation of objects and possible interactions with other agents—like avatars or bots (Schubert et al., 2001). The researchers further argued that presence should involve at least two components: (a) “the suppression of the actual environment and the focusing on the VE” (1999, p. 273), and (b) “the mental construction of a space out of the VE in which the body can be moved" (1999, p. 273). In their later research (2001), they redefined these components accordingly as (a) "the sense that we [the users] are concentrating on the virtual environment, and ignoring the real environment" (p. 269); and (b) "the sense that we [the users] are located in and act from within the virtual environment" (p. 269). Additionally, they concluded that the presence in VE results from the construction of a spatial-functional mental model of VE, which embraces these two components. Wang and Kim (2008) commented that "conflicting projectable features from the real world must be suppressed for presence to emerge and the VE must be perceived of in term of embodied action" (p. 78). Based on the construction of a spatial-functional mental model of VE, Schubert et al. (1999; 2001) developed their Igroup Presence Questionnaire (IPQ).

Yet, the final version of IPQ synthesized two studies. In the first experiment, Schubert et al. (1999) formed three presence and five immersion factors (see Table 7). Respectively, the presence factors were Spatial Presence (SP), Involvement (INV), and Realness (REAL). Both SP and INV items supported the distinction between a spatial-constructive and attention component, which in origin has been derived from the embodied presence model (Schumie et al., 2001), which Schubert et al. (1999) used in their initial operationalization of presence. The immersion factors consisted of Quality of Immersion (QI), Drama (DRAMA), Interface Awareness (IA), Exploration of VE (EXPL), and Predictability and Interaction (PRED). In the second experiment, the factor structures were replicated in order to obtain reliable results. Particularly, SP, INV, REAL, EXPL, and PRED were the focus on this study. Based on confirmatory factor analysis (CFA), Schubert et al. (2001) developed standardized loadings in the three-component presence model (see Appendix J: Figure 12), which also confirmed a prediction from an earlier study that presence experiences involve two distinct components, spatial-constructive and attention. In addition, the researchers discovered a third subjective component: judgments of realness.

Therefore, they concluded that physical presence consists of the following components, which also serve as the operationalization foundation for this study: (a) *Spatial Presence* (5 items), which describes the sense of being physically present in the VE; (b) *Involvement* (4 items), which measures the attention devoted to the VE and the involvement experienced; and (c) *Experienced Realism* (3 items), which depicts the realism attributed to and experienced within the virtual environment. One additional component, *General Presence* (the sense of being there), which reflects Slater, Usoh, and Steed's (1994) definition of the sense of presence ("I had a sense of being in virtual environment"), loads together with the subscales on the second-order factor (see Table 8). The IPQ was also used in the experiment for this study, and further description of methods in which this questionnaire has been synthesized is included in the methodology section.

Table 7

Factor Analysis Study 1: Factors, Numbers of Items, and Explained Variance (Schubert et al., 1999)

Component	Name	Label	Number of Items	Eigenvalue	% of Variance Explained
1	Spatial presence	SP	14	14.087	20.717
2	Quality of immersion	QI	8	4.574	6.726
3	Involvement	INV	10	3.824	5.624
4	Drama	DRA	7	3.083	4.533
5	Interface awareness	IA	7	2.485	3.655
6	Exploration of VE	EXPL	6	2.262	3.326
7	Predictability & interaction	PRED	6	1.967	2.893
8	Realness	REAL	5	1.901	2.795

Table 8

Standardized Loading in the Three-component Presence Model (Schubert et al., 2000)

Predictor	Criterium	Abbreviated Item	Standardized Loadings	
			Study 1	Study 2
PRES	SP	Spatial presence (latent variable)	0.852	0.921
PRES	INV	Involvement (latent variable)	0.474	0.740
PRES	REAL	Realness (latent variable)	0.672	0.824
PRES	G1	Sense of being in a place	0.876	0.804
SP	SP1	Sense of VE continuing - behind me	0.491	0.545
SP	SP2	Sense of seeing only pictures	-0.566	-0.458
SP	SP3	Sense of being in the virtual space	0.633	0.634
SP	SP4	Sense of acting in the VE	0.845	0.765
SP	SP5	Felt presence in the VE	0.808	0.794
INV	INV1	Awareness of real world stimuli	-0.685	-0.521
INV	INV2	Awareness of real environment	-0.647	-0.763
INV	INV3	Attention to the real environment	-0.671	-0.646
INV	INV4	Captivated by the VE	0.624	0.707
REAL	REAL1	How real seemed VE in comparison with the real world	0.781	0.667
REAL	REAL2	Consistency of experiencing the VE and a real environment	0.553	0.598
REAL	REAL3	How real seemed VE in comparison with an imagines world?	0.572	0.617

Notes: INV2, INV3, and REAL2 are actually anchored reverse, but their loadings were multiplied by -1 for ease of interpretation. Loadings of PRES on G1, SP on SP5, INV on INV4, and REAL on REAL3 were fixed to achieve identifiability, which prevents computation of significance for these variables. All other loadings are highly significant at $p < 0.001$.

Social presence. Although the social presence has been widely studied, there is a lack of complete agreement on how to operationalize this concept (Biocca et al., 2001; Danchak et al., 2001; Huguet et al., 1999; Nowak, 2001). Yen and Tu (2008) concluded that in most cases, the concept of social presence is examined from the perspective of only one dimension—"the perception of the quality of communication" (p. 306). In general, social presence pertains to the feeling of being together, of socially interacting with a virtual or subordinately positioned communication user.

From the historic perspective, social presence was first defined by Short et al. (1976) as "a degree of salience of the other person in a mediated communication and the consequent salience of their interpersonal interactions" (p. 65), which describes how meaningful interactions between technology users can be within a mediated environment based on its qualities. In its original context, Short et al. (1976) discussed conceptualization of the social presence on telecommunication media and emphasized the importance of the medium's perceived capacity to transmit cues that have been available in face-to-face-communication (Garau, 2003). Their approach also links the social presence to: (a) *the concept of immediacy*, which can be defined as "directness and intensity of interaction between two entities" (Mehrabian, 1967, p. 325) or psychological distance between interactants (Weiner & Mehrabian, 1968) and all communication behaviors that "enhance closeness to and nonverbal interaction with another" (Mehrabian, 1968, p. 203; Patterson & Manusov, 2006); and (b) *the concept of intimacy*, which is based on Argyle and Dean's (1965) Intimacy Equilibrium Model, according to which a degree of intimacy might be signaled by such factors as proximity, eye contact, smiling, and personal topics of conversation (Hardy & Heyes, 1999) and intimacy is categorized as dimension(s) of relationship

(Argyle, 1969) during which conversational partners can negotiate (Biocca, Harms, & Burgoon, 2003).

Biocca et al. (2001) and Rettie (2003) criticized Short et al.'s (1976) approach for being focused only on the quality of the medium and not taking into consideration the user's social context (Yen & Tu, 2008). Consequently, many studies investigating social presence concluded that it should be explored as a multidimensional construct. For instance, according to Biocca (1997), social presence consists of three elements (form, behaviors, and sensory):

> The minimum level of social presence occurs when users feel that a form, behavior, or sensory experience indicates the presence of another intelligence. The amount of social presence is the degree to which a user feels access to the intelligence, intentions, and sensory impressions of another.

Tu and McIsaac (2002) asserted the possibility of measuring social presence in three dimensions: social context, online communications, and interactivity. On the other hand, Danchak et al. (2001) proposed that the degree of social presence is determined by the levels of immediacy and intimacy (Cooke, 2007). Yen and Tu (2008), in their analysis of online social presence, envisaged the concept as a degree of (a) *perception* (online communication), (b) *feeling* (social context), (c) *reaction* (interactivity), and (d) *trustworthiness* (privacy) of "being connected by CMC to another intellectual entity through electronic media" (p. 307). Garau (2003), in her review of literature, suggested that social presence might be analyzed from the perspective of: (a) *a perceptual illusion of non-mediation*, (b) *access to another intelligence*, and (c) *medium vs. experience*.

The first approach echoes Lombard and Ditton's (1997) definition of presence as the illusion of nonmediation, which "occurs when a person fails to perceive or acknowledge the existence of a medium in his/her communication environment". However, apart from appearing to be only transparent, the medium can be also seen as a transformation into something else: a social entity.

From the perspective of the second category, social presence reflects "the degree to which a user feels access to the intelligence, intentions and sensory impressions of another" (Biocca, 1997). Biocca underlined the importance of social clues and pointed out that since social presence is mediated by communication technology, it might be described as *mediated social presence* or *social telepresence*, which is "a temporary judgment of the nature of interaction with the other, as limited or augmented by the medium" (Biocca et al., 2001).

Finally, the last dyad of Garau's (2003) proposition to study social presence highlights the property of the medium versus the subjective experience of the user. According to Heeter's (2001) analysis of social presence, "Experienced social presence is the particular feeling of connectedness experienced by a person during a specific use of a technology for telerelating. Expected social presence is the potential of a communication medium to facilitate meaningful social interaction" (p. 10). In her previous study, Heeter (2001) underlined that social presence "is contextual, dependent upon the history of the relationship, the communication content of interaction, and the communication characteristics of the medium used in the interaction" (p. 11).

For the purpose of this study, two studies will be discussed at greater length: (a) the Networked Minds Theory (NMT) of social presence elaborated by Biocca and Harms (2002) and (b) Swinth and Blascovich's (2002) three levels of social interaction. Both serve as theoretical rudiments for Bailenson et al.'s (2003) five-item social presence questionnaire used in this study.

First, in regard to the NMT of social presence, Biocca and Harms (2002) connoted that this is "a theory of the *interaction of mind and technology* focused on *mediated interaction only*, specifically *how different technological forms and mediated embodiments* of the other influence the processes and mental representations in social interaction" (emphasis in original, p. 11). Secondly, Biocca and Harms (2002) envisioned the social presence according to the following definition, " 'sense of being with another in a mediated environment,' social presence is the moment-to-moment awareness of co-presence of a mediated body and the sense of accessibility of the other being's psychological, emotional, and intentional states" (p. 10). Thus, taking into consideration the theoretical framework of the NMT of social presence, and in accordance with Bailenson et al.'s (2001) argument that social presence, when seen from the perspective of mediated embodiments, might help to expand our understanding on all social interactions, which is also applicable to the objectives of this study, Biocca and Harms' (2002) NetMinds Social Presence Inventory Model (see Appendix J: Figure 5) is worthy of closer examination. Respectively, Biocca and Harms (2002) proposed that there are three levels of social presence: (a) *perceptual*, (b) *subjective*, and (c) *intersubjective*.

The first level involves "the detection and awareness of the co-presence of other's mediated body" (Biocca & Harms, 2002, p. 13). This level is grounded in the works of social psychologist Erving Goffman. In mediated interactions, the senses of the user are extended, to some degree, by technology; thus, as mentioned earlier, the virtual representation (e.g., avatar) is a key medium for communicating both the presence of self and others and the construction of some model of others' internal statuses. Taking this approach further and commenting on the virtual spaces, Biocca and Harms (2002) emphasized, “In a society where mediated interaction is increasingly common, we may spend more time in social and parasocial interactions with mediated others than in face-to-face interactions with people ‘in the flesh’” (p. 14). Along similar lines, Lee and Noss (2003) asserted that social presence reflects “the sense that other intelligent beings co-exist and interact” with the user (p. 289-290).

The second level executes the psycho-behavioral accessibility of the other, and, as asserted by the authors, it “focuses on the perceived accessibility of the other, the sense that the user has of their awareness of and access to the others attentional engagement, emotion state, comprehension, and behavioral interaction” (Biocca & Harms, 2002, p. 13). In the context of VEs and based on the premise that the embodiment in VE is reflected by the construction of digital representation, it might be relevant to underline the importance of a simulation theory of other minds (Carruthers & Smith, 1996) that is epitomized by the second level. The theory proposes “a person understands another by projecting himself imaginatively into the other’s conditions, thus stimulating the other’s mental processes with one’s own” (Auyang, 2000, p. 429). Therefore, as Biocca and Harms (2002) highlighted that since the users do not have direct access to the one’s mind through the interaction that is mediated by technology, “they may be simulating the minds of others ‘as if’ the other person were them, there, in that situation” (p. 21).

The last level of social presence pertains to intersubjectivity, which puts emphasis on the nature of interaction that when mediated is mostly dynamic. Taking into consideration a fact that “the user’s sense of social presence is in part a function of how they perceive the other’s sense of social presence of them,” this level determines “the degree to which one individual perceives the social presence to be mutual (within interactant symmetry), and intersubjectively the degree to which the pair of interactants share this sense of social presence among each other (cross-interactant symmetry;" Biocca & Harms, 2002, p. 13). It references Goffman's (1963) notion to "be perceived in this sensing of being perceived" (p. 17) discussed in the next section. To further clarify, the *within interactant symmetry* refers to "the degree of symmetry or correlation between the user's (A) sense of social presence and their perception (A->B) of his partner's sense of social presence" (Biocca & Harms, 2002, p. 28). The *cross interactant symmetry*, on the other hand, involves "the degree of symmetry or correlation between the user's (A) sense of social presence and his partner's (B) perception of user's social presence" (Biocca & Harms, 2002, p. 29). Both types of symmetry accentuate that the social presence is a reciprocal entity (Garau, 2003).

According to Swinth and Blascovich (2002), the social presence is "the actual, imagined, or implied presence of others (Allport, 1985) and we argue that others need not be physically present for them to exert social influence over the thoughts, feelings, or behaviors of another" (p. 9). While Biocca and Harms' study does not clearly distinguish social presence from copresence and rather combines both in their model of social presence, Swinth and Blascovich (2002) defined copresence as "a person's perception and feeling that others are co-situated within an interpersonal environment" (p. 10). The authors also made the following important observation regarding both types of presence:

> …actual social presence is not necessary for interactants to experience copresence. Rather, we believe that copresence can also occur when one perceives that others are co-situated within the same interpersonal environment, even when they are, in reality, physically situated in different locations. (2002, p. 11)

Accordingly, in comparison to Biocca and Harms' study (2002), Swinth and Blascovich (2002) proposed three different levels that are involved in the user's experience of social interaction in a mediated environment: (a) "a user's sense that there are other social entities co-situated within some interpersonal environment" (p. 7), which include both human and artificial agents (bots); (b) "the extent to which others appear to be real" (p. 7), meaning determination if these social entities with which the user interacts are real or artificial; and (c) "the extent to which social entities are engaged and responsive to one another" (p. 7), which actuates if the social entities are present and have the capacity to interact. To a significant degree, the first and second levels can be seen as references to Biocca and Harms' (2002) concepts of copresence and access to another's intelligence (Garau, 2003).

Building on these two theoretical works, Bailenson et al. (2003) formulated a five-item Social Presence Questionnaire (BSPQ), which can be seen as a consolidation of Biocca and Harms (2002) and Swinth and Blascovich's (2002) ways of defining social presence (see Table 9). The BSPQ is used also in Bailenson's other studies (Bailenson et al., 2004; 2001; Bailenson & Yee, 2006) and is designed to measure how much a participant perceives avatars or embodied agents to be like an actual person. At this moment, one important clarification in regard to avatars and embodied agents should be made, as very often, both terms are confused with each other. In Bailenson et al.'s (2005) nomenclature, avatars are "digital representations of human users to represent individuals within multiuser virtual environments in real time" (p. 379) and embodied agents are "digital representations of computer programs that have been designed to interact with, or on behalf of, a human as interactive guides or as interactants within virtual environments" (p. 379). Bailenson et al. (2001) pointed out that "people feel high social presence if they are in a VE and behave as if interacting with other veritable human beings" (p. 590). The BSPQ is described in more detail in the methodology section.

Table 9

Social Presence According to: (a) Biocca and Harms (2002), (b) Swinth and Blascovich (2002)

	Biocca and Harms (2002)	Swinth and Blascovich (2002)
Definition of Social Presence	"sense of being with another in a mediated environment", social presence is the moment-to-moment awareness of co-presence of a mediated body and the sense of accessibility of the other being's psychological, emotional, and intentional states" (p. 10).	"the actual, imagined, or implied presence of others (Allport, 1985) and we argue that others need not be physically present for them to exert social influence over the thoughts, feelings, or behaviors of another" (p. 9).
Level 1	Perceptual: "the detection and awareness of the co-presence of other's mediated body" (p. 13).	"a user's sense that there are other social entities co-situated within some interpersonal environment" (p. 7).
Level 2	Subjective: the psycho-behavioral accessibility of the other.	"the extent to which others appear to be real" (p. 7).
Level 3	Intersubjective: "the degree to which one individual perceives the social presence to be mutual (within interactant symmetry), and intersubjectively the degree to which the pair of interactants share this sense of social presence among each other (cross-interactant symmetry;" p. 13).	"the extent to which social entities are engaged and responsive to one another" (p. 7).

Copresence. The concept of copresence requires greater clarification regarding its theoretical framework and relationship to physical and social presence. Garau (2003) made an important observation that "in numerous cases, the use of the term *social presence* or *copresence* reflects a matter of preference" (emphasis in original, p. 81). However, as discussed before, IJsselsteijn, Freeman, and de Ridder (2000) postulated that physical presence, social presence, and copresence should be treated as separate categories of presence, with copresence as the intersection and "the sense of being together in a shared space, combining significant characteristics of both physical and social presence" (p. 182), as Figure 6 (see Appendix J) exemplifies. In a similar vein, Nowak (2001) argued that social presence and copresence should be viewed in separate ways:

> The conceptual description of these concepts appears to be the same or very similar. The indicators of social presence considered here ask about people's perceived ability of a medium to provide social presence, and do not directly measure the sense of another person, which copresence attempts to. (p. 12)

The term copresence has its rudiments in sociology (Garau, 2003), especially in the works of Goffman (1963), which focus on the performance rules for public behavior and emphasize synchronous, embodied interactions in shared physical spaces, where focused and unfocused interactions take place. This is especially important when taking into consideration previously elaborated discussion about communication models, which highlight that a human interaction can occur linearly, in one-way only or two-way, with reciprocal or feedback-based human communication. Goffman (1963) articulated that, "Persons must sense that they are close enough to be perceived in whatever they are doing, including their experiencing of others, and close enough to be perceived in this sensing of being perceived" (p. 17).

Many studies operationalized copresence in various ways. For instance, copresence might be defined as the sensory experience of being in a place other than the one that the user is physically in with other users (Casanueva & Blake, 2000). Schroeder et al. (2001) conceptualized copresence as "the subjective sense of being together or being co-located with another person in a computer-generated environment" (p. 786) and accented the importance of the joint action: "Copresence is more about what participants do together rather than being aware of each other's presence" (Schroeder, 2011, p. 43).

In this study, Zhao's (2003) taxonomy of copresence, which is based on two major characteristics of colocation, is highlighted. The concept of colocation refers to stimulation of communication by interaction, which can take place either at physical proximity (the users are both present at the same physical location/site) or electronic/remote proximity (the users are present but are not located in their physical proximity). Zhao (2003) defined copresence as "a form of human colocation in space-time that allows for instantaneous and reciprocal human contact" (p. 446) and offered six types of copresence: *corporeal copresence*, *corporeal telecopresence*, *virtual copresence*, *virtual telecopresence*, *hypervirtual copresence*, and *hypervirtual telecopresence*. Table 10 briefly describes characteristics of each type of copresence.

Requirements for establishing copresence have varied across studies, but most researchers specify that media users must be aware of others and have a sense of being in the mediated environment with them (Bailenson et al., 2005; Gerhard, Moore, & Hobbs, 2004; Nowak & Biocca, 2003; Zhao, 2001, 2003).

Table 10

Taxonomy of Copresence. Adapted from Zhao (2003)

Distance Between the Users		
Presence:	**Physical Proximity**	**Electronic Proximity**
Both Sides:	Corporeal Copresence: both users are present at the same site and with each other's physical proximity.	Corporeal Telcopresence: both users are present in person at their sites but are not in their physical proximity.
Examples:	→ F2F; Nonverbal clues	→CMC/Internet; "Face to device" (p. 447)
One Side:	Virtual Copresence: both users are present in each other's physical proximity but only one is present as person and other as physical representation, also known as *social robots.*	Virtual Telcopresence: both users are present in each other's electronic proximity, but only one is present as person at the site and other as digital representation, also known as *agents/interactive computer programs/social bots*.
Examples:	→Instrumental Social Robots (ISR): stimulate "the causative aspect of human interaction" (p. 448). Examples: bank ATMs →Communicate Social Robots (CSR)*:* stimulate "the emotive aspect of human interaction and are used to substitute for people in their intimate contact with other human individuals (p. 448). Examples: Furby, Aibo, Kismet	→ISR: used in "automated response services, handle routine human inquires on behalf of human operators" (p. 448). Examples: MapQuest, Siri, S Voice →CSR: used "typically for personal recreation, interact with real people on emotional level" (p. 448). They are different from standard computer software because they are particularly designed to communicate with humans in place of humans. Also, they mimic human interaction and provide entertainment, interpersonal training and psychological comfort. Examples: ELIZA, CleverBot
Neither Side:	Hypervirtual copresence: both users are virtually present at the site through physical representation, which are in each other's physical proximity.	Hypervirtual telecopresence: both users are virtually present at the site through digital representation that is located in each other's electronic proximity.
Examples:	→"Serving as the surrogates for humans, robotic devices interact with each other in close range on behalf of the individuals they represent" (p. 449). Example: robotic football games.	→"These digital robots or software bots interact with each other in cyberspace on behalf of the individuals they represent" (p. 449). Examples: SL avatar, Hero

Relationships among physical presence, social presence, and copresence. Garau (2003) concluded that different schools of thought exist in regard to relationships between physical presence, social presence, and copresence. There is also an evident lack of empirical research that would further investigate a possible interrelation between these phenomena. Bulu (2012) attentively pointed out, “Research on the relationship among different types of presences presents conflicting results” (p. 155). Therefore, a brief discussion about how physical, social, and copresence relate with each other is provided below.

Physical and social presence. According to De Greef and IJsselsteijn (2000), the possible correlation between physical and social presence may be affected by the shared determinants. Therefore, there is an indirect relationship between them. The authors further postulated:

> Social presence, or the ‘sense of being together’, is quite different from physical presence, or the sense of ‘being there’ in a mediated environment. Although a number of medium manipulations will have a similar effect on both social and physical presence, and unifying definition has been proposed, the two types of presence can be meaningfully distinguished. (p. 2)

In contrast, Heeter (1992) defined the social presence as a sub-category of presence and also as a general catalyst of presence, thus promoting a unidirectional causal relationship between physical presence and social presence: “The premise of social presence is simply that if other people are in the virtual world, that is more evidence that the world exists. If they ignore you, you begin to question your own existence” (p. 266). Thie and Wijk (1998), in their study, found that there is a significant positive relationship between social and physical presence. Zhang and

Zigurs (2009) concluded another interesting point about the relationship between social and physical presence and argued that social presence is related more to the overall design than to physical presence. Wang and Wang (2008), on the other hand, found that physical presence is in an orthogonal relationship to social presence and suggested that “people might experience social presence even the medium provides minimum physical presence; or medium provide a high level of physical presence but not necessarily social presence” (Bulu, 2012, p. 156). Along the same lines, Riva and IJsselsteijn (2003) commented,

> The obvious difference is that of communication which is central to social presence but unnecessary to establish a sense of physical presence. Indeed a medium can provide a high degree of physical presence without having the capacity for transmitting reciprocal communicative signals at al. Conversely, one can experience a certain amount of social presence, or the ‘nearness’ of communication partners, using applications that supply only a minimal physical representation… This is not to say, however, that the two categories are unrelated. There are likely to be a number of common determinants, that are relevant to both social and physical presence. (p. 3)

Physical presence and copresence. Slater et al. (2000), in their examination of physical presence and copresence, asserted that despite the fact that both types of presence may co-vary, it is not an explicit reason for causality; therefore, there is either an unknown (Garau, 2003) or orthogonal (Balu, 2012) relationship between physical presence and copresence: “Talking on a phone with someone might give a strong sense of ‘being with them’ but not of being in the same place as them” (Slater et al., 2000, p. 41).

On the other hand, Schroeder (2002) postulated, “Shared VEs often combine a high degree of presence with a high degree of copresence because the sense of being in another place and of being there with another person reinforces each other” (p. 5), which, in turn, establishes a reciprocal relationship between physical presence and copresence. Another study found a significant positive relationship between physical presence and copresence (Schroeder et al., 2000, 2001; Schroeder, 2002; Slater et al., 2000; Tromp et al., 1998), while others found no relationship at all (Bystron & Barfield, 1999; Casanueva, 2001). However, as Sallnas (2002) reflected, it is “important to investigate interrelations between these two dimensions in relation to performance and to measure collaboration objectively” (p. 2).

Overview and Preparation of the Study

This research seeks to examine the user’s experiences of interactivity and presence while using technology of VE, exemplified by a virtual world of SL. McCarthy and Wright (2004) pointed out that “it is difficult to develop an account of felt experience with technology” (p. 15) mainly because experience is hard to define and it embraces being of rich and evasive at the same moment. Laurel (1991) proposed interpreting the experience of interacting with a computer to the experience of theatre and commented: “Both have capacity to represent actions and situations…in ways that invite us to extend our minds, feelings, and sensations” (1991, p. 32). For Laurel, in the light of interacting with computers, the human senses create the opportunity for user’s execution of action, engagement, and formulation of his or her agency (McCarthy & Wright, 2004). In respect to experiences generated by the VE, as mentioned earlier, Schroeder (2011) pointed out three elements that formulate the user’s experience: place, task, and interpersonal interaction and communication. Taking into consideration the potential of the VE to elevate the sense of physical and/or social presence, the relationship between the user and VE and the nature of formed experiences during that encounter become even more complex and difficult for systematic examination.

Consistent with Ling et al.'s research (2003), the collaborative/shared virtual environments (CVEs, SVEs, MUVEs) have been fittingly associated with the social interaction and learning during the last two decades. Particularly, a platform of virtual world—Second Life (SL)—has been widely used across many interdisciplinary studies. In the evaluation of the learning in SL, De Lucia et al. (2009) found that the learning corresponds strongly with the user's perception of belonging to that learning community and the user's perception of awareness, presence, and communication. Boulos et al. (2007), in their overview of the potential of VWs such as SL in medical and health education, convincingly asserted the pedagogical capability of SL and listed a good number of projects: "Heart Murmur Sim" (San José State University), "Nutrition Game" (Ohio University), "The Gene Pool" (Texas Wesleyan University in Fort Worth), and "The US Centers for Disease Control and Prevention." Ultimately, Jarmon et al. (2009) examined the instructional effectiveness of SL as an experiential learning environment for interdisciplinary communication and used research methods of journal content analysis, surveys, focus groups, and virtual world snapshots and video to investigate applicability of SL as a learning tool.

De Lucia et al. (2009) asserted the potential of VE's technology:

> This kind of environment renounces to the adoption of immersive hardware, but offers several advantages: settings can be created with a reduced cost, can be accessed by a

large number of people, and does not require specific devices. Some of them are multi-user environments, enabling several people to share the same setting. (p. 220)

Drawing on the conclusions from De Lucia et al.'s (2009) study, the researcher chose SL for her experiment because of all the technological, economical, and accessibility advantages that SL provides in comparison to other systems. Bani et al. (2009) designated SL as "a multi-user participant-created 3D world, [that] has achieved a great diffusion, by offering off-the-shelf components (avatars, scripted objects, and animations) that can be easily modified, reused, and bought" (p. 125). It is also important to mention a feature of photo and artistic realism, which is the implementation in the design of SL's simulators that helps to create environments similar to the real physical spaces. Moreover, a rich level of metaphorical realism that has also been used in the design of SL supports the user's models from real life, which, in turn, can increase the level of usability of these VEs in the first place (Reeves & Minocha, 2011). In a similar vein, De Lucia et al. (2009) evaluated SL as "a believable hypothesis on the 3D future evolution of the Web," which has been created "to naturally favor the social dimension of their 'residents'" (p. 221).

Warburton (2009) called attention to the importance of socialization and social acts, which reinforce SL's popularity among the users and are stimulated by "multiple communication channels, viewable avatar profiles and the intricately built architecture and objects" (p. 419). In his analysis of SL, Warburton (2009) also applied Engeström's (1999) conceptualization of an *object-driven sociality*, which has its theoretical foundations in Activity Theory (AT; Leont'ev, 1978; Vygotsky, 1978)—the "idea that learning is a mediated activity which occurs within a social context" (Down, 2004, p. 188). Although Engeström (1999) proposed five principles on which AT is established, in the context of SL and Warburton's analogy, it is relevant to focus only on the first: "[A] collective, artifact-mediated and object-oriented activity system, seen in its network relations to other activity systems, is taken as the primary unit of analysis" (1999, p. 4). Taking this principle into consideration, Warburton (2009) argued that sociality in SL emerges "in the bonds that form within virtual communities and the subcultures that develop in-world [in SL]" that consequently generate "the rich landscape of objects and people" (p. 419). Precisely, because people in SL have relationships with all created elements of that environment (either by other people or by the user him/herself), these objects gain a notion of sociability and shared interest from other users and resemble a visual representation of one's "shared" creativity. In turn, VW, like SL, provides "a reason (we can call them social objects) around which people can connect together and want to continue those connections" (Warburton, 2009, p. 420), which is mainly sustained through a rich spectrum of communication tools that is available in this environment.

Therefore, another reason for using SL, in establishment of the experimental settings for the quantitative study of physical and social presence, was the possibility to allow participants to communicate with other people who were also logged to the platform in a fairly synchronous and interactive way, as was described in an earlier portion of the study.

The physical presence of users in SL could be manifested by their virtual embodiments—avatars. According to Biocca (1997), one can experience him/herself when "one's actual self is mediated by technology" (Lee, 2004, p. 40) or is artificially generated by technology (Mantovani, 1995). On that account, Lee (2004) defined a virtual self as "either the para-authentic representation of a technology user, or an artificially constructed alter-self (or selves) existing inside a virtual environment" (p. 40). Taking this definition further, Lee (2004) commented, "Although the act of experiencing an actual self can be neither explicit nor usual in real experience, the act of experiencing a virtual self is both explicit (e.g., perceiving, manipulating, and interacting with your [one's] avatars) and quite common in virtual experience" (p. 40). Another significant advantage of having an avatar is the opportunity to interact with other social entities. Their reactions to other virtual selves (such as sending responses or acknowledging one's virtual self) "play a key role in eliciting the feeling that alter-selves exist inside a virtual environment" (Lee, 2004, p. 40). Yee et al. (2007), in their analysis of the ways in which social norms of gender and behaviors of avatars are constructed, such as interpersonal distance (IPD) and eye gaze, discovered that "our social interactions in online virtual environments, such as Second Life, are governed by the same social norms as social interactions in the physical world" (p. 119). Therefore, in most cases, the avatars mimic and reciprocate behaviors of their real doppelgängers, which, in turn, can serve as a starting point "to study social interaction in virtual environments and generalize them to social interaction in the real world" (Yee et al., 2007, p. 119).

Based on their study, Bailenson et al. (2007) concluded that the sense of presence (Blascovich, 2002; Heeter, 1992; Lee, 2004; Lombard & Ditton, 1997; Loomis, 1992) assesses "how 'real' one believes a mediated environment is in terms of nonverbal behaviors (Garau et al., 2001), physiological responses (Slater, Usoh, & Steed, 1994), and other measures" (p. 116). Bearing this definition of presence in mind, Warburton (2009) identified three separate layers of presence for SL that are pertinent for the objectives of this study and have been accordingly adapted in the experiment. The *physical presence layer* (PPL) consists of two elements: (a) *visual proximity* or “the main window on the 3-D setting” (Warburton, 2009, p. 420), which allows the avatars to see each other (in either endogenous or exogenous POV); and (b) *physical proximity*, which helps to determine other users’ location in 3D metaverse (supported by a tool of in-world 2D maps—both a SL world map and a region’s mini-map) and interpret gestures, poses, and all body movements of other users’ avatars. The *communication presence layer* (CPL) aids in the possibility of interacting with others and exchanges messages by using communications tools (for a review, please refer to Appendix J: Figure 3). Lastly, the *status presence layer* (SPL), though it “provides minimal information about in-world presence” (Warburton, 2009, p. 420), signals the actual availability mode of others—either on- or offline. From the practical point of view, the physical presence layer can be seen as a possible catalyst for the physical presence as operationalized by Schubert et al. (2001). The communication layer and status, on the other hand, can foster the sense of social presence since both accessorize the user with the possibility of social interaction and communication acts.

For the purpose of this study, 21 avatars (seven per each condition) were prepared in advance. To each participant, the avatar matching his or her gender was assigned in accordance with Weibel et al. (2008), who argued that to guarantee a stronger identification between the participant and his or her avatar, the gender of the avatar and participant should be the same. In addition, to avoid risks for a construction of bias in racial identity of the participant, which, in consequence, could affect the participant’s identification with his or her virtual self, all avatars were designed to be as racially ambiguous as possible (see Appendix E: Figure 4, 5, 6). The exogenous viewpoint for the avatar was chosen, which allowed the participant to see him/herself embodied as an avatar and enabled the participant to have a better view of the world and control the environment from the position of the avatar (Ivory, 2012), as mentioned earlier.

Research questions and hypotheses. Taking into consideration the review of the literature as well as discussions about existing approaches to examining interactivity and presence, the following research questions and hypotheses were objectives of this study:

RQ1: Which features are responsible for the construction of interactive experience?

H1: A higher degree of perceived interactivity leads to a higher level of physical presence.

H2: A higher degree of perceived interactivity leads to a higher level of social presence.

H3: During the interactive experience, the sense of physical presence and social presence will have a reciprocal relationship.

Methodology

Design of the Experiment

To investigate differences in the user experience of physical and social presence, the researcher established three conditions through which varying levels of interactive experience could be generated: (1) pre-determined, (2) middle-determined, (3) open-ended. The researcher manipulated a degree engagement, responsiveness, control, and communication in each condition that had its distinct (with a fairly unfamiliar theme) and separate simulator to which twenty- six (*N*=26) participants were randomly assigned. Moreover, the researcher controlled time so that each subject in the three conditions spent an equal amount of time to explore. Accordingly, when participants entered a particular simulator, they were asked to perform the following task: “Please spend ten minutes on exploring and learning about the place to which you were assigned." The "welcome screen" from which participants began their exploration of SL was uniform among all conditions and had the following interface options activated by default (see Appendix J: Figure 8): (1) a simulator/region mini-map (PPL—physical proximity: how to find oneself in relation to the physical place of VE [marked by yellow dot] and others [green dots]; (2) nearby text chat (CPL; the possibility to communicate with others); (3) navigation controls (PPL—physical and visual proximity: how to walk, run, fly); (4) camera controls (PPL—visual proximity: zoom in/out, pan left/right, mouselook [endogenous POV]). The other parts of the interface, such as profile, people, voice chat (disabled in the experiment), and destinations, could be turned on by the participant. Before the actual experiment session started, five minutes of tutorial were provided on the orientation-themed simulator, where each participant could learn a basic set of skills of how to use SL or to test the elements of interface mentioned above. The participants received a handout (see Appendix D) with additional information regarding the interface, which they could use during the experiment. A brief description of differences between each condition is discussed below.

Condition 1: pre-determined. The first condition was constructed in a simulator "Virtual Ability," the main purpose of which, in general, is to help new users learn how to use SL. The simulator consisted of a pre-determined and restricted path, with charts and information signs of how to use different options of the SL interface, including how to navigate and move through the VE, create new objects, change appearance, and communicate. From the starting point, the participant was asked to explore and learn about the "Virtual Ability" simulator by following the green arrows that were implemented along the path. In this way, the participant's movement and navigation were strictly guided to ensure that he or she did not get lost in the VE (see Appendix J: Figure 9) and was moving along a path during the entire experimental stage. Also, in regard to modification of the content or task, freedom was given only in the amount of information that the participant had read. Practically speaking, the participant did not have to read every single sign; however, he or she had to follow the arrows. If the participant decided to learn more, she or he could execute specific actions that were mentioned on a particular sign. For instance, in addition to textual instructions, the participant could test the ability of his or her avatar to fly in practice by following a step-by-step manual that had been displayed on the sign. If a task was completed successfully, the participant was notified in the form of a congratulatory message in a chat window. Therefore, the participant was receiving a continuous feedback about his or her progress in the execution of a task.

The participant was isolated from other people's avatars and could communicate only with the embodied agents (bots) that belonged to the path—for example, when the participant was reading about how to communicate in SL. As a part of the exercise, the participant could test communication tools when talking with the embodied agent of monkey. However, this communication was limited to "pre-programmed" responses, which were not controlled by any human agent, as opposed to the avatar that was controlled by the participant. Logistically speaking, if the participant wrote something in a chat window, a monkey responded to the participant's message with limited linguistic flexibility, which was based on a partial recognition of the participant's words and not on logical reasoning. Although the option of communication was provided in this condition, a conversation itself due to the nature of the artificiality of the second party (the embodied agent of monkey) was rather restricted and could occur out of context, as a few examples from the actual experiment illustrate and will be discussed in the results section.

Despite the fact that the path was surrounded by an island-themed design, which also included spatialized sounds similar to the real beach (for example, sounds of waves, wind, and birds, which the participant could hear at any given moment during the exploration of the simulator), the goal was to keep and focus the participant's attention on reading the signs. In turn, all acquired information about the place was based on reading pre-determined materials; if a participant wanted to learn more about practical components of this information, he or she could perform actions that were included on a particular sign. However, the participant was not required to execute these actions and thus, a choice about exercising a particular action was given to the participant. The overall experience was directly task-oriented.

Condition 2: middle-determined. The second condition was designed in a simulator "Japan Kanto," a replica of the Edo Period Japanese environment (~1650), characterized by a high fidelity and realistic visual representation of Japanese architecture, art, culture, and gardens from this period. Although a simulator primarily supports users who are interested in role-playing gaming (RPG), which in this case is the participation and promotion of the Edo Period, the environment of Japan Kanto can also be explored as a tourist destination: the open-air museum (see Appendix J: Figure 10). For instance, users can visit the Kaibatsu Samurai Clan at the virtual replica of Matsumoto Castle, the Harusaki Onsen, a traditional Edo Period hot spa, or one of the many Tea Houses that have been designed for public access as places of social gathering. When the participant was sent to this simulator, he or she could choose one of the four paths to explore. However, there were not any signs or additional materials regarding information about a particular path. The choice about the exploration of “path” was given to the participants from the beginning, highlighting the physical aspects of VE. In addition to marvelous visuals of Japanese architecture, the participant’s experience was supplemented by a rich amount of spatialized sounds of birds, sea, water, and wind. Although there were not any other avatars around, the participants could hear sounds of people talking, laughing, original Japanese singing, or samurai fighting while visiting different parts of the simulator. During the exploration of a particular path, the participant could interact with existing objects (hummingbird, boat) or create and build new objects. Therefore, anything that the participant was able to learn about this simulator was directly based on his or her choice and the amount of explored space that he or she wished to explore in the first place.

Condition 3: open-ended. The third condition was set up in a three-dimensional matrix of Dublin city. However, in contrast to the second condition, the Dublin simulator did not include any spatialized sounds. The starting point for the participants was near a replica of the University of Dublin, Trinity College (1652), one of the oldest universities in Ireland (see Appendix J: Figure 11). The participants were asked to explore Dublin city in any direction they wanted; therefore, the participant had a freedom in choice of direction similar to the second condition. In addition, near any significant building of Dublin city, the participant could find a sign with the building’s name and a brief history. Some replicas of Dublin architecture in its 3D representation include St. Stephen’s Green, The Bank of Ireland, Bewley’s Coffee House, Grafton Street, Ha’Penny Bridge, and The Shelbourne Hotel. On the other hand, in contrast to the pre-determined and middle-determined conditions, only in the Dublin simulator could participants find avatars of other people. Thus, a third condition was promoting not only exploration of the physical space (which was a major case for the second condition), but predominantly the opportunity to talk and learn about Dublin city from other people by communication exchange, making the option of communication the most accessible in contrast to other conditions. For instance, apart from exploration of Dublin as a place, the participant could visit the Blarney Stone, an equivalent of a virtual restaurant/pub, where the participant could have social interactions with other people.

Operationalization of Variables

Independent variable: interactivity. In this study, the interactivity is the independent variable and is defined as the user's perception of engagement, responsiveness, control, and communication in the mediated environment of SL. It is operationalized as one of the following situations: Condition X_1 (pre-determined), Condition X_2 (middle-determined), or Condition X_3 (open-ended), in which the user can encounter the sense of physical and/or social presence as results of interactive experiences. To measure the user's perception of interactive qualities for SL, the rating scale (developed by Robinette (2011), was used in the survey and included in Question 8 & Question 9 (see Appendix B). Participants' responses to the items from Question 8 & Question 9 were highly correlated ($\alpha = .87$). Therefore, all items were averaged to form a perceived interactivity rating.

Dependent variables: physical and social presence. According to Schubert et al. (2001), the sense of physical presence is "the subjective sense of being in a virtual environment" (Schubert et al., 2001). Accordingly, as a result of the factor analyses and the structural equation modeling (SEM) and based on the construction of a spatial-functional mental model of VE (for details, please refer to literature review), Schubert et al. (2001) constructed the Igroup Presence

Questionnaire (IPQ) to conceptualize and operationalize physical presence. In this research Schubert et al.'s (2001) was used and applied in the experiment to collect data on the user's sense of physical presence.

As discussed earlier, social presence reflects the perception of being in an environment with other people. In light of the Networked Minds Theory (NMT) of social presence elaborated by Biocca and Harms (2002) and Swinth and Blascovich's (2002) three levels of social interaction, Bailenson et al. (2003) developed their five-item self-report, the Social Presence Questionnaire (BSPQ), which can be seen as a consolidation (see Appendix J: Figure 13) of Biocca and Harms (2002) and Swinth and Blascovich's (2002) ways of defining social presence. In this study, Bailenson et al.'s (2003) approach was used to measure other-awareness and perceived realism of the other avatars as well as how human-like and socially relevant the other avatars were.

In conjunction with research findings from Schubert et al. (2001) and Bailenson et al. (2003), the dependent variables (Y) for this study were operationalized in the form of self-reported measures of physical presence (Y_1) and social presence (Y_2). Figure 7 (see Appendix J) illustrates the hypothesized relationships among these variables. Table 11 reports the instruments employed in this study, along with the sources of the measures.

Table 11

The Methodological Instruments Employed in the Present Study

Methodological Tools			
	Variables		
	Dependent	**Independent**	
	Interactivity	Physical Presence	Social Presence
	The user's perception of engagement, responsiveness, control, and communication in the mediated environment of Second Life.	"The subjective sense of being in a virtual environment" (Schubert et al., 2001).	The perception of being in an environment with other people. [Based on the Networked Minds Theory (NMT) by Biocca and Harms (2002) and Swinth and Blascovich's (2002) three levels of social interaction].
Operationalization:	Condition X_1 (pre-determined), Condition X_2 (middle-determined), or Condition X_3 (open-ended), in which the user can encounter the sense of physical and/or social presence as results of interactive experiences.	The dependent variables (Y) for this study were operationalized in the form of self-reported measures of physical presence (Y_1) and social presence (Y_2).	
Self-Report:	The rating scale in the survey (Question 8 & 9, see Appendix N).	Igroup Presence Questionnaire (IPQ): 10 items (see Appendix B).	Social Presence Questionnaire (BSPQ): 5 items (see Appendix B).
References:	Robinette (2011)	Schubert et al. (2001)	Bailenson et al. (2003)

Questionnaires. For the purpose of this study, post-experiment questionnaires were developed for further investigation of physical presence and social presence. Each construct used previously validated scales for measuring. Specifically, the sense of physical presence was assessed using Schubert et al.'s (2001) IPQ, and the sense of social presence was measured with Bailenson et al.'s (2003) Social Presence Questionnaire (BSPQ).

The logic behind the selection of these specific questionnaires is grounded in their relevance to what the study aims to measure. For example, the conceptualizations upon which the IPQ is based are particularly well matched with those of this study. For the purpose of this study, IPQ (2002) was modified and used to measure participants' perceptions of (a) *involvement* as captivation of one-way attention (items: INV2, INV3, INV4), (b) *spatial presence* as participants' sense of being there through self-awareness as well as acting from within it (items: SP1, SP2, SP4, SP5 and G1), and (c) *realism* of the environment (items: REAL 2, REAL 4). Overall, 10 items (of 14 total) were used in the experiment. The reliability of the modified scale was α=. 78. A complete report on the IPQ's scale reliability is presented in the results section. For the purpose of measuring social presence, Bailenson et al.'s (2003) BSPQ was administered as it applied to this study's goals. Specifically, BSPQ asked participants only about their perceptions of others in the virtual environment, rather than about interactions with other avatars or objects (Bailenson et al., 2005). The reliability of the BSPQ scale was α=. 71. Both questionnaires asked questions on a 5-point-Likert scale (strongly disagree to strongly agree).

Apart from the questions adapted from IPQ and BSPQ that have been implemented into a survey, a few questions regarding general demographic information (gender, age), the experience of playing video games (level of expertise, familiarity with SL and/or other games, and the quality of interactivity in SL [adapted from Robinette, 2011]) were added to the survey. Overall, participants were asked to answer 13 questions. A complete copy of the survey is included in Appendix B.

Sampling Procedures

The recruitment of participants for the experiment was administrated in accordance with the requirements and policy of the Rochester Institute of Technology (RIT) and the Institutional Review Board (IRB). The researcher had individually contacted faculty members of the Department of Communication, College of Liberal Arts (COLA) and requested permission to distribute information about a research study in any of the undergraduate level classes that a particular instructor was teaching during the spring quarter 2012. In addition, the researcher received help in promoting participation in her research; two instructors decided to offer incentives in their classes for participation in the study. The researcher established a website devoted to her study with a brief description of the planned experiment, possible dates when interested students could sign up, and the location where the experiment was taking place. Each student who signed up to participate was accordingly scheduled for one of eight available sessions and notified with a confirmation email about his or her schedule choice. Moreover, an invitation with a link to the website was sent out through the email subscription lists in the Department of Communication, the School of Interactive Games and Media, and the School of Informatics. Promotional posters and fliers were also distributed in the popular parts of RIT's campus.

Before the experiment started, the researcher arranged a meeting with the management of the computer labs at COLA to ensure proper use of its space and equipment for the experiment.

Accordingly, eight sessions were scheduled at the Liberal Arts Mac Lab. The researcher received permission to use 25 Apple 24" iMac computer stations, along with the headphones plugged into each computer. Details regarding operation systems, hardware, and software that were used in the experiment are presented in Table 12.

Table 12

Technical Details for Apple 24" iMac Used in the Experiment.

Technical Details for Apple 24" iMac	
Operation System	• OS X 10.6.8
Hardware	• Intel Core 2 Duo 2.8 GHz • 4 GB DDR2 SDRAM • 320 GB Serial ATA 2 Hard Drive • 256 MB ATI Radeon HD 2600 Pro
Software	• Second Life Viewer v3.3.1 (254524)

One day before the official experiment started, the pilot session was arranged to run SL software and to ensure that it worked properly on all computers. In addition, in order to provide uniform interface rendering and operationalization after each participant had logged in to SL, the same set of settings was configured on all computers. In regard to the logistics, 21 accounts (name of avatars was uniform UserEx[1-7]) and passwords were prepared in advance; thus, when the experiment started, the participant only had to press the "Login" button. After each experimental session, the researcher restarted each avatar's account to the default configuration from the beginning of the experiment for the next session.

Overall, 78 (N=78) students (undergraduate and graduate) participated in the experiment that took place from May 4 to May 18, 2012. To each of three experimental conditions, twenty-six (N=26) subjects were assigned randomly.

Experimental Procedures

When subjects reported to the study venue at the Liberal Arts Mac Lab, located in the COLA, for their appointment, the researcher welcomed all participants and provided information regarding the objectives of the study. Firstly, the researcher assigned each participant to a computer seat, where the participant received the handout "Experiment Welcome Materials" (see Appendix C), that consisted of a brief description of instructions and steps involved in the experiment.

After a review of the experiment's procedures on the welcome screen of the assigned computer, each participant was asked to read and sign (by clicking the appropriate box) the Online Consent Form (see Appendix A). Then, the researcher distributed the hard copy of the Consent Form to every subject. Next, to enhance the subjects' focus on the experiment, the researcher prevented all distractions from phone calls, text messages, or e-mails as much as possible; next the researcher distributed specific instructions (“Instructions Module 1/2/3”; see Appendix D) for the experiment. In addition, signs were posted near each computer’s desktop used in the experiment to ensure compliance with study procedures.

All participants received the same set of instructions and were notified once again about their right to terminate participation at any time:

1) *Please click “Login,” as indicated in the picture below* (pointing to the picture in the “Instruction Module 1/2/3” handout).

2) *After logging in, please spend five minutes on a tutorial session. You can use the instructions provided in the handout materials to learn how to use the SL interface* (all materials that could be tested are included in the “Instruction Module 1/2/3” handout). *Please make sure that your headphones work properly (stereo channels are active). In case of problems, please notify the researcher BEFORE the tutorial session ends*.

3) Comment: After a tutorial session was over, the participant was sent to the specific simulator that correlated with the condition to which the participant was assigned.

[When on the simulator, the participant was asked to do the following:]

Please spend 10 minutes exploring and learning about the place to which you were assigned by:

- [For Module 1; Simulator: “Virtual Ability”]: *following the green arrows and reading all signs along the path*.

- [For Module 2; Simulator: "Japan Kanto"]: *choosing one of the four paths*.
- [For Module 3; Simulator: "Dublin City"]: *going in any direction you want to*. *You may use all the skills that you have just acquired during the tutorial session AND/OR all materials included above* (in the "Instruction Module 1/2/3" handout).

4) [After ten minutes of the experimental session, the participant was asked to do the following:]

   Please open a Chrome browser and take the survey at [the survey's address]. *On the last page of the survey, please click on the "Submit" button to finalize your participation in the experiment*.

Data Analysis Procedures

All data was collected using "SurveyGizmo," a Web-based software company that enabled the creation of the online materials used in the experiment (the survey and the consent form). Next, data was analyzed using IBM SPSS© Statistics (Version 20) to run all appropriate analyses, including descriptive statistics, the reliability of scales (IPQ and BSPQ), One-Way Between-Groups ANOVA with Post-Hoc Tests (for IPQ and BSPQ), and the correctional analyses of IPQ and BSPQ scales.

RQ1 was analyzed by employing descriptive statistics to determine which qualities of SL supported the generation of interactive experiences features. H1 and H2 were tested using a One-Way Between-Groups ANOVA tool to designate the effects of the independent variable (IV)—with three conditions: Condition X_1 (pre-determined), Condition X_2 (middle-determined), and Condition X_3 (open-ended)—on the dependent variables (DVs)—physical presence and social presence. For H3, correlational analysis of IPQ and BSPQ was performed. All parametric tests used an alpha of 0.05 to determine statistical significance. The next section discusses the results for all parametric tests that have been applied in this study.

Results

The Sample

Subjects participating in the study (N = 78) were predominantly between the ages of 18 and 34; 46.2% of the subjects were male (n = 36) and 53.8% were female (n = 42). While 82.1% (n = 64) reported having previous experience with playing video games, 17.9% (n = 14) reported not having such experience. In addition, a small number of participants reported having a previous experience with SL (19.2%, n = 15). Independently of knowing or not knowing the SL platform prior to the experiment, the subjects were randomly assigned to one of three possible conditions (1: pre-determined, 2: middle determined, 3: open-ended). The number of subjects per condition was N = 26. A distribution of gender for each condition and the level of video game playing are presented in Appendix E (see Table 1 and Figure 1).

Moreover, the participants were able to describe their experiences after the experiment in the form of open-ended responses for Question 13 (see the survey, Appendix B). Overall, participants (N = 78) used 112 different adjectives to describe their experiences with regard to SL. The most popular adjectives were “interesting” (n = 31) and “funny” (n = 20). Although Question 13 was not mandatory, 97.4 % of all participants (N = 78) provided answers, suggesting a high level of participation and collaboration in the study’s objectives. A full list of adjectives used is provided in Table 2 (see Appendix H).

Another open-ended and non-mandatory question (Question 3) asked participants about their preferences in terms of playing specific video games. Overall, participants listed 219 titles of video games played (see Appendix H: Table 1). The title that was mentioned most often was *Call of Duty* (*n* = 13), equally with *The Sims* (*n* = 13). The next games in order of popularity were *Mario Bros* (*n* = 10), *The Legends of Zelda* (*n* = 9), Halo (*n* = 8), and *Super Mario Bros* (*n* = 8). Surprisingly, *World of Warcraft*, which is often cited as the most popular MMORPG (Ivory, 2012; Blizzard Entertainment, 2010), was mentioned only four times.

Preliminary Analyses

Before discussing the results from the self-measure questionnaires examining physical and social presence, it is important to elaborate as to whether participants had interactive experiences and what they thought about SL as a media form. Accordingly, the survey asked participants to determine which qualities of the SL medium could be associated with the generation of interactive experiences on a five-point Likert scale. The questions that addressed this issue, and had been also used to answer RQ1, were Question 8 and Question 9 (for the survey see Appendix B).

Question 8 asked participants to rank the extent to which “This virtual world was…interesting, engaging, responsive, easy to navigate and operate, interactive, entertaining.” In general, the participants (*N* = 78) assigned the ranking of “This virtual world was…interesting,” giving it the highest mean score (*M* = 3.91, *SD* = .80). In second place was “This virtual world was… engaging” (*M* = 3.72, *SD* = .97) and in third place was “This virtual world was… interactive” (*M* = 3.64, *SD* = .9). Appendix E (see Table 2) illustrates all of the attributes about which the participants were asked, ranked from the highest to lowest mean scores. When taking into consideration differences in condition, the major interactive quality was different only for condition 1, with the highest mean being that for "This virtual world was…engaging" (*N* = 26, *M* = 3.96, *SD* = .6), then "This virtual world was… interesting" (*M* = 3.92, *SD* = .74) and "This virtual world was… interactive" (*M* = 3.88, *SD* = .71). For condition 2 (*N* = 26, *M* = 4.0, *SD* = .94) and condition 3 (*N* = 26, *M* = 3.81, *SD* = .75) "This virtual world was… interesting" was ranked with the highest mean scores. Accordingly, in second place for condition 2 "This virtual world was… engaging" (*M* = 3.69, *SD* = .97) and for condition 3 "This virtual world was interactive" (*M* = 3.62, *SD* = .98). In third place for condition 2 (*M* = 3.54, *SD* = .99) and condition 3 (*M*=3.62, *SD* = 1.2) was, "This virtual world was… entertaining." Table 3 (see Appendix E) describes the distribution of mean scores for each quality among three conditions.

Question 9 asked participants to evaluate their experience in terms of whether or not "While I was in the virtual world, I felt… engaged, in control, able to choose (and/or modify the content), able to response quickly." Overall, participants (*N* = 78) selected "While I was in the virtual world, I felt engaged" (*M* = 3.6, *SD* = .87) as the most relevant reflection of their experiences. Next, respectively, were "While I was in the virtual world, I felt in control" (*M* = 3.54, *SD* = .92) and "While I was in the virtual world, I felt able to modify the content" (*M* = 3.28, *SD* = 1.11; see Appendix E: Table 4 for all mean scores). Condition 3 had an influence over the participants' responses, as they ranked "While I was in the virtual world, I felt in control" with the highest mean score (*N* = 26, *M* = 3.4, *SD* = 1.0), followed by "While I was in the virtual world, I felt engaged" (*M* = 3.38, *SD* = 1.02) and "While I was in the virtual world, I felt able to modify the content" (*M* = 3.23, *SD* = 1.18), which was also in third place in terms of responses in condition 1 (*M* = 3.58, *SD* = .76). For condition 1 (*N* = 26, *M* = 3.77, *SD* = .76) and condition 2 (N = 26, *M* = 3.65, *SD*=0.8), "While I was in the virtual world, I felt engaged" received the highest scores. For both conditions, "While I was in the virtual world, I felt in control" was also in second place (condition 1: *M* = 3.69, *SD* = .79; condition 2: *M* = 3.5, *SD* = .95). In third place for condition 2 was "While I was in the virtual world, I felt able to response quickly" (*M* = 3.08, *SD* = 1.1). Table 5 (see Appendix E) shows all of the results for Question 9 based on condition.

The final question investigating the level of interactivity was Question 10. The participants were given the definition of the concept of interactivity proposed by Bucy and Tao (2007; for the survey see Appendix N) and had to compare the activities they just participated in with the other forms of media used on a regular basis in terms of being either more or less interactive. For the most part, 60.3% participants (*n* = 47) stated that SL was more interactive than other media (see Appendix E: Table 6). The conditions did not influence this statement. The results were as follows: in condition 1, 57.7% (*n* = 15); condition 2, 65.4% (*n* = 17); and condition 3, 57.7% (*n* = 15) subjects described their experiences to be more interactive than they were while using other media (see Appendix E: Table 7, Figure 2a, Figure 2b, Figure 2c). However, the researcher found an interesting distribution of interactive experiences when taking into consideration the participants' genders (see Figure 3). As Table 8 (see Appendix E) illustrates, in condition 1, 54.5% of women (*n* = 6) declared SL to be less interactive while 66.7% of men (*n* = 10) found SL to be more interactive. In condition 2, 55.6% of men (*n* = 5) stated that SL was less interactive while 76.5% of women (*n* = 13) affirmed SL as more interactive. Finally, in condition 3, 64.3% of women (*n* = 9) described SL to be more interactive, while 50% of men (n = 6) designated SL as both less and more interactive than other media for this condition.

Research Question 1. Taking into consideration the results from Question 8 and Question 9, it is possible to answer the question of which specific qualities of SL supported the generation of interactive experiences. Therefore, independently of the condition to which participants had been assigned, interactive experiences could be constructed when the world was (a) interesting, (b) engaging, and (c) interactive. Secondly, the participants felt that while being in SL the most important impressions about this virtual world were: (a) engagement, (b) control, and (c) ability to modify the content.

Apart from the survey's results for Question 8 and 9, during the experiment sessions some participants exhibited the practical outcomes of content modification in the form of changing the appearances of avatars they had been assigned. Although the experimental task did not ask or require participants to change their digital representations, as Figure 4, 5, and 6 (see Appendix E) illustrate, participants adjusted their personal preferences to the default avatars independently of the condition. There were seven default avatars per condition (marked by a black frame on Figure 4, 5, 6). Each avatar is a modification of the default one. After each session, any modified avatars were reset to the default settings. Overall, in condition 1 and condition 2, participants created 20 different personalizations of avatars (10 per each condition) and in condition 3, 11 avatars.

Hypotheses Results

The Reliability of Scales. The IPQ and BSPQ were used to determine the levels of physical and social presence after participants finished the experiment. According to Schubert et al. (2001), the IPQ (14 items) has good internal consistency, as reported in two studies of PQI and PQII, with an overall Cronbach's reliability alpha, a measure that is used to assess reliability across the individual items of a scale (Cohen & Cohen, 1983), of .85 and .87. In the current study, the Cronbach alpha coefficient was .78 and 10 items of original scale were used (see Appendix F: Table 1 and Table 2).

The BSPQ has been previously used in CVE research (Bailenson et al., 2003; Bailenson & Yee, 2006), where Cronbach's alpha was .8 and .85. In this study, the Cronbach alpha coefficient was .71 (see Appendix F: Table 3 and Table 4).

The rating scale of interactive qualities was used to measure the user's perception of engagement, responsiveness, control, and communication in the mediated environment of Second Life (see Appendix B) with an overall Cronbach's alpha .87 for 10 items (see Appendix E: Table 9).

Hypothesis 1. In order to determine if users who play interactive games experienced high levels of physical presence, a one-way between groups analysis of variance (ANOVA) was conducted to explore the impact of interactivity on each of three subscales (Spatial Presence [SP = SP1 + SP2 + SP4 + SP5], Involvement [INV = INV2 + INV3 + INV4], Realness [REAL = REAL2 + REAL4]), general Sense of Being There (G1), and the overall IPQ scale (Total Physical Presence = G1 + SP + INV + REAL). Participants were divided into three conditions and randomly assigned to one: (a) condition 1: pre-determined, (b) condition 2: middle-determined, and (c) condition 3: open-ended.

Firstly, the researcher determined if the assumption of homogeneity was not violated (see Appendix F: Table 5). For the SP subscale, Levene's test of homogeneity of variances was p =

.074, which is greater than .05, and thus the homogeneity of variance was not violated. For the INV subscale, p = .047, which is less than .05; thus the Robust Tests of Equality of Means (see Appendix F: Table 6) were also analyzed. For the Welch test, p = .79 and for the Brown-Forsythe test p = .75. Therefore, the homogeneity of variances was not violated for the INV subscale. For the REAL subscale, p =.37 and for the Total Physical Presence scale, p = .36. In both cases, p was greater than .05, and thus the homogeneity of variance was not violated.

Unfortunately, the researcher did not find any statistically significant difference among the three interactivity groups (see Appendix F: Table 7), so therefore H1 is not supported for (a) G1 $F(2,75)$ = 1.48, p = .23; (b) SP $F(2,75)$ = .59, p = .55; (c) INV $F(2,75)$ = .28, p = .75; (d) REAL $F(2,75)$ = .77, p = .46; (e) Total Physical Presence $F(2,75)$ = .041, p = .96. However, although lacking statistical significance, when looking at the actual difference in mean scores between the conditions (see Appendix F: Table 8), (a) G1 was reported with the highest mean score in condition 2 (N = 26, M = 3.58, SD = .64); (b) SP had reached the highest mean score in condition 3 (N = 26, M = 13.31, SD = 2.57); (c) INV in condition 1 (N = 26, M = 8.38, SD = 2.33); and (d) REAL in condition 2 (N = 26, M = 5.38, SD = 1.24). With regards to total Physical Presence, the highest mean has been detected for **condition 1** (M = 2.99, SD = .62). Table 10 (see Appendix F) illustrates the ANOVA results for each item of the IPQ scale. Therefore, there was no main effect of the experimental conditions on the sense of physical presence and H1 is not supported. This non-supportive finding is expected given that the three conditions were not statistically significant from each other, in terms of Question 8 and Question 9, which reflected the degree of interactivity.

Hypothesis 2. To investigate if users who play interactive games experienced a high level of social presence, a one-way between groups analysis of variance (ANOVA) was conducted to explore the impact of interactivity on Total Social Presence, which consisted of the BSPQ's five items: (a) "I perceived that I was in the presence of another person in the room with me" (BSPQ1),(b) "I felt that the person was watching me and was aware of my presence" (BSPQ2), (c) "The thought that the person was not a real person crossed my mind a few times while being in the virtual world" (BSPQ3), (d) "The person appeared to be alive and conscious of me" (BSPQ4), and (e) "I perceived the person as being only an artificially generated image by the computer and not real person" (BSPQ5). Participants kept the same condition to which they were assigned at the beginning of the experiment, either: (a) condition 1: pre-determined, (b) condition 2: middle-determined, or (c) condition 3: open-ended.

Levene's test of the homogeneity of variances was conducted to ensure that the assumption of homogeneity of variance was not violated (see Appendix F: Table 11). For (a) BSPQ1 $p = .029$, which is less than .05, however, in the Welch test $p = .45$ and Brown-Forsythe $p = .39$, thus the homogeneity of variance was not violated (see Appendix F: Table 12); (b) BSPQ2 $p = .64$; (c) BSPQ3 $p = .74$; (d) BSPQ4 $p = .93$; (e) BSPQ5 $p = .61$; and (f) Total Social Presence $p = .36$.

The researcher did not find any statistically significant difference among three interactivity groups (see Appendix F: Table 13) for (a) BSPQ1 $F(2,75) = .93$, $p = .39$; (b) BSPQ2 F (2,75) = .029, $p = .97$; (c) BSPQ4 F(2,75) = .7, $p = .49$; (d) BSPQ5 F(2,75) = .91, $p = .4$; (e) Total Social Presence F(2,75) = 1.55, $p = .21$. When looking at the actual difference in mean scores between the three conditions (see Appendix F: Table 14), (a) BSPQ1 was reported with the highest mean score in condition 1 (*N* = 26, *M* = 3.38, *SD* = .94); (b) BSPQ2 had reached the highest mean score in condition 2 (*N* = 26, *M* = 2.96, *SD* = 1.1); (c) BSPQ4 in condition 1 (*N* = 26, *M* = 3.19, *SD* = 1.2); (d) BSPQ5 in condition 1 (*N* = 26, *M* = 2.96, *SD* = 1.2). In regard to total Social Presence, the highest mean was detected for **condition 1** (*M* = 3.16, *SD* = .85).

Only for BSPQ3 did the researcher find a statistically significant difference among the three interactivity groups $F(2,75) = 3.91$, $p = .024$. Tukey post-hoc comparisons of the three conditions (see Appendix F: Table 15a and Table 16b) indicate that condition 1 (*M* = 3.35, 95% CI [2.86, 3.83]; see Appendix F: Figure 1) gave significantly higher preference ratings than condition 3 [*M* = 2.46, 95% CI [1.99, 2.94]), $p = .02$. Comparisons between condition 2 (*M* = 3.15, 95% [2.66, 3.65]) and the other two conditions were not significant at $p > .05$ level.

Hypothesis 3. H3 examined if there was a relationship between the sense of physical presence and social presence without and by condition. In order to determine the strength of the relationship and the direction, a correlational analysis of the IPQ scale and the BSPQ scale was computed.

Before performing a correlational analysis, two scatterplots were generated to check for violation of the assumption of linearity and homoscedasticity. The first scatterplot (without taking conditions into consideration) did not have any outliers (see Appendix G: Figure 1). Also, an inspection of the normal probability plots (Normal Q-Q Plots) for Total Physical Presence and Total Social Presence were examined to determine if scores for both scales appeared to be reasonably distributed (see Appendix G: Figure 3a and 3b). In both plots, the observed value for each score was plotted against the expected value from the normal, with a reasonably straight line that suggested a normal distribution. The second scatterplot (by condition; see Appendix G:

Figure 2) also did not have any outliers. For condition 1, points were arranged in a narrow shape, while for condition 2 and 3 points were spread all over.

Next, the relationships between Total Physical Presence (as measured by the IPQ scale) and Total Social Presence (as measured by the BSPQ) without and by each condition were investigated using the Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. Moreover, the strength of the relationship was based on the guidelines provided by Cohen (1988, p.79-81), which suggest: (a) small r = .10 to .29, (b) medium r = .30 to .49, and (c) large r = .5 to 1.

The results of the correlational analysis of Total Physical Presence and Total Social Presence, without taking into consideration experimental conditions, indicate that there was a medium, positive correlation between the two variables, $r = .34$, $N = 78$, $p \leq .002$ (see Appendix G: Table 1). While incorporating experimental conditions, only for condition 1 was there a strong, positive correlation between the two variables, $r = .59$, $N = 26$, $p \leq .001$, with high levels of Total Physical Presence associated with high levels of Total Social Presence (see Appendix G: Table 2). Therefore H3 is “partially” supported since the significant correlation was found only in **condition 1**.

Discussion

Based upon repeated calls to investigate the relationship between the sense of presence and interactivity in communication research, the current study explored differences in the perception of physical presence and social presence when being immersed in one of three conditions characterized by various levels of interactivity—pre-determined, middle-determined, and open-ended—that had been accommodated by the virtual environment of SL.

Although previous studies reported interactivity to be a stimulus for the sense of physical presence (Garramone et al., 1986; Lombard & Snyder-Duch, 2001; Perse et al., 1992; Steuer, 1992) or social presence (Rafaeli, 1988; Rourke et al., 2001; Tu, 2002), in this study, the researcher did not detect any statistically significant differences among the three experimental conditions for either physical presence or social presence.

Only for one item (BSPQ3) from the BSPQ scale ("The thought that the person was not a real person crossed my mind a few times while being in the virtual world") did the researcher find that condition 1 gave significantly higher preference ratings than condition 3. This finding demonstrates that despite a low chance of meeting any other avatars in condition 1 (except for the embodied agents), in comparisons to condition 2 or 3, participants still had perceptions of being present with the others in the VE of SL. However, as discussed before, participants in condition 1 could only communicate with the embodied agent of the monkey, which was a part of the exercise to learn how to communicate in SL, and this task itself was not mandatory (as described in the methodology section). In consequence, any conversation between the participant and the agent was limited and rather restricted due to the nature of the artificiality of the second party. Some responses provided in these conversations, which were saved from the experimental sessions of condition 1, are included in Appendix I. The researcher did not have any data with regards to conversations between participants and other avatars in conditions 2 and 3.

In a similar vein, as described in the literature review, interactivity has been interpreted as the extent to which participants can communicate simultaneously in response to each other's messages (Sohn & Lee, 2005). Accordingly, although conditions 2 and 3 both allowed participants to engage in conversational acts with other avatars, only in condition 1 were participants able to execute communication. Moreover, the highest mean scores for the total Physical Presence (*M* = 2.99, *SD* = .62) and the total Social Presence (*M* = 3.16, *SD* = .85) were also noticed for condition 1. In attempting to explain the advantages of condition 1 over conditions 2 and 3 in the mean scores for physical presence and social presence, it is appropriate to assume that the continuous captivation of the participant's attention due to exercising specific tasks, which was the main organizational premise for condition 1, is an influential factor that should be taken into consideration in explaining the observed disparities. When examining two items of the INV subscale (see Appendix F: Table 9) that address the importance of attention in condition 1, the following mean scores were reported: (a) INV3 (no attention to the real environment) 2.58 and (b) INV4 (attention captivated by the virtual environment) 2.85. Also, the INV subscale, overall, had the highest mean score in condition 1 (*N* = 26, *M* = 8.38, *SD* = 2.33).

According to Schubert et al. (1999), the user can experience presence when the possibilities of his or her bodily actions in the VE are mentally represented as "meshed sets of patterns of actions and that presence is experienced when these actions include the perceived possibility to navigate and move the own body in the VE" (1999, p. 1). As exemplified earlier, Schubert et al. (2001) reformulated these components accordingly as (a) "the sense that we [the users] are concentrating on the virtual environment, and ignoring the real environment" (p. 269) and (b) “the sense that we [the users] are located in and act from within the virtual environment” (p. 269). Considering the importance of acting in the VE, after the analysis of mean scores for other items of the IPQ scale in condition 1, item SP4 (sense of acting in the virtual environment) had the highest mean score among all items ($N = 26$, $M = 3.42$, $SD = 1.02$).

Another relevant conclusion that could be drawn from the experiment involves the construction of spatial presence, which was one of the components of the overall sense of presence in the VE and was defined as the sense of being physically present in the VE (Schubert et al., 2001). Wirth et al. (2007) stated that the spatial presence involves the concept of mental models. According to the authors, the mental model of the environment in which the participant interacts serves as a pre-condition for the sense of spatial presence, and, similarly to Schubert et al.’s study (1999, 2001), is grounded in a cognitive experience. As Tamborini and Skalski (2006) commented, “Although sensory cues can enhance the perception of spatial presence, cognition more than cues govern this experience. People construct models of environments from the spatial cues they perceive and their memories of the spatial environments” (p. 227). Based on the collected data, the sense of spatial presence (SP) reported the highest mean score for condition 3 ($N = 26$, $M = 13.31$, $SD = 2.57$). In accordance with Tamborini and Skalski’s (2006) observation, this finding might be grounded in the fact that condition 3 exemplified a 3D replica of Dublin city. Because of a visual representation of Dublin’s architecture, which correlates with the architecture of cities in the real environment (in terms of design logistics and realness of textures), the participants’ mental model followed an analogy between the real city and the ways in which they perceived 3D Dublin city. However, condition 3 consisted only of the visual mappings of the real city and did not incorporate any audio-spatial clues for the participant to benefit from. Therefore, sensory depth of the presented information in condition 3 was restricted to visual channels only, which, in consequence, could decrease the level of realness for that environment. This point can be supported by the highest mean score of the REAL subscale in condition 2 (see Appendix F: Table 9), in which the participants felt the most accurate representation of the real environment (N = 26, M = 5.38, SD = 1.24), and which not only promoted the marvelous architecture of Japan but also agglomerated various spatially based audio clues (for a description of condition 2 please see methodology section).

As discussed earlier, Steuer (1992) considered interactivity to be a characteristic of the medium and addressed its relation to the sense of presence in VE. The author examined the human experience of presence in conjunction with the technological variables of vividness and interactivity that predetermine the extent of the experienced presence (Schorr, 2003). While vividness determines the ability of a technology to produce a sensory-rich mediated environment, interactivity refers to "the extent to which users can participate in modifying the form and content of a mediated environment in real time" (Steuer, 1992, p. 46). While reviewing whether or not participants actually did modify the content or form of the experimental environment to which they had been assigned, the researcher discovered that although participants received tasks and specific directions in terms of what to do in a given environment, they devoted some of their time in the VE not to following directions but rather to modifying and personalizing their avatars. As mentioned in the results section, participants implemented 31 individual adjustments to the avatars to which they had been assigned. These modifications suggest that participants, apart from executing an experimental task, were also looking for ways in which to directly change or alter some components of the task. Therefore, in fostering the sense of physical presence, it is crucial to provide the participants with tools to control the form and content of the VE.

As discussed earlier, Bulu (2012) perceptively pointed out, “Research on the relationship among different types of presences presents conflicting results” (p. 155). In contrast to previous studies, the relationship between physical presence and social presence has been operationalized as an indirect relationship (De Greef & IJsselsteijn, 2000) or a unidirectional causal relationship (Heeter, 1992). This study supports Thie and Wijk’s (1998) conclusion that there is a significant positive relationship between social and physical presence. In their study, Thie and Wijk tested whether or not physical presence would be higher if social presence cues were maximized. In the experimental setting, 48 subjects (in three groups) were asked to execute decision-making tasks in SVE/CVE, while manipulating social presence by social presence cues (e.g., non-verbal cues, proximity and orientation, and physical appearance of others). The authors found that by manipulating social presence cues it is possible to increase physical presence as a whole. In this study, the possibility of communicating with other avatars while in the VE, and therefore incorporating social presence cues into the participant’s experience of social presence, had been manipulated across all three conditions. Although condition 3 provided the highest possibility of meeting and interacting with other avatars because the multidirectionality of interaction and freedom of choice in how to interact in the first place had been a predominant feature of condition 3, users could, but did not have to, follow the same patterns of interaction. In contrast, although condition 1 provided the lowest chance of interacting with others (except for the embodied agent), because this option was part of a possible trajectory for the task (an exercise of how to communicate with others in SL), the participants in this condition received a social clue that it is possible to communicate with others during execution of the task. In conditions 2 and 3, despite the fact that participants could engage in interactions with the other avatars, they did not receive specific instructions or clues on how to initiate these actions. The results from the correlational analysis between Total Physical Presence and Total Social Presence indicate there was a medium, positive correlation between the two variables, $r = .34$, $N = 78$, $p \leq .002$. However, only for condition 1 was there was a strong, positive correlation between the two variables, $r = .59$, $N = 26$, $p \leq .001$, with high levels of Total Physical Presence being associated with high levels of Total Social Presence.

Finally, in regard to the non-supportive findings for H1 and H2, the main reason for the null findings may be attributed to the fact that the experimental conditions were not able to produce meaningful differences across conditions in terms of perceived interactivity, although conditions 2 and 3 provided more interactive features than condition 1. Although speculative, it might be because conditions 2 and 3 required some skills to fully explore possible interactive features provided and the subjects in those conditions lacked such skills and knowledge. In fact, prior literature indicates that expertise is a qualifying variable (moderator) that determines the effectiveness of machine interactivity.

As discussed earlier, Liu and Shrum (2002) in their research on website interactivity emphasized the multidimensional nature of the interactivity. The researchers defined interactivity as “the degree to which two or more communicating parties can act on each other, on the communication medium, and on the message and the degree to which such influences are synchronized (p. 54) and argued that the interactivity consists of three aspects of interaction: user-machine, user-user, and user-message (or in Barnes’s, 2003, nomenclature, respectively: a human-computer interaction, interpersonal interaction, and information interaction). To further explore dimensions of website interactivity, in their later study, Liu and Shrum (2009) manipulated the level of a Web site interactivity and task involvement while measuring the consumers' experience in using the Internet. They concluded that for consumers with more experience, a high interactivity site was more effective than a low-interactivity site. In contrast, for consumers with low or no experience, the attitudes toward a high-interactivity site were less positive than for a low-interactivity site. In addition, researchers found that when a level of involvement is low, both types of consumers—experienced and un-experienced in using a Web site—will not be motivated enough to engage themselves in the interaction with a Website, even if the level of interactivity is high.

Conclusion

The popular "philosopher of cyberspace" Michael Heim (1993) asserted the following about VR technology:

> VR is the first technology to be born socially self-critical. Publicly debated at birth, VR is being talked about even though it is still in its early embryonic stages…[and] may be signaling a new relationship we have to technology in general. After all, is not VR the world reborn in artificial form? …Many think this advance speculation is appropriate, for we are positing ourselves to create whole worlds in which we will pass part of our lives. (p. 142)

Despite the fact that it may take some time before a complete "illusion of non-mediation" and the sense of "being there" can be accomplished, with dynamic progress in the development of tools for new media, the moment of reaching metaphysical maturity in VEs is drawing closer.

With regard to these environments, Riva and Galimberti (2001) concluded that their key feature rests on interactions, which, in turn, serve as the building blocks for a fluid form of network and community. Now that people can interact in such environments, a shift may be observed from culture-defining mass media to the proliferation of media as a source of interpersonal communication and interactive experiences. In that sense, communication does not simply represent a transmission of information; more profoundly, it helps to rarefy the structural and processional features of CMC.

In this study, the researcher examined the phenomenon of interactivity and its scope in fostering and intensifying the user experience during participation in a MUVE like SL. As discussed earlier, interactivity is a complex construct that is embodied in a range of debates concerning: (a) the connection between technology and the users, (b) semantic relatedness and "a process-related construct about communication" (Rafaeli, 1997, p. 3), and (c) the extent to which the user subjectively experiences interactivity. In the face of such multidimensionality, this study promoted the definition of Bucy and Tao (2007) of interactivity as "technological attributes of mediated environments that enable reciprocal communication and information exchange, which afford interaction between communication technology and users, or between users through technology" (p. 656). While applying this definition to the study, the researcher manipulated interactivity in terms of technological features and their capacity to engage the users to interact with SL. Taking into account Bucy and Tao's (2007) observation that "the recognition that user interactions and perceptions are evoked by technological engagement and are not synonymous with it" (p. 657), the interactivity could be operationalized as the independent and distinct variable. The manipulation of interactivity resulted in the construction of physical presence and social presence, that were measured with the help of the following self-reports: Schubert et al.’s (2001) IPQ and Bailenson et al.’s (2003) Social Presence Questionnaire (BSPQ).

Finally, the major conclusion that can be drawn from this study is that when taking into consideration a minimal level of sensory cues that the virtual world of *Second Life* (in comparison with HMD or CAVE-type systems) provided to the perceptual apparatus of the users, it can be argued that the user experience is not only governed by technological inputs, but also (and predominantly) by top-down knowledge, which interacts “with these input signals to construct an apparently coherent and complete mental representation” of the VE (IJsselsteijn & Riva, 2003, p. 140). Therefore, apart from rendering a replica of a real environment with the highest level of fidelity possible, the sense of presence can be fostered when the virtual environment provides the user with the opportunity to interact and execute actions, as well as to share created artifacts with other people. At the same moment, however, it is important to emphasize that although both interactivity and presence are critical elements that supplement ways to understand the user experience of interactive and communication technologies, as statistical results suggest, they still are missing from a systematic research in communication studies. Thus, in future research, more studies should be conducted exploring the relationships between presence and interactivity and their potential to enrich the user experience while participating in MUVEs.

References

Ahern, R. K., & Stromer-Galley, J. (2000). The interaction effect: An experimental study of high and low interactivity political websites. *Paper Presented at the 50th Annual Conference of the International Communication Association, Acapulco, Mexico*.

Alba, J., Lynch, J., Weitz, B., Janiszewski, C., Lutz, R., Sawyer, A., & Wood, S. (1997). Interactive home shopping: Consumer, retailer, and manufacturer incentives to participate in electronic marketplaces. *Journal of Marketing*, *61*(3), 38-53.

Allen, J., & Chudley, J. (2012). *Smashing UX design: Foundations for designing online user experiences*. Chichester, West Sussex, UK: John Wiley & Sons.

Allport, A. (1985). The historical background of social psychology. In G. Lindzey & E. Aronson (Eds.), *Handbook of social psychology* (pp. 1-46). New York: Random House.

Amichai-Hamburger, Y., Fine, A., & Goldstein, A. (2004). The impact of Internet interactivity and need for closure on consumer preference. *Computers in Human Behavior*, *20*(1), 103-117.

Argyle, M. (1969). *Social interaction.* London: Methuen.

Auyang, S. Y. (2000). *Mind in everyday life and cognitive science*. Cambridge, MA: MIT Press.

Baecker, R. M. (1987). *Readings in human computer interaction: A multidisciplinary approach*. Los Altos, CA: Morgan Kaufmann.

Bailenson, J., & Yee, N. (2006). A longitudinal study of task performance, head movements, subjective report, simulator sickness, and transformed social interaction in collaborative virtual environments. *Presence: Teleoperators and Virtual Environments, 15*(6), 699-716.

Bailenson, J. N., Aharoni, E., Beall, A. C., Guadagno, R. E., Dimov, A., & Blascovich, J. (2004). Comparing behavioral and self-report measures of embodied agents' social presence in immersive virtual environments. *Proceedings of the 7th Annual International Workshop on PRESENCE 2004, Spain*.

Bailenson, J. N., Blascovich, J., Beall, A. C., & Loomis, J. M. (2001). Equilibrium theory revisited: Mutual gaze and personal space in virtual environments. *Presence: Teleoperators and Virtual Environments*, *10*(6), 583-598.

Bailenson, J. N., Blascovich, J., Beall, A. C., & Loomis, J. M. (2003). Interpersonal distance in immersive virtual environments. *Personality and Social Psychology Bulletin*, *29*(X), 1-15.

Bailenson, J. N., Swinth, K., Hoyt, C., Persky, S., Dimov, A., & Blascovich, J. (2005). The independent and interactive effects of embodied-agent appearance and behavior on self-report, cognitive, and behavioral markers of copresence in immersive virtual environments. *Presence: Teleoperators and Virtual Environments*, *14*(4), 379-393.

Bani, M., Genovesi, F., Ciregia, E., Piscioneri, F., Rapisrda, B., & Salvatori, E. (2009). Learning by creating historical buildings. In J. Molka-Danielsen & M. Deutschmann (Eds.), *Learning and teaching in the virtual world of Second Life*. Trondheim: Tapir Academic Press.

Barfield, W., & Furness, T. A. (1995). *Virtual environments and advanced interface design*. New York, NY: Oxford University Press.

Barnes, S. B. (2003). *Computer-mediated communication: Human-to-human communication across the Internet*. Boston: Allyn and Bacon.

Benford, S., Dourish, P., & Rodden, T. (2000). Introduction to the special issue on human-computer interaction and collaborative virtual environments. *ACM Transactions on Computer-Human Interaction*, *7*(4), 439-441.

Benyon, D., Smyth, M., & Helgason, I. (2009). *Presence for everyone: A short guide to presence research*. Edinburgh: Centre for Interaction Design.

Ben-Ze'ev, A. (2004). *Love online: Emotions on the Internet*. Cambridge: Cambridge University Press.

Bettinghaus, E. (2004). Communication models. In J. Ball, F. C. Byrnes, & J. S. Adam (Eds.), *Research, principles, and practices in visual communication* (pp. 16-28). Greenwich: IAP, Information Age Publishing.

Bezjian-Avery, A., Calder, B., & Iacobucci, D. (1998). New media interactive advertising vs. traditional advertising. *Journal of Advertising Research*, *38*(4), 23-32.

Biocca, F., & Harms, C. (2002). Defining and measuring social presence: Contribution to the networked minds theory and measure (F. Biocca & F. R. Gouveia, Eds.). *Proceedings of the 5th International Workshop on PRESENCE 2002*.

Biocca, F., & Levy, M. (1995). Virtual reality as a communication system. In F. Biocca & M. R. Levy (Eds.), *Communication in the age of virtual reality* (pp. 15-31). Hillsdale, NJ: L. Erlbaum Associates.

Biocca, F., & Levy, M. (1995a). The vision of virtual reality. In F. Biocca & M. R. Levy (Eds.), *Communication in the age of virtual reality* (pp. 3-14). Hillsdale, NJ: L. Erlbaum Associates.

Biocca, F. (1992). Virtual reality technology: A tutorial. *Journal of Communication*, *42*(4), 23-

72.

Biocca, F. (1997). The cyborg's dilemma: Progressive embodiment in virtual environments. *Journal of Computer-Mediated Communication, 3*(2). Retrieved October 23, 2012, from http://jcmc.indiana.edu/vol3/issue2/biocca2.html

Biocca, F., Burgoon, J., Harm, C., & Stoner, M. (2001). Criteria and scope conditions for a theory and measure of social presence. *PRESENCE 2001, Phildephia, 2001*. Retrieved November 23, 2012, from http://www.temple.edu/ispr/prev_conferences/proceedings/2001/Biocca1.pdf

Biocca, F., Harms, C., & Burgoon, J. K. (2003). Toward a more robust theory and measure of social presence: Review and suggested criteria. *Presence: Teleoperators and Virtual Environments*, *12*(5), 456-480.

Blascovich, J. (2002). Social influence within immersive virtual environments. In R. Schroeder (Ed.), *The social life of avatars: Presence and interaction in shared virtual environments* (pp. 127-145). London: Springer.

Blizzard Entertainment. (2010, October 7). World of Warcraft® subscriber base reaches 12 million worldwide. *Blizzard Entertainment*. Retrieved November 3, 2012, from http://us.blizzard.com/en-us/company/press/pressreleases.html?id=2847881

Boellstorff, T. (2008). *Coming of age in Second Life: An anthropologist explores the virtually human*. Princeton: Princeton University Press.

Boulos, M. K., Hetherington, L., & Wheeler, S. (2007). Second Life: An overview of the potential of 3-D virtual worlds in medical and health education. *Health Information and Libraries Journal*, *24*(4), 233-245.

Bricken, W. (1990, September 10). Virtual Reality: Directions of Growth Notes from the SIGGRAPH '90 Panel. *Virtual Reality: Directions of Growth*. Retrieved November 5, 2012, from http://www.hitl.washington.edu/publications/m-90-1/

Brown, J. S., & Duguid, P. (2000). *The social life of information*. Boston: Harvard Business School Press.

Bruner, E. (1986). Experience and its expressions [Introduction]. In E. M. Bruner & V. Turner (Eds.), *The anthropology of experience*. Urbana: University of Illinois press.

Bucy, E. P., & Newhagen, J. E. (1999). The micro- and macrodrama of politics on television: Effects of media format on candidate evaluations. *Journal of Broadcasting & Electronic Media*, *43*(2), 193-210.

Bucy, E. P., & Tao, C. C. (2007). The mediated moderation model of interactivity. *Media Psychology*, 647-672.

Bucy, E. P. (2004a). Interactivity in society: Locating an elusive concept. *The Information Society*, *20*(5), 373-383.

Bucy, E. P. (2004b). The interactivity paradox: Closer to the news but confused. In E. P. Bucy & J. E. Newhagen (Eds.), *Media access: Social and psychological dimensions of new technology use* (pp. 47-72). Mahwah, NJ: Lawrence Erlbaum.

Bulu, S. T. (2012). Place presence, social presence, co-presence, and satisfaction in virtual worlds. *Computers & Education*, *58*(1), 154-161. doi: 10.1016/j.compedu.2011.08.024

Burgoon, J. K., Bonito, J. A., Bengtsson, B., Cederberg, C., Lundeberg, M., & Allspach, L. (2000). Interactivity in human–computer interaction: A study of credibility, understanding, and influence. *Computers in Human Behavior*, *16*(6), 553-574.

Burke, K., & Chidambaram, L. (1999). How much bandwidth is enough? a longitudinal examination of media characteristics and group outcomes. *Journal MIS Quarterly*, *23*(4), 557-580. Retrieved November 1, 2012, from http://dl.acm.org/citation.cfm?id=343625

Bystrom, K., & Barfield, W. (1999). Collaborative task performance for learning using a virtual environment. *Presence: Teleoperators and Virtual Environments*, *8*(4), 435-448.

Calleja, G. (2011). *In-game: From immersion to incorporation*. Cambridge, MA: MIT Press.

Carroll, J. M. (2009). *Learning in communities: Interdisciplinary perspectives on human centered information technology*. London: Springer.

Carruthers, P., & Smith, P. K. (1996). *Theories of theories of mind*. Cambridge: Cambridge University Press.

Casanueva, J., & Blake, E. H. (2000). The effects of avatars on co-presence in a collaborative virtual environment. *Paper Presented at the EGVE'00 - 6th Eurographics Workshop on Virtual Environments, June 2000*.

Casanueva, J. (2001). *Presence and co-presence in collaborative virtual environments* (Unpublished master's thesis). University of Cape Town, South Africa.

Castronova, E. (2002). Virtual worlds: A first-hand account of market and society on the Cyberian Frontier. *The Gruter Institute Working Papers on Law, Economica, and Evolutionary Biology, 1*.

Chou, T., & Ting, C. (2003). The role of flow experience in cyber-game addiction. *CyberPsychology & Behavior*, *6*(6), 663-675.

Coelho, C., Tichon, J., Hine, T. J., Wallis, G., & Riva, G. (2006). Media presence and inner presence: The sense of presence in virtual reality technologies. In G. Riva, M. T. Anguera, & F. Mantovani (Eds.), *From communication to presence: Cognition, emotions and culture towards the ultimate communicative experience* (pp. 25-45). Amsterdam: IOS Press.

Cohen, J., & Cohen, P. (1983). *Applied multiple regression-correlation analysis for the behavioral sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Cohen, J. W. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: L. Erlbaum Associates.

Cooke, L. W. (2007). *Frontiers in higher education*. New York: Nova Science.

Coyle, J. R., & Thorson, E. (2001). The effects of progressive levels of interactivity and vividness in Web marketing sites. *Journal of Advertising*, *30*(3), 65-77.

Csikszentmihalyi, M. (2002). *Flow: The classic work on how to achieve happiness*. London: Rider.

Danchak, M. M., Walther, J. B., & Swan, K. P. (2001). Presence in mediated instruction: Bandwidth, behavior, and expectancy violations. *Paper Presented at the Annual Meeting on Asynchronous Learning Networks, Orlando, FL*.

De Greef, P., & IJsselsteijn, W. (2000). Social presence in the photoshare tele-application. *Paper Presented at PRESENCE 2000 - The 3rd International Workshop on Presence, 2000, Delft, The Netherlands*.

De Lucia, A., Francese, R., Passero, I., & Tortora, G. (2009). Development and evaluation of a virtual campus on Second Life: The case of SecondDMI. *Computers & Education*, *52*(1), 220-233.

December, J. (1996). What is computer-mediated communication. *What Is Computer-Mediated Communication*. Retrieved September 30, 2012, from http://www.december.com/john/study/cmc/what.html

Dennis, A. R., & Valacich, J. S. (1999). Rethinking media richness: Towards a theory of media synchronicity. *Proceedings of the 32nd Annual Hawaii International Conference on System Sciences, 1999. HICSS-32.*

Dennis, A. R., Fuller, R. M., & Valachich, J. S. (2008). Media, tasks, and communication processes: A theory of media synchronicity. *MIS Quarterly*, *32*, 575-600.

Deutsch, K. W. (1952). On communication models in the social sciences. *The Public Opinion Quarterly, 16*(3), 356-380.

Dholakia, R. R., Zhao, M., Dholakia, N., & Fortin, D. R. (2000). Interactivity and revisits to websites: A theoretical framework (working paper). *The Research Institute for Telecommunications and Information Marketing*. Retrieved November 10, 2012, from http://ritim.cba.uri.edu/wp2001/wpdone3/Interactivity.pdf

Dillon, P. M., & Leonard, D. C. (1998). *Multimedia and the Web from A to Z*. Phoenix, AZ: Oryx Press.

Down, C. M. (2004). Situated and situational learning. In J. S. Stein & S. Farmer (Eds.), *Connotative learning: The trainer's guide to learning theories and their practical application to training design* (pp. 181-194). Dubuque, Ia.: Kendall Hunt.

Draper, J. V., Kaber, D. B., & Usher, J. M. (1999). Speculations on the value of telepresence. *CyberPsychology & Behavior, 2*, 349-362.

Durlak, J. T. (1987). A typology for interactive media. In M. L. McLaughlin (Ed.), *Communication yearbook 10* (pp. 743-757). Beverly Hills, CA: Sage Publications.

Dyson, E. (1993). Interactivity means 'active' participation (using computers to facilitate interpersonal communication). *Computerworld*, *27*(50), 33-34.

Egenfeldt-Nielsen, S., Smith, J. H., & Tosca, S. P. (2008). *Understanding video games: The essential introduction*. New York: Routledge.

Ellis, C. A., Gibbs, S. J., & Rein, G. (1991). Groupware: Some issues and experiences. *Communications of the ACM*, *34*(1), 39-58.

Engeström, Y., Miettinen, R., & Punamäki-Gitai, R. (Eds.). (1999). *Perspectives on activity theory*. Cambridge: Cambridge University Press.

Ermi, L., & Mayra, F. (2005). Fundamental components of the gameplay experience: Analyzing immersion. *Paper Presented at DIGRA 2005: Changing Views: Worlds in Play, Vancouver*.

Eveland, W. P., & Dunwoody, S. (2001). User control and structural isomorphism or disorientation and cognitive load?: Learning from the web versus print. *Communication Research*, *28*(1), 48-78.

Ferris, P. (1997). What is CMC? An overview of scholarly definitions. *Computer-Mediated Communication Magazine*, *4*(1).

Flaherty, L. M., Pearce, K., & Rubin, R. B. (1998). Internet and face-to-face communication: Not functional alternatives. *Communication Quarterly*, 250-268.

Fontaine, G. (1992). The experience of a sense of presence in intercultural and international encounters. *Presence: Teleoperators and Virtual Environments*, *1*(4), 482-490.

Gane, N., & Beer, D. (2008). *New media: The key concepts*. Oxford: Berg.

Garau, M. (2003). *The impact of avatar fidelity on social interaction in virtual environments* (Unpublished doctoral dissertation). Department of Computer Science, University College London.

Garau, M., Slater, M., Bee, B., & Sasse, M. A. (2001). The impact of eye gaze on communication using humanoid avatars. *Presented at the ACM CHI 2001 Human Factors in Computing Systems Conference, Seattle, WA.*

Gerhard, M., Moore, D., & Hobbs, D. (2004). Embodiment and copresence in collaborative interfaces. *International Journal of Human-Computer Studies*, *61*(4), 453-480.

Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.

Gibson, W. (1984). *Neuromancer*. New York: Ace Books.

Gibson, W. (1991). Academy leader. In M. Benedikt (Author), *Cyberspace: First steps* (pp. 27-30). Cambridge, MA: MIT Press.

Glenberg, A. M. (1997). What memory is for. *Behavioral and Brain Sciences*, *20*(01).

Glenn, J. C., Gordon, T. J., & Florescu, E. (2011). *2011 state of the future*. Washington D.C.: Millennium Project.

Goffman, E. (1963). *Behavior in public places; notes on the social organization of gatherings.* New York: Free Press of Glencoe.

Grau, O. (2003). Introduction. In *Virtual art from illusion to immersion* (pp. 14-15). Cambridge: MIT Press.

Gross, M., Würmlin, S., Naef, M., & Lamboray, E. (2003). Blue-c: A spatially immersive display and 3D video portal for telepresence. *Proceedings of ACM SIGGRAPH, July*, 819-827.

Grunig, J. E., & Grunig, L. A. (1989). Toward a theory of public relations behavior of organizations: Review of a program of research. In J. E. Grunig & L. A. Grunig (Eds.), *Public relations research annual* (pp. 27-63). Hillsdale, NJ: Lawrence Erlbaum Associates.

Ha, L., & James, E. L. (1998). Interactivity reexamined: A baseline analysis of early business web sites. *Journal of Broadcasting & Electronic Media*, *42*(4), 457-474.

Haklay, M. (2010). *Interacting with geospatial technologies*. Chichester, West Sussex, UK: John Wiley.

Hanssen, L., Jankowski, N. W., & Etienne, R. (1996). Interactivity from the perspective of communication studies. In N. W. Jankowski & L. Hanssen (Eds.), *The contours of multimedia: Recent technological, theoretical and empirical developments* (pp. 61-73). Luton, Bedfordshire, U.K.: University of Luton Press.

Hardy, M., & Heyes, S. (1999). *Beginning psychology*. Oxford: Oxford University Press.

Heeter, C. (1986). *Perspectives for the development of research on media systems* (Doctoral dissertation, Michigan State University, 1986). Michigan State University.

Heeter, C. (1989). Implications of new interactive technologies for conceptualizing communication. In J. L. Salvaggio & J. Bryant (Eds.), *Media use in the information age: Emerging patterns of adoption and consumer use* (pp. 217-235). Hillsdale, NJ: L. Erlbaum Associates.

Heeter, C. (1992). Being there: The subjective experience of presence. *Presence: Teleoperators and Virtual Environments*, *1*(2), 262-271.

Heeter, C. (2001). Reflections on real presence by a virtual person. *The 4th Annual International*

Workshop PRESENCE 2001, Temple University, Philadelphia, PA,. Retrieved November 22, 2012, from http://www.temple.edu/ispr/prev_conferences/proceedings/2001/Heeter.pdf

Heim, M. (1993). *The metaphysics of virtual reality*. New York: Oxford University Press.

Heim, M. (1998). *Virtual realism*. New York: Oxford University Press.

Heim, M. (2001). The erotic ontology of cyberspace. In D. Trend (Author), *Reading digital culture* (pp. 70-86). Malden, MA: Blackwell.

Held, R. M., & Durlach, N. I. (1992). Telepresence, presence: Teleoperators and virtual environments,. *Presence: Teleoperators and Virtual Environments, 1*, 109-112.

Hewett, T. (1992). *ACM SIGCHI curricula for human-computer interaction*. New York: ACM.

Hinckley, K., & Wigdor, D. (2012). Input technologies and techniques. In G. Salvendy (Ed.), *Handbook of human factors and ergonomics* (pp. 95-132). Hoboken, NJ: John Wiley.

Hoffman, H. G. (2004). Virtual reality therapy. *Scientific American Online*. Retrieved October 5, 2012, from http://www.sciam.com/

Hoffman, H. G., Prothero, J., Wells, M. J., & Groen, J. (1998). Virtual chess: Meaning enhances users' sense of presence in virtual environments. *International Journal of Human-Computer Interaction*, *10*(3), 251-263.

Holland, J., & Baker, S. M. (2001). Customer participation in creating site brand loyalty. *Journal of Interactive Marketing*, *15*(4), 34-45.

Hook, K., & Dahlback, N. (1992). Can cognitive science contribute to the design of VR applications. *The 5th MultiG Workshop, Stockholm*.

Horton, D., & Wohl, R. R. (1956). Mass communication and para-social interaction: Observations on intimacy at a distance. *Psychiatry*, *19*, 215-229.

Huang, H. Y. (2003). *Effects of interactivity and expressiveness on perceived social presence, memory and persuasion in interactive health communications* (Unpublished doctoral dissertation). The University of North Caroline at Chapel Hill.

Huguet, P., Galvaing, M. P., Monteil, J. M., & Dumas, F. (1999). Social presence effects in the stroop task: Further evidence for an attentional view of social facilitation. *Journal of Personality and Social Psychology*, *77*(5), 1011-1025.

Husserl, E. (1964). *The phenomenology of internal time-consciousness*. Bloomington: Indiana University Press.

IJsselsteijn, W., & Riva, G. (2003). Being there: The experience of presence in mediated environments. In G. Riva, F. Davide, & W. A. IJsselsteijn (Eds.), *Being there: Concepts, effects and measurements of user presence in synthetic environments*.

IJsselsteijn, W. (2003). Presence in the past. In G. Riva, F. Davide, & W. A. IJsselsteijn (Eds.), *Being there: Concepts, effects and measurements of user presence in synthetic environments* (pp. 18-40). Amsterdam: IOS Press.

IJsselsteijn, W. (2005). History of telepresence. In O. Schreer, P. Kauff, & T. Sikora (Eds.), *3D videocommunication: Algorithms, concepts, and real-time systems in human centred communication* (pp. 7-21). Chichester, England: Wiley.

IJsselsteijn, W. A., Ridder, H. D., Freeman, J., & Avons, S. E. (2000). Presence: Concept, determinants and measurements. *Proceedings of the SPIE*, *3959*, 520-529.

International Society for Presence Research. (2000). *The Concept of Presence: Explication*

Statement. Retrieved November 2, 2012, from http://ispr.info

Ivory, J. D. (2012). *Virtual lives: A reference handbook*. Santa Barbara, CA: ABC-CLIO.

Jarmon, L., Traphagan, T., Mayrath, M., & Trivedi, A. (2009). Virtual world teaching, experiential learning, and assessment: An interdisciplinary communication course in Second Life. *Computers & Education*, *53*(1), 169-182.

Jennett, C., Cox, A., Cairns, P., Dhoparee, S., Epps, A., Tijs, T., & Walton, A. (2008). Measuring and defining the experience of immersion in games. *International Journal of Human-Computer Studies*, *66*(9), 641-661.

Jensen, J. F. (1998). Interactivity: Tracking a new concept in media and communication studies. *Nordicom Review*, *19*(1), 185-204.

Johnson, G., Bruner II, G., & Kumar, A. (2006). Interactivity and its facets revisited: Theory and empirical test. *Journal of Advertising*, *35*(4), 35-52.

Johnson, P. (2010). *Second Life, media, and the other society*. New York: Peter Lang.

Kalawsky, R. S. (2000). The validity of presence as a reliable human performance metric in immersive environments. *Presence 2000: The 3rd International Workshop on PRESENCE 2000, Delft, Netherlands*.

Kamieth, F., Schäfer, J., Naranjo, J. C., Arca, A., & Aleotti, J. (2010). Workshop on interaction techniques in real and simulated assistive smart environments. In B. D. Ruyter (Ed.), *Ambient intelligence: First international joint conference, AmI 2010, Malaga, Spain, November 10-12, 2010 : Proceedings* (pp. 333-336). Berlin: Springer.

Kapp, K. M., & O'Driscoll, T. (2010). *Learning in 3D: Adding a new dimension to enterprise learning and collaboration*. San Francisco, CA: Pfeiffer.

Kim, S. (2011). Web-interactivity dimensions and shopping experiential value. *Journal of Internet Business*, (9).

King, G., & Krzywinska, T. (2006). *Tomb raiders and space invaders: Videogame forms and contexts*. London: I.B. Tauris.

Kiousis, S. (1999). Broadening the boundaries of interactivity: A concept explication. *Annual Conference Association for Education in Journalism and Mass Communication, August, New Orleans, L.A.*

Kiousis, S. (2002). Interactivity: A concept explication. *New Media & Society*, *4*(3), 355-383.

Konijn, E. A., & Bijvank, M. N. (2009). Doors to another me: Identity construction through digital game play. In U. Ritterfeld, M. J. Cody, & P. Vorderer (Eds.), *Serious games: Mechanisms and effects* (pp. 180-203). New York: Routledge.

Kovalchick, A., & Dawson, K. (2004). *Education and technology: An encyclopedia*. Santa Barbara, CA: ABC-CLIO.

Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh: The embodied mind and its challenge to Western thought*. New York: Basic Books.

Landay, J. A., & Myers, B. A. (1995). Interactive sketching for the early stages of user interface. *CHI'95 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 43-50.

Lanier, J., & Biocca, F. (1992). An insider's view of the future of virtual reality. *Journal of Communication*, *42*, 150-172.

Lanier, J., Minsky, M., Fisher, S., Druin, A., & Conn, C. (1989). Virtual environments and interactivity: Windows to the future. *ACM SIGGRAPH Computer Graphics*, *23*(5), 7-18.

Lasswell, H. D. (1948). The structure and function of communication in society. In L. Bryson (Ed.), *The communication of ideas: A series of addresses*. New York: Institute for Religious and Social Studies.

Laurel, B. (1991). *Computers as theatre*. Reading, MA: Addison-Wesley Pub.

Lee, K. M., & Nass, C. (2003). Designing social presence of social actors in human computer interaction. *Proceeding CHI '03 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 289-296.

Lee, K. M. (2004). Presence, Explicated. *Communication Theory*, *14*(1), 27-50.

Leont′ev, A. N. (1978). *Activity, consciousness, and personality*. Englewood Cliffs, NJ: Prentice-Hall.

Lessiter, J., Freeman, J., Keogh, E., & Davidoff, J. (2001). Development of a new cross-media presence questionnaire: The ITC-sense of presence inventory. *Presence: Teleoperators and Virtual Environments*, *10*, 282-297.

Li, H., Daugherty, T., & Biocca, F. (2005). Impact of 3D advertising on product knowledge, brand attitude and purchase intention. In M. R. Stafford (Ed.), *Advertising, promotion, and new media* (pp. 148-173). Armonk, NY.: M.E. Sharpe.

Lieb, T. (1998). Inactivity on interactivity. *Journal of Electronic Publishing*, *3*(3).

Lim, S., & Reeves, B. (2009). Being in the game: Effects of avatar choice and point of view on psychophysiological responses during play. *Media Psychology*, *12*(4), 348-370.

Linden, J. (2007, February 28). Bringing voice to Second Life [Web log post]. Retrieved October 1, 2012, from http://community.secondlife.com/t5/Features/Bringing-Voice-to-Second-Life/ba-p/559643/page/11

Ling, C., Gen-Cai, C., Chen-Guang, Y., & Chuen, C. (2003). Using collaborative knowledge base to realize adaptive message filtering in collaborative virtual environment. *Proceedings, 2003. ICCT 2003. International Conference on Communication Technology*, *2*, 1655-1661.

Lister, M. (2003). *New media: A critical introduction*. London: Routledge.

Liu, Y., & Shrum, L. J. (2009). A dual-process model of interactivity effects. *Journal of Advertising*, *38*(2), 53-68.

Liu, Y., & Shrum, L. J. (2002). What is interactivity and is it always such a good thing? Implications of definition, person, and situation for the influence of interactivity on advertising effectiveness. *Journal of Advertising*, *31*(4), 53-64.

Liu, Y. P. (2003). Developing a scale to measure the interactivity of websites. *Journal of Advertising Research*, *43*(2), 207-216.

Lombard, M., & Ditton, T. (1997). At the heart of it all: The concept of presence. *Journal of Computer-Mediated Communication*, *3*(2). Retrieved November 2, 2012, from http://jcmc.indiana.edu/vol3/issue2/lombard.html

Lombard, M., & Jones, M. T. (2006). Defining presence. *Presented at the Ninth International Workshop on PRESENCE 2006, Cleveland, Ohio, USA*.

Lombard, M., & Snyder-Duch, J. (2001). Interactive advertising and presence: A framework. *Journal of Interactive Advertising*, *1*(2). Retrieved October 2, 2012, from http://jiad.org/article13

Loomis, J. M. (1992). Distal attribution and presence. *Presence, Teleoperators, and Virtual Environment*, *1*, 113-118.

Malaby, T. M. (2009). *Making virtual worlds: Linden Lab and Second Life*. Ithaca: Cornell University Press.

Manetta, C., & Blade, R. A. (1998). Glossary of virtual reality terminology. *International Journal of Virtual Reality*.

Manninen, T. (2003). Interaction manifestations in multi-player games. In G. Riva, F. Davide, & W. A. IJsselsteijn (Eds.), *Being there: Concepts, effects and measurements of user presence in synthetic environments* (pp. 296-304). Amsterdam: IOS Press.

Mantovani, G. (1995). Virtual reality as a communication environment: Consensual hallucination, fiction, and possible selves. *Human Relations*, *48*(6), 669-683.

Markus, M. L. (1990). Toward a 'critical mass' theory of interactive media. In J. Fulk & C. W. Steinfield (Eds.), *Organizations and communication technology* (pp. 194-218). Newbury Park, CA: Sage Publications.

Massey, B. L., & Levy, M. R. (1999). `Interactive' online journalism at English-language web newspapers in Asia: A dependency theory analysis. *International Communication Gazette*, *61*(6), 523-538.

McCarthy, J., & Wright, P. (2004). *Technology as experience*. Cambridge, MA: MIT Press.

McGreevy, M. W. (1992). The presence of field geologists in Mars-like terrain. *Presence: Teleoperators and Virtual Environments*, *1*(4), 375-403.

McKeown, L. (2007). Taking action learning online in the 3D virtual world of Second Life. *The International Review of Research in Open and Distance Learning*, *8*(3).

McLuhan, M. (1964). *Understanding media: The extensions of man*. New York: McGraw-Hill.

McMillan, S. (2002). Exploring models of interactivity from multiple research traditions: Users, documents, and systems. In L. A. Lievrouw & S. M. Livingstone (Eds.), *Handbook of new media: Social shaping and consequences of ICTs* (pp. 163-182). London: SAGE.

McMillan, S. J., & Downes, E. J. (2000). Defining interactivity: A qualitative identification of key dimensions. *New Media & Society*, *2*(2), 157-179.

McMillan, S. J., & Hwang, J. S. (2002). Measures of perceived interactivity: An exploration of the role of direction of communication, user control, and time in shaping perceptions of interactivity. *Journal of Advertising*, *31*, 29-42.

McQuail, D. (2010). *McQuail's mass communication theory*. London: Sage Publ.

Mehbabian, A. (1967). Orientation behaviors and nonverbal attitude communication. *Journal of Communication*, *17*(4), 324-332.

Mehrabian, A. (1968). Some referents and measures of nonverbal behavior. *Behavior Research Methods & Instrumentation*, *1*(6), 203-207.

Miles, I. (1992). When mediation is the message: How suppliers envisage new markets. In M. Lea (Ed.), *Contexts of computer-mediated communication* (pp. 145-167). New York: Harvester Wheatsheaf.

Mindell, D. A. (2004). *Between human and machine: Feedback, control, and computing before cybernetics*. Baltimore: Johns Hopkins University Press.

Minsky, M. (1980). Telepresence. *OMNI Magazine*, *2*, 45-51.

Molyneux, R. E. (2003). *The Internet under the hood: An introduction to network technologies for information professionals*. Westport, CT: Libraries Unlimited.

Morse, M. (1998). *Virtualities: Television, media art, and cyberculture*. Bloomington: Indiana University Press.

Mundorf, N., & Bryant, J. (2002). Realizing the social and commercial potential of interactive technologies. *Journal of Business Research*, *55*, 665-670.

Murray, J. H. (1997). *Hamlet on the holodeck: The future of narrative in cyberspace*. Cambridge: MIT Press.

Murschetz, P. C. (2011). The business value of interactivity. In C. Salomon (Ed.), *Communication Yearbook 35* (pp. 387-423). Taylor & Francis.

Narula, U. (2006). *Communication models*. New Delhi, India: Atlantic.

Narula, U. (2006b). *Dynamics of mass communication: Theory and practice*. New Delhi: Atlantic.

Neuman, W. R. (1991). *The future of the mass audience*. Cambridge [England]: Cambridge University Press.

Newhagen, J. E., & Rafaeli, S. (1996). Why communication researchers should study the Internet: A dialogue. *Journal of Communication*, *46*(1), 4-13.

Nielsen, J. (2010). *Usability engineering*. Amsterdam: Morgan Kaufmann.

Norman, D. A. (1986). Cognitive engineering. In D. A. Norman & S. W. Draper (Eds.), *User centered system design: New perspectives on human-computer interaction* (pp. 31-61). Hillsdale, NJ: L. Erlbaum Associates.

Norman, D. A. (1998). *The design of everyday things*. London: MIT.

Novak, T. P., Hoffman, D. L., & Yung, Y. (2000). Measuring the customer experience in online environments: A structural modeling approach. *Marketing Science*, *19*(1), 22-42.

Nowak, K. L., & Biocca, F. (2003). The effect of the agency and anthropomorphism on users' sense of telepresence, copresence, and social presence in virtual environments. *Presence: Teleoperators and Virtual Environments, 12*(5), 481-494.

Nowak, K. L. (2001). Defining and differentiating copresence, social presence and presence as transportation. *Paper Presented at the PRESENCE 2001 Conference, Philadelphia*.

O'Keefe, D. J. (2003). Message properties, mediating states, and manipulation checks: Claims, evidence, and data analysis in experimental persuasive message effects research. *Communication Theory*, *13*(3), 251-274.

O'Reilly, T. (2005). What is Web 2.0. *O'Reilly Media*. Retrieved September 23, 2012, from http://oreilly.com/web2/archive/what-is-web-20.html

Patterson, M. L., & Manusov, V. L. (2006). *The SAGE handbook of nonverbal communication*. Thousand Oaks, CA: Sage Publications.

Perse, E. M., Burton, P. I., Lears, M. E., Kovner, E. S., & Sen, R. J. (1992). Predicting computer-mediated communication in a college class. *Communication Research Reports, 9*(2), 161-170.

Pescovitz, D. (1999). Getting real in cyberspace. *Scientific American Presents*, (2).

Pinchbeck, D., & Stevens, B. (2005). Schemata, narrative and presence. In M. Slater (Ed.), *The 8th international workshop on PRESENCE 2005: Conference proceedings* (pp. 221-226). London: University College London, Dept. of Computer Science.

Piwek, L. (2008). The dynamic representation of reality and of ourself between real and virtual worlds (A. Briggle, Ed.). In K. Waelbers & P. Brey (Eds.), *Current issues in computing and philosophy* (pp. 24-31). Amsterdam, Netherlands: IOS Press.

Preece, J. (2000). *Online communities: Designing usability, supporting sociability*. New York:

John Wiley.

Quiring, O. (2009). What do users associate with ‘interactivity’?: A qualitative study on user schemata. *New Media & Society*, *11*(6), 899-920.

Radford, A. (2000). Games and learning about forming architecture. *Automation in Construction, 3*, 379-385.

Rafaeli, S., & Ariel, Y. (2007). Assessing interactivity in computer-mediated research. In A. N. Joinson (Ed.), *The Oxford handbook of Internet psychology*. Oxford: Oxford University Press.

Rafaeli, S., & Sudweeks, F. (1997). Networked interactivity. *Journal of Computer-Mediated Communication*, *2*(4).

Rafaeli, S. (1985). If the computer is a medium, what is the message: Explicating interactivity. *Paper Presented at the International Communication Association Convention, Honolulu, HI.*

Rafaeli, S. (1988). Interactivity: From new media to communication. In R. Hawkins, J. M. Wiemann, & S. Pingree (Eds.), *Advancing communication science: Merging mass and interpersonal processes* (pp. 110-134). Newbury Park, CA: Sage Publications.

Raskar, R., Welch, G., Cutts, M., Lake, A., Stesin, L., & Fuchs, H. (1998). The office of the future: A unified approach to image-based modeling and spatially immersive displays. *SIGGRAPH '98 Proceedings of the 25th Annual Conference on Computer Graphics and Interactive Techniques*, 179-188.

Rebelo, F., Duarte, E., Noriega and, P., & Soares, M. (2011). *Human factors and ergonomics in* *consumer product design: Methods and techniques* (pp. 381-402) (M. M. Soares, W. Karwowski, & N. Stanton, Eds.). Boca Raton, FL: CRC Press.

Reddi, N. C. (2010). *Effective public relations and media strategy*. PHL Learing, India.

Reeves, A. J., & Minocha, S. (2011). Relating pedagogical and learning space design in Second Life. In A. Cheney & R. L. Sanders (Eds.), *Teaching and learning in 3D immersive worlds: Pedagogical models and constructivist approaches* (pp. 31-59). Hershey, PA: Information Science Reference.

Rettie, R. (2003). Connectedness, awareness and social presence. *Paper Presented at 6th Annual International Workshop on PRESENCE 2003*.

Rheingold, H. (1993). *The virtual community: Homesteading on the electronic frontier*. Reading, MA: Addison-Wesley Pub.

Rice, R. E. (1984). *The new media: Communication, research, and technology*. Beverly Hills: Sage Publications.

Rice, R. E. (1987). Computer-mediated communication and organizational innovation. *Journal of Communication*, *37*(4), 65-94.

Rimal, R. N., & Flora, J. A. (1997). Interactive technology attributes in health promotion: Practical and theoretical issues. In R. L. Street, W. R. Gold, & T. Manning (Eds.), *Health promotion and interactive technology: Theoretical applications and future directions* (pp. 19-38). Mahwah, NJ: Lawrence Erlbaum Associates.

Riva, G. (2009). Presence as cognitive process. In D. Benyon, M. Smyth, & I. Helgason (Eds.), *Presence for everyone: A short guide to presence research* (pp. 29-32). Edinburgh: Centre for Interaction Design.

Riva, G., & Galimberti, C. (2001). Virtual communities: Social interaction and identity in an electronic environment. In G. Riva & F. Davide (Eds.), *Communications through virtual technologies: Identity, community, and technology in the communication age* (pp. 23-46). Amsterdam: IOS Press.

Riva, G., Davide, F., & IJsselsteijn, W. A. (2003). *Being there: Concepts, effects and measurements of user presence in synthetic environments*. Amsterdam: IOS Press.

Riva, G., Waterworth, J. A., Waterworth, E. L., & Mantovani, F. (2011). From intention to action: The role of presence. *New Ideas in Psychology*, *29*(1), 24-37.

Robinette, J. L. (2011). *Understanding interactive experiences: Perceived interactivity and presence with and without other avatars in the online virtual world Second Life* (Doctoral dissertation, University of Kentucky, 2011). University of Kentucky.

Roda, C., & Thomas, J. (2006). Attention aware systems: Theories, applications, and research agenda. *Computers in Human Behavior*, *22*(4), 557-587.

Roda, C. (2011). *Human attention in digital environments*. Cambridge: Cambridge University Press.

Roehm, H. A., & Haugtvedt, C. P. (1999). Interactive communications via the www: Implications for theory and practice. In D. W. Schumann & E. Thorson (Eds.), *Advertising and the world wide web* (pp. 27-40). Mahwah, NJ: Lawrence Erlbaum Associates.

Rogers, E. M., & Rafaeli, S. (1985). Computers and communication. In B. D. Ruben (Ed.), *Information and behavior*. New Brunswick, NJ: Transaction Books.

Rogers, E. M. (1995). *Diffusion of innovations*. New York: Free Press.

Rosson, M. B., & Carroll, J. M. (2002). *Usability engineering: Scenario-based development of human-computer interaction*. San Fancisco: Academic Press.

Rourke, L., Anderson, T., Garrison, D. R., & Archer, W. (2001). Assessing social presence in asynchronous text-based computer conferencing. *Journal of Distance Education*, *14*(3), 51-70.

Ruffini, G. (2009). Presence and reality. In D. Benyon, M. Smyth, & I. Helgason (Eds.), *Presence for everyone: A short guide to presence research* (pp. 11-15). Edinburgh: Centre for Interaction Design.

Sadowski, W., & Stanney, K. M. (2002). Presence in virtual environments. In K. M. Stanney (Ed.), *Handbook of virtual environments: Design, implementation, and applications*. Mahwah, NJ: Lawrence Erlbaum Associates.

Sallnas, E. L. (2002). Collaboration in multi-modal virtual worlds: Comparing touch, text, voice and video. In R. Schroeder (Ed.), *The social life of avatars: Presence and interaction in shared virtual environments* (pp. 172-187). London: Springer.

Schackman, D. (2009). Exploring the new frontiers of collaborative community. *New Media & Society*, *11*(5), 875-885.

Schorr, A. (2003). Interactivity: The new media use option - state of the art. In A. Schorr, W. Campbell, & M. Schenk (Eds.), *Communication research and media science in Europe: Perspectives for research and academic training in Europe's changing media reality* (pp. 57-112). Berlin: Mouton de Gruyter.

Schramm, W. (1954). How communication works. In W. Schramm (Ed.), *The process and effects of mass communication*. Urbana: University of Illinois Press Urbana.

Schroeder, R. (1996). *Possible worlds: The social dynamic of virtual reality technology*. Boulder, CO: Westview Press.

Schroeder, R. (2002). *The social life of avatars: Presence and interaction in shared virtual environments*. London: Springer.

Schroeder, R. (2008). Defining virtual worlds and virtual environments. *Journal of Virtual Worlds Research, 1*(1).

Schroeder, R. (2011). *Being there together: Social interaction in virtual environments*. New York: Oxford University Press.

Schroeder, R., Steed, A., Axelsson, A. S., Heldal, I., Abelin, A., Widestrom, J., ... Slater, M. (2001). Collaborating in networked immersive spaces: As good as being there together. *Computers & Graphics, 25*(5), 781-788.

Schubert, T., Friedman, F., & Regenbrecht, H. (2001). The experience of presence: Factor analytic insights. *Presence: Teleoperators and Virtual Environments, 10*, 266-281.

Schubert, T., Friedmann, F., & Regenbrecht, H. (1999). Embodied presence in virtual environments. In R. Paton & I. Neilson (Eds.), *Visual representations and interpretations* (pp. 268-278). London: Springer.

Schuemie, M. J., Van der Straaten, P., Krijn, M., & Van der Mast, C. A. (2001). Research on presence in virtual reality: A survey. *CyberPsychology & Behavior, 4*(2), 183-201.

Schultz, T. (2000). Mass media and the concept of interactivity: An exploratory study of online forums and reader email. *Media, Culture & Society, 22*, 205-221.

Severin, W. J., & Tankard, J. W. (2001). *Communication theories: Origins, methods, and uses in the mass media*. New York: Longman.

Shannon, C. E., & Weaver, W. (1949). *The mathematical theory of communication.* Urbana: University of Illinois Press.

Sheridan, T. B. (1992). Musings on telepresence and virtual presence. *Presence: Teleoperators and Virtual Environments*, *1*, 120-125.

Shin, M. (1998). Promoting students' self-regulation ability: Guidelines for instructional design. *Educational Technology*, *38*(1), 38-44.

Shneiderman, B., & Plaisant, C. (2010). *Designing the user interface: Strategies for effective human-computer interaction*. Boston: Addison-Wesley.

Shneiderman, B. (1998). *Designing the user interface: Strategies for effective human-computer-interaction*. Reading, Mass: Addison Wesley Longman.

Shneiderman, B. (2002). *Leonardo's laptop: Human needs and the new computing technologies*. Cambridge, MA: MIT Press.

Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications*. London: Wiley.

Sicilia, M., Ruiz, S., & Munuera, J. L. (2005). Effects of interactivity in a web site. *Journal of Advertising*, *34*(3), 31-45.

Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments. *Presence: Teleoperators and Virtual Environments*, *6*(6), 603-616.

Slater, M. (2002). *Siggraph 2002 course notes on understanding virtual environments: Immersion, presence and performance*. TX: ACM-Siggraph.

Slater, M. (2003). A note on presence terminology. *Presence Connect*, *3*(3).

Slater, M., Brogni, A., & Steed, A. (2003). Physiological responses to breaks in presence: A pilot study. *The 6th Annual International Workshop on PRESENCE 2003*.

Slater, M., Sadagic, A., Usoh, M., & Schroeder, R. (2000). Small-group behavior in a virtual and real environment: A comparative study. *Presence: Teleoperators and Virtual Environments*, *9*(1), 37-51.

Slater, M., Usoh, M., & Steed, A. (1994). Depth of presence in virtual environments. *Presence: Teleoperators and Virtual Environments*, *3*(2), 130-144.

Smart, J., Cascio, J., & Paffendof, J. (2007). Metaverse roadmap: Pathways to the 3D Web. *Metaverse Roadmap: Pathways to the 3D Web*. Retrieved October 12, 2012, from http://metaverseroadmap.org/index.html

Smith, G. M. (1999). *On a silver platter: CD-ROMs and the promises of a new technology*. New York, NY: New York University Press.

Sohn, D., & Lee, B. K. (2005). Dimensions of interactivity: Differential effects of social and psychological factors. *Journal of Computer-Mediated Communication*, *10*(3). Retrieved October 12, 2012, from http://jcmc.indiana.edu/vol10/issue3/sohn.html

Spivack, N. (2007, May 2). Nova Spivack : "Web 3.0 will combine the Semantic Web with social media, enabling a new generation of richer, more shareable, mashable content." [Interview by T. Pellegrini]. Retrieved October 1, 2012, from http://www.semantic-web.at/news/nova-spivack-x22-web-3-0-will-combine-the-semantic-web-with-social-media-enabling-a-new-ge

Steinberg, S. (2007). *An introduction to communication studies*. Cape Town, South Africa: Juta.

Stephanidis, C., Kouroumalis, V., & Antona, M. (2012). Interactivity: Evolution and emerging trends. In G. Salvendy (Ed.), *Handbook of human factors and ergonomics* (pp. 1374-1406). Hoboken, NJ: Wiley.

Steuer, J. (1992). Defining virtual reality: Dimensions determining telepresence. *Journal of Communication*, *42*(4), 73-93.

Stewart, D. W., & Pavlou, P. A. (2002). From consumer response to active consumer: Measuring the effectiveness of interactive media. *Journal of the Academy of Marketing Science*, *30*(4), 376-396.

Stromer-Galley, J., & Foot, K. A. (2000). Citizens, campaigns and online interactivity. *Paper Presented at the International Communication Association, Acapulco, Mexico*.

Sundar, S. S. (2004). Theorizing interactivity's effects. *The Information Society*, *20*, 385-389.

Sundar, S. S., Kalyanaraman, S., & Brown, J. (2003). Impression formation effects in political campaign sites. *Communication Research*, *30*(1), 30-59.

Sundar, S. S., Narayan, S., Obregon, R., & Uppal, C. (1998). Does web advertising work? Memory for print vs. online media. *Journalism & Mass Communication Quarterly*, *75*(4), 822-835.

Sutcliffe, A. (2003). *Multimedia and virtual reality: Designing multisensory user interfaces*. Mahwah, NJ: Lawrence Erlbaum.

Swinth, K. R., & Blascovich, J. (2002). Perceiving and responding to others: Human-human and human-computer social interaction in collaborative virtual environments. *The 5th Annual International Workshop on PRESENCE 2002, Porto, Portugal*.

Tamborini, R., & Skalski, P. (2006). The role of presence in the experience of electronic games.

In P. Vorderer & J. Bryant (Eds.), *Playing video games: Motives, responses, and consequences* (pp. 225-240). Mahwah, NJ: Lawrence Erlbaum Associates.

Taylor, T. L. (2002). Living digitally: Embodiment in virtual worlds. In R. Schroeder (Ed.), *The social life of avatars: Presence and interaction in shared virtual environments*. London: Springer.

Thie, S., & Wijk, J. (1998). A general theory on presence: Experimental evaluation of social virtual presence in a decision making task. *Paper Presented at the Presence in Shared Virtual Environments Workshop, University College London, UK*.

Thorson, K. S., & Rodgers, R. (2006). Relationships between blogs as eWOM and interactivity, perceived interactivity, and parasocial interaction. *Journal of Interactive Advertising*, *6*(2). Retrieved October 23, 2012, from http://jiad.org/article79

Tremayne, M., & Dunwoody, S. (2001). Interactivity, information processing, and learning on the world wide web. *Science Communication*, *23*(2), 111-134.

Tremayne, M. (2005). Lessons learned from experiments with interactivity on the web. *Journal of Interactive Advertising*, *5*(2), 40-46.

Tromp, J., Bullock, A., Steed, A., Sadagic, A., Slater, M., & Frecon, E. (1998). Small group behaviour experiments in the coven project. *IEEE Computer Graphics and Applications*, *18*(6), 53-63.

Tu, C. H., & McIsaac, M. (2002). The relationship of social presence and interaction in online classes. *American Journal of Distance Education*, *16*(3), 131-150.

Tu, C. H. (2002). The impacts of text-based CMC on online social presence. *The Journal of Interactive Online Learning*, *1*(2).

Tullis, T., & Albert, B. (2008). *Measuring the user experience: Collecting, analyzing, and presenting usability metrics*. Amsterdam: Morgan Kaufmann.

Turkle, S. (1995). *Life on the screen: Identity in the age of the Internet*. New York: Simon & Schuster.

Van Dam, A., Forsberg, A. S., Laidlaw, D. H., LaViola, J. J., & Simpson, R. M. (2000). Immersive VR for scientific visualization: A progress report. *IEEE Computer Graphics and Applications*, *20*(6).

Van Dijk, J. (1999). *The network society: Social aspects of new media*. London: Sage Publications.

Verderber, R. F. (1990). *Communicate!* Belmont, CA: Wadsworth Pub.

Virilio, P. (2000). *Polar inertia*. London: Sage.

Vorderer, P., & Chan, E. (2006). Massively multiplayer online games. In P. Vorderer & J. Bryant (Eds.), *Playing video games: Motives, responses, and consequences* (pp. 77-90). Mahwah, NJ: Lawrence Erlbaum Associates.

Vorderer, P. (2000). Interactive entertainment and beyond. In D. Zillmann & P. Vorderer (Eds.), *Media entertainment: The psychology of its appeal*. Mahwah, NJ: Lawrence Erlbaum Associates.

Vygotskij, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, Ed.). Cambridge: Harvard University Press.

Wallach, H. S., Safir, M. P., Samana, R., Almog, I., & Horef, R. (2011). How can presence in psychotherapy employing VR be increased? Chapter for inclusion in: Systems in health care using agents and virtual reality. In S. Brahnam & L. C. Jain (Eds.), *Advanced* *computational intelligence paradigms in healthcare 6. Virtual reality in psychotherapy, rehabilitation, and assessment* (Ser. 337, pp. 129-147). Springer Berlin Heidelberg.

Walther, J. B., Gay, G., & Hancock, J. T. (2005). How do communication and technology researchers study the Internet? *Journal of Communication*, *55*(3), 632-657.

Wang, R., & Wang, X. (2008). Here and there: Experiencing co-presence through mixed reality-mediated collaborative design system. *Proceedings of IEEE The 8th International Conference on Information Technology and Application*.

Wang, X., & Kim, M. J. (2008). Exploring presence and performance in mixed reality-based design space. In X. Wang & M. A. Schnabel (Eds.), *Mixed reality in architecture, design and construction* (pp. 75-90). Springer.

Warburton, S. (2009). Second Life in higher education: Assessing the potential for and the barriers to deploying virtual worlds in learning and teaching. *British Journal of Educational Technology*, *40*(3), 414-426.

Waterworth, J. A., & Waterworth, E. L. (2003). The core of presence: Presence as perceptual illusion. *Presence Connect*, *3*(3).

Watson, J. (1998). *Media communication: An introduction to theory and process*. Houndmills, Basingstoke, Hampshire: Palgrave Macmillan.

Weibel, D., Wissmath, B., Habegger, S., Steiner, Y., & Groner, R. (2008). Playing online games against computer- vs. human-controlled opponents: Effects on presence, flow, and enjoyment. *Computers in Human Behavior, 24*(5), 2274-2291.

West, R. L., & Turner, L. H. (2011). *Understanding interpersonal communication: Making choices in changing times*. Boston, MA: Wadsworth.

Wiener, M., & Mehrabian, A. (1968). *Language within language: Immediacy, a channel in verbal communication*. New York: Appleton-Century-Crofts.

Wiener, N. (1961). *Cybernetics: Or the control and communication in the animal and the machine*. Cambridge, MA: MIT Press.

Williams, F., Rice, R. E., & Rogers, E. M. (1988). *Research methods and the new media*. New York: Free Press.

Wirth, W., Hartmann, T., Bocking, S., Vorderer, P., Klimmt, C., Holger, S., ... Jancke, P. (2007). A process model for the formation of spatial presence experiences. *Media Psychology*, *9*, 493-525.

Witmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence: Teleoperators and Virtual Environments*, *7*(3), 225-240.

Wood, J. T. (2009). *Interpersonal communication: Everyday encounters*. Boston, MA: Wadsworth, Cengage Learning.

Woolley, B. (1993). *Virtual worlds: A journey in hype and hyperreality*. London: Penguin Books.

Wu, G. (1999). Perceived interactivity and attitude toward website. *Paper Presented at 1999 Annual Conference of American Academy of Advertising Albuquerque, New Mexcio*. Retrieved October 12, 2012, from http://users.wfu.edu/carterra/iworld_site/iworld_readings/percieved_interactivity.pdf

Wu, G. (2000). *The role of perceived interactivity in interactive ad processing* (Doctoral dissertation, University of Texas at Austin, 2000). University of Texas at Austin.

Yee, N., Bailenson, J. N., Urbanek, M., Chang, F., & Merget, D. (2007). The unbearable likeness of being digital: The persistence of nonverbal social norms in online virtual environments. *CyberPsychology & Behavior, 10*(1), 115-121.

Yen, C. J., & Tu, C. H. (2008). Test validation of the computer-mediated communication questionnaire (CMCQ): What does it actually measure? *Paper Presented at the Annual Meeting of American Educational Research Association (AERA), New York, NY*.

Yoo, W., Lee, Y., & Park, J. (2010). The role of interactivity in e-tailing: Creating value and increasing satisfaction. *Journal of Retailing and Consumer Services*, *17*(2), 89-96.

Zaphiris, P., Ang, C. S., & Laghos, A. (2012). Online communities. In J. A. Jacko (Ed.), *The human-computer interaction handbook: Fundamentals, evolving technologies, and emerging applications* (pp. 625-641). Boca Raton, FL: CRC Press.

Zeltzer, D. (1992). Autonomy, interaction and presence. *Presence: Teleoperators and Virtual Environments*, *1*(1), 127-132.

Zhai, P. (1998). *Get real: A philosophical adventure in virtual reality*. Lanham, MD: Rowman & Littlefield.

Zhang, C., & Zigurs, I. (2009). An exploratory study of the impact of a virtual world learning environment on student interaction and learning satisfaction. *AMCIS 2009 Proceedings*.

Zhao, S. (2003). Toward a taxonomy of copresence. *Presence: Teleoperators and Virtual Environments*, *12*(5), 445-455.

Zillmann, D., & Vorderer, P. (2000). *Media entertainment: The psychology of its appeal*. Mahwah, NJ: Lawrence Erlbaum Associates.

Appendices

Appendix A: The Consent Form

RESEARCH CONSENT FORM

Tittle of the Research: EXAMINATION OF INTERACTIVE EXPERIENCE

The purpose of this research is to identify qualities of virtual environments which are responsible for creating of interactive experience, and determine aspects of interpersonal communication in effectuating these qualities in the first place. You will be asked to spend 15 minutes on playing the game that will be assigned to you. Following this exercise, you will be asked to complete the online questionnaire designed to measure your experience of interactivity. It should not take you more than 10 minutes.

The whole experiment will take approximately 50 minutes to complete. We don't anticipate any risk of physical or mental injury. Participation is voluntary. Therefore, you may choose not to participate, and may discontinue participation at any time without penalty.

All responses will remain confidential. Your privacy will be protected to the maximum extent as allowable by law. Data gathered today will be analyzed only to the aggregate so that your name will not be associated with the answers you provide. Your name and signature at the bottom of this online consent form will be kept separate from your responses. You will receive a hard copy of the consent for your own records. On request, and within these restrictions, results may be available to you.

If you have questions or concerns regarding your rights as a study participant, you may contact - anonymously, if you wish - Heather Foti, MPH, Associate Director of the Human Subjects Research Office (HSRO) at the Rochester Institute of Technology by phone (585-475-7673), email (hmfsrs@rit.edu) or regular mail (Human Subjects Research Office (HSRO), 2nd Floor, Bldg 87, Administrative Services Building/Innovation Center, Suite 2400, Rochester, NY 14623-5608)

If you have any questions about this research, please contact the researcher, Malwina Buldys (646-464-2565, mab7440@rit.edu) for further assistance.

By checking this box, typing my name in the signature box below and clicking "Submit", I am providing my electronic signature certifying that I voluntarily agree to participate in this research.

(Type your name)

____

(Type date)

Submit

Appendix B: The Survey

USER EXPERIENCE IN A VIRTUAL ENVIRONMENT
"Examination of Interactive Experience: Construction of Physical and Social Presence in Virtual Environments."

Dear Participant,

You are about to begin our survey devoted to examination of your experience in the virtual environment. In overall, there are 13 questions related to experience you just had. Please make sure to follow our instructions in the survey.

Thank you for your collaboration and support.

Malwina Buldys

1. Please select a module mode of your assignment: *

- 1
- 2
- 3

Back Next

10%

2. Do you have any previous experience of playing video games? *

- Yes
- No

Back Next

20%

3. Can you list names of these games?

Back Next

30%

4. How you would describe your experience of playing video games? *

- Beginner/Novice
- Moderate
- Expert/Veteran

Back Next

45%

5. Have you played Second Life before today? *

- Yes
- No

Back Next

55%

6. Please indicate how much you agree or disagree with each statement based on the experience you just had. Please keep in mind that there are no right or wrong answers. *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Somehow I felt that the virtual world surrounded me. *	○	○	○	○	○
I felt like I was just perceiving pictures. *	○	○	○	○	○
I had a sense of acting in the virtual space, rather than operating something from outside. *	○	○	○	○	○
I felt present in the virtual space. *	○	○	○	○	○
I was not aware of my real environment. *	○	○	○	○	○
I still paid attention to the real environment. *	○	○	○	○	○
I was completely captivated by the virtual world. *	○	○	○	○	○
The virtual world seemed more realistic than the real world. *	○	○	○	○	○

Please rate the following questions on a scale 1-5

	1	2	3	4	5
In the computer generated world I had a sense of "being there" (1=not at all; 5=very much) *	○	○	○	○	○
How much did your experience in the virtual environment seem consistent with your real world experience ? (1=not consistent at all; 5=very consistent) *	○	○	○	○	○

Back Next

64%

7. Please indicate how much you agree or disagree with each statement based on the experience you just had. Please keep in mind that there are no right or wrong answers. *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I perceived that I was in the presence of another person in the room with me. *	○	○	○	○	○
I felt that the person was watching me and was aware of my presence. *	○	○	○	○	○
The thought that the person was not a real person crossed my mind a few times while being in the virtual world. *	○	○	○	○	○
The person appeared to be alive and conscious to me. *	○	○	○	○	○
I perceived the person as being only as artificially generated image by computer and not a real person. *	○	○	○	○	○

Back Next

73%

Please indicate how much you agree or disagree with each statement based on the experience you just had. Please keep in mind that there are no right or wrong answers.

8. This world was... *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Interesting *	○	○	○	○	○
Engaging *	○	○	○	○	○
Responsive *	○	○	○	○	○
Easy to navigate through and operate *	○	○	○	○	○
Interactive *	○	○	○	○	○
Entertaining *	○	○	○	○	○

9. While I was in the virtual world, I felt... *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Engaged *	○	○	○	○	○
In Control *	○	○	○	○	○
Able to choose (and/or modify the content) *	○	○	○	○	○
Able to response quickly *	○	○	○	○	○

10. Bucy and Tao (2007) defined the concept of interactivity as:

"Technological attributes of mediated environments that enable reciprocal communication and information exchange, which afford interaction between communication technology and users, or between users through technology."

Taking the above definition into consideration, please compare the activities you just participated in to the other forms of media used on a regular basis: *

more interactive	less interactive
○	○

Please complete the following information:

11. Please enter your age. *

[ ]

12. Your gender is: *

○ Male

○ Female

13. How you would describe your experience today?

[ ]

Back Submit

91%

Appendix C: Experiment Welcome Materials

USER EXPERIENCE IN A VIRTUAL ENVIRONMENT
"Examination of Interactive Experience: Construction of Physical and Social Presence in Virtual Environments."

Dear Participant,

My name is Malwina Buldys and I am enrolled in the Master of Science in Communication and Media Technologies Program.
The experiment in which you will participate today is part of my Master Thesis.
The study is entitled "Examination of Interactive Experience: Construction of Physical and Social Presence in Virtual Environments" and its main purpose is to identify qualities of virtual environments which are responsible for creating of interactive experience, and determine aspects of interpersonal communication in effectuating these qualities in the first place.

Your attendance in the experience is greatly appreciated.

Please read the following instructions and steps involved in the experiment. The schedule of the experiment will cover each step continuously.

STEP 1: Assignment of the module and the computer's station

Welcome & Introduction (Overview of the procedures)

STEP 2: Consent Form: Electronic Version & the Hard Copy

STEP 3: PHASE I (15 minutes)

a) Please turn off all electronic devices

b) Please wear the headphones

c) Tutorial Session: 5 min

d) Game: 10 min

STEP 4: PHASE II (10 minutes)

a) The online survey

STEP 5: THE END

PLEASE PROCEED TO THE NEXT PAGE WHEN INSTRUCTED

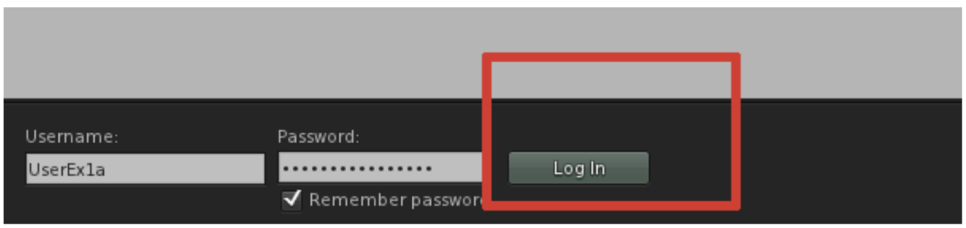
EXAMINATION OF INTERACTIVE EXPERIENCE - MASTER THESIS
by Malwina Buldys

Appendix D: Instructions Module 1/2/3

MODULE 1

Logging In:

Please click "Login" in as indicated of the picture below:



First Screen:

After login in, please spend five minutes on a tutorial session. You can use the instructions provided in the handout to learn how to use the SL interface. Please make sure that your headphones work properly (stereo channels are active). In case of problems, please notify the researcher BEFORE the tutorial session ends.

Screen:

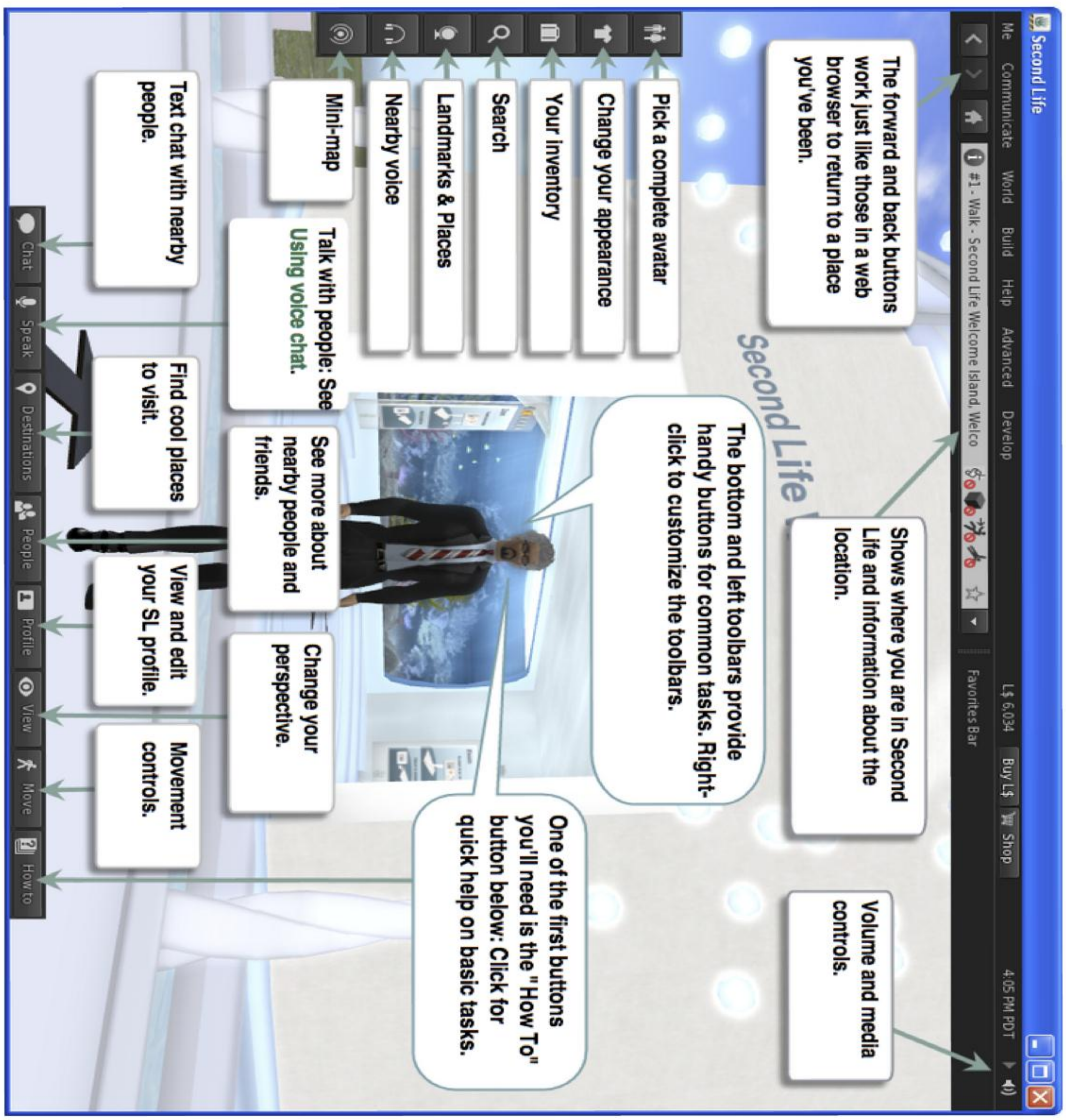
Interface of Second Life:

Movement & Navigation:

There are three ways to make your avatar walk:

1. Click to walk. **Simply click on the ground at the point** to which you want to go. If your mouse pointer turns into a hand instead of an arrow, you won't move but will instead interact with an object.
2. **Use the arrow keys.** The up-arrow ↑ and down-arrow ↓ keys walk you forward and backward, respectively. The left-arrow ← and right-arrow → keys turn you left and right, respectively.
3. **Use the W, S, A, and D keys.** The W and S keys make you walk forward and backward. The A and D keys turn you left and right, respectively. Make sure

you click inworld first so that the chat field doesn't have focus. Otherwise, you'll be typing chat text instead of walking.



Text Chat:

1. Click the Chat button (by default in the bottom toolbar) to text chat with people nearby. Everyone within twenty meters of you will be able to see what you type.
2. Click the triangle icon in the chat field to show recent chat history.
3. Mouse over names in chat history and then click on the icon for more options.

END OF TUTORIAL SESSION

PLEASE READ CAREFULLY THE FOLLOWING SECTION

TASK:

1. Please spend 10 minutes exploring and learning about the place to which you were assigned by following the green arrows and reading all signs along the path.

Movement

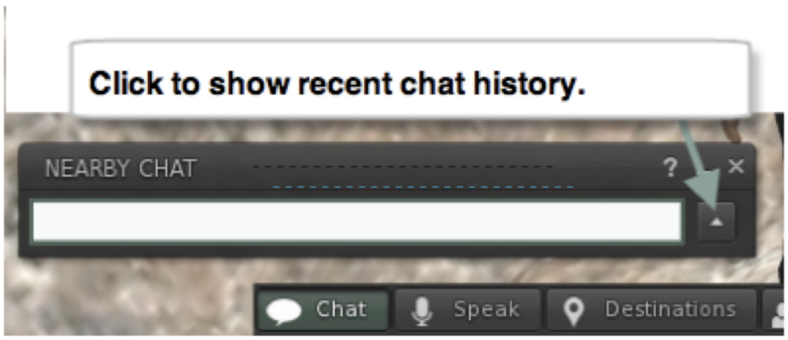
Walk forward	W or ↑
Walk backward	S or ↓
Turn left	A or ←
Turn right	D or →
Run	Double-tap W or ↑ (forward); S or ↓ (backward)
Always run	Ctrl+R
Jump	E or PgUp (Tap once)
Toggle flying	F or Home
Fly up	Hold E or hold PgUp
Fly down	Hold C or hold PgDn

View

Mouselook	M
Reset View	Esc
Look at	Hold Alt and click mouse to re-center
Zoom in	Ctrl+0
Zoom default	Ctrl+9

2. You might use all skills you have just acquired during the tutorial session AND/ OR all materials included above.

HAVE FUN AND GOOD LUCK!



END OF PART 1

THE SURVEY:

1. Please open a Chrome browser and take the survey at:

http://bit.ly/JhJgKN

2. On the last page of the survey, please click on the "Submit" button to finalize your participation in the experiment.

END OF THE EXPERIMENT

Appendix E: Results

Table E1

Results for Question 4: The Level of Playing Video Games

Gender			Freq.	%	Valid %	Cumulative %
1 male	Valid	0 never played before	5	13.9	13.9	13.9
		1 beginner/novice	5	13.9	13.9	27.8
		2 moderate	17	47.2	47.2	75.0
		3 expert/veteran	9	25.0	25.0	100.0
		Total	36	100.0	100.0	
2 female	Valid	0 never played before	9	21.4	21.4	21.4
		1 beginner/novice	20	47.6	47.6	69.0
		2 moderate	9	21.4	21.4	90.5
		3 expert/veteran	4	9.5	9.5	100.0
		Total	42	100.0	100.0	

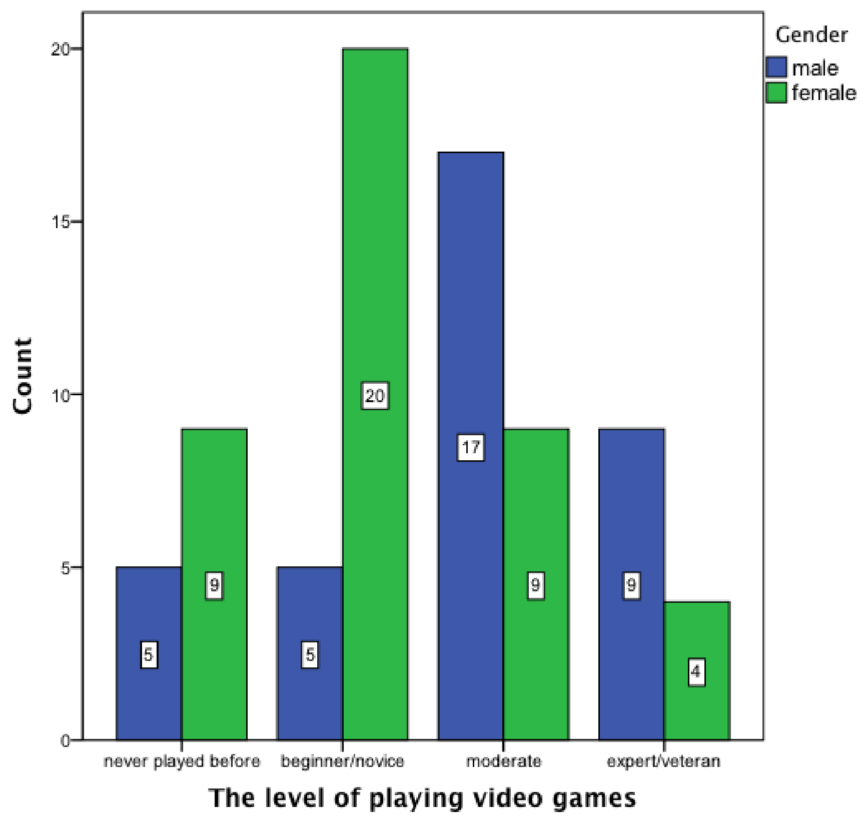


Figure E1. The level of playing video games based on genders.

Table E2

Results for Question 8: Not Condition Based

	N	Min	Max	*M*	*SD*
World was interesting	78	1	5	3.91	.809
World was engaging	78	1	5	3.72	.966
World was interactive	78	1	5	3.64	.897
World was entertaining	78	1	5	3.63	1.021
World was easy to navigate	78	1	5	3.28	1.056
World was responsive	78	1	5	3.17	.986

Table E3

Results for Question 8: Condition based

Condition 1: pre-determined	*N*	Min	Max	*M*	*SD*
World was engaging	26	2	5	3.96	.599
World was interesting	26	2	5	3.92	.744
World was interactive	26	2	5	3.88	.711
World was entertaining	26	2	5	3.73	.874
World was responsive	26	2	5	3.54	.761
World was easy to navigate	26	1	5	3.50	.949

Condition 2: middle-determined	*N*	Min	Max	*M*	*SD*
World was interesting	26	1	5	4.00	.938
World was engaging	26	2	5	3.69	.970
World was entertaining	26	1	5	3.54	.989
World was interactive	26	2	5	3.42	.945
World was responsive	26	1	5	3.04	.999
World was easy to navigate	26	2	5	2.96	1.038

Condition 3: open-ended	*N*	Min	Max	*M*	*SD*
World was interesting	26	2	5	3.81	.749
World was interactive	26	1	5	3.62	.983
World was entertaining	26	1	5	3.62	1.203
World was engaging	26	1	5	3.50	1.208
World was easy to navigate	26	1	5	3.38	1.134
World was responsive	26	1	5	2.92	1.093

Table E4

Results for Question 9: Not Condition Based

	Not Condition Based				
	N	Min	Max	*M*	*SD*
User was engaged	78	1	5	3.60	.873
User was in control	78	1	5	3.54	.921
User could modify	78	1	5	3.28	1.115
User could respond	78	1	5	3.19	.994

Table E5

Results for Question 9: Condition Based

	Condition 1: pre-determined				
	N	Min	Max	*M*	*SD*
User was engaged	26	2	5	3.77	.765
User was in control	26	2	5	3.69	.788
User could modify	26	1	4	3.58	.758
User could respond	26	2	4	3.35	.745

	Condition 2: middle-determined				
	N	Min	Max	*M*	*SD*
User was engaged	26	1	5	3.65	.797
User was in control	26	1	5	3.50	.949
User could respond	26	1	5	3.08	1.093
User could modify	26	1	5	3.04	1.311

	Condition 3: open-ended				
	N	Min	Max	*M*	*SD*
User was in control	26	1	5	3.42	1.027
User was engaged	26	1	5	3.38	1.023
User could modify	26	1	5	3.23	1.177
User could respond	26	1	5	3.15	1.120

Table E6

Results for Question 10: Experience of Interactivity (Not Condition Based)

		Freq.	% Valid	%	Cumulative %
Valid	1 more interactive	47	60.3	60.3	60.3
	2 less interactive	31	39.7	39.7	100.0
	Total	78	100.0	100.0	

Table E7

Results for Question 10: Experience of Interactivity (Condition Based)

Module mode			Freq.	%	Valid %	Cumulative %
1 pre-determined	Valid	1 more interactive	15	57.7	57.7	57.7
		2 less interactive	11	42.3	42.3	100.0
		Total	26	100.0	100.0	
2 middle	Valid	1 more interactive	17	65.4	65.4	65.4
		2 less interactive	9	34.6	34.6	100.0
		Total	26	100.0	100.0	
3 open	Valid	1 more interactive	15	57.7	57.7	57.7
		2 less interactive	11	42.3	42.3	100.0
		Total	26	100.0	100.0	

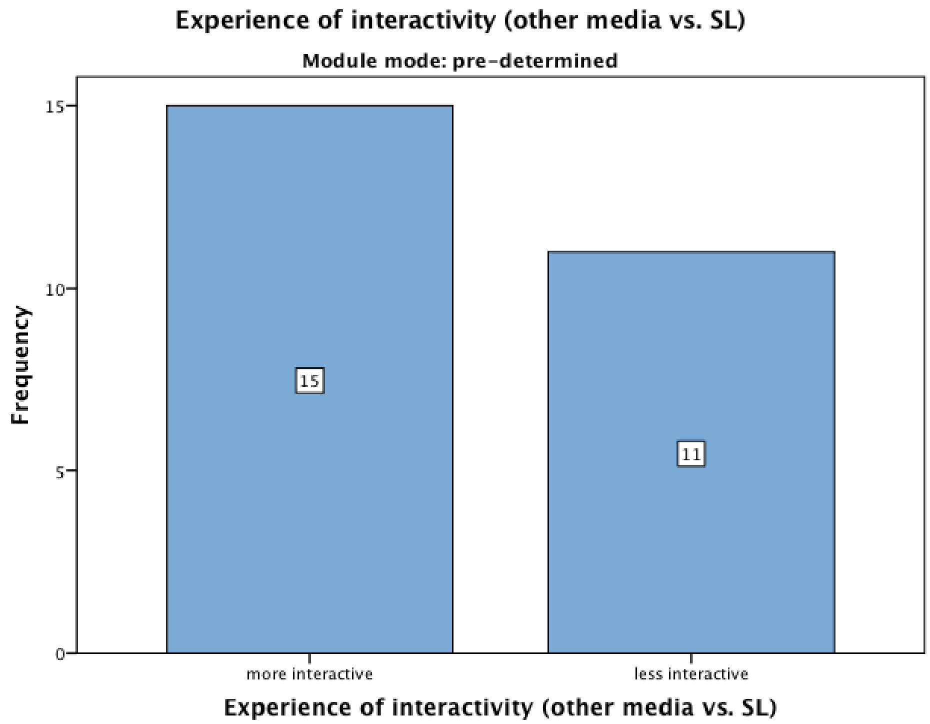


Figure E2a. Experience of interactivity: pre-determined condition.

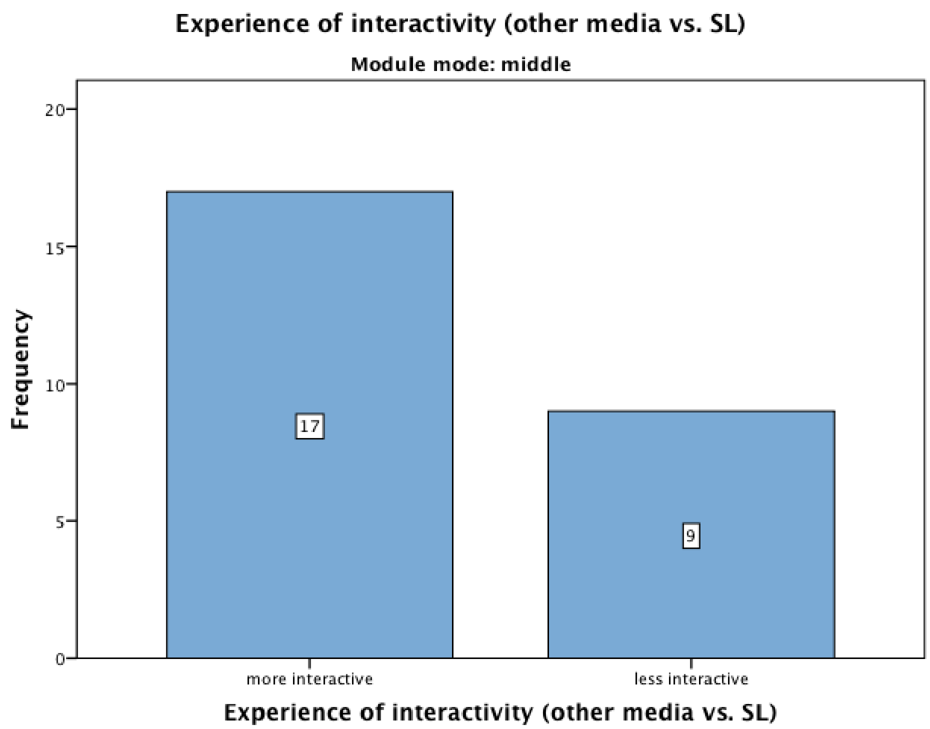


Figure E2b. Experience of interactivity: middle-determined condition.

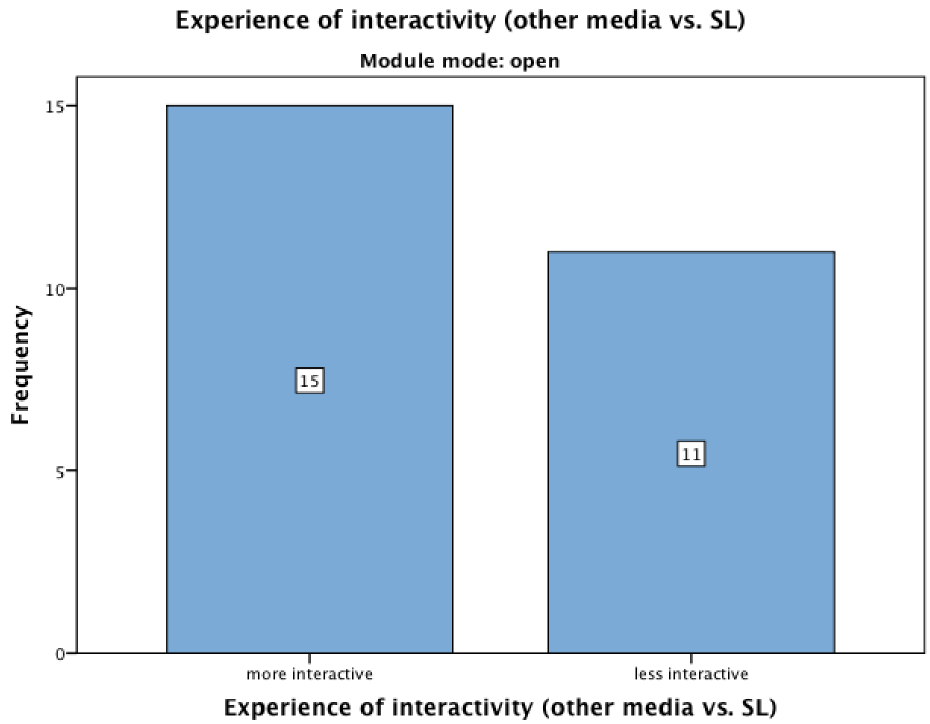


Figure E2c. Experience of interactivity: open-ended condition.

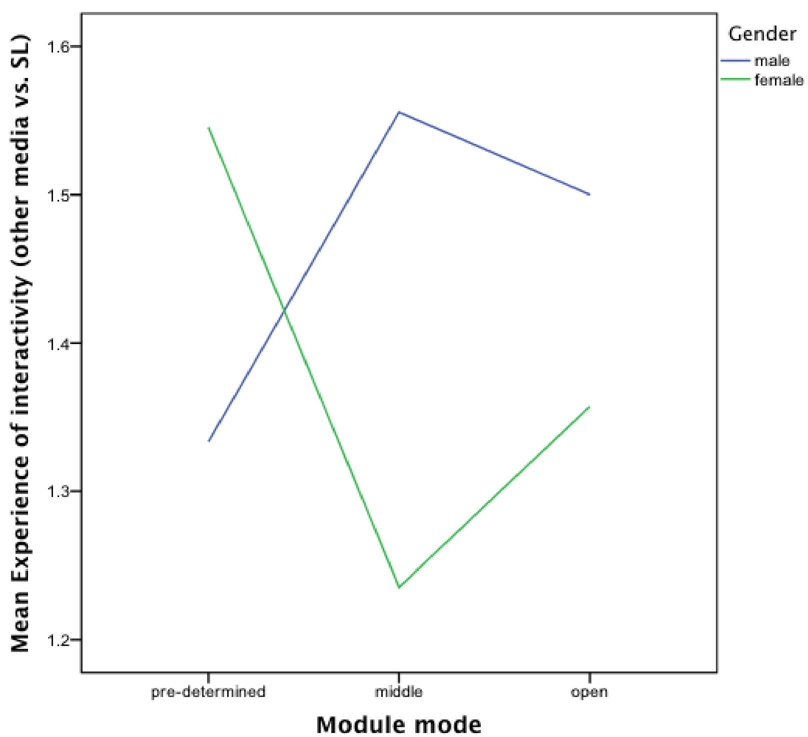


Figure E3. Experience of interactivity (condition and gender based).

Table E8

Results for Question 10: Experience of Interactivity (Condition and Gender Based)

Module mode	Gender			Freq.	%	Valid %	Cumulative %
1 pre-determined	1 male	Valid	1 more interactive	10	66.7	66.7	66.7
			2 less interactive	5	33.3	33.3	100.0
			Total	15	100.0	100.0	
	2 female	Valid	1 more interactive	5	45.5	45.5	45.5
			2 less interactive	6	54.5	54.5	100.0
			Total	11	100.0	100.0	
2 middle	1 male	Valid	1 more interactive	4	44.4	44.4	44.4
			2 less interactive	5	55.6	55.6	100.0
			Total	9	100.0	100.0	
	2 female	Valid	1 more interactive	13	76.5	76.5	76.5
			2 less interactive	4	23.5	23.5	100.0
			Total	17	100.0	100.0	
3 open	1 male	Valid	1 more interactive	6	50.0	50.0	50.0
			2 less interactive	6	50.0	50.0	100.0
			Total	12	100.0	100.0	
	2 female	Valid	1 more interactive	9	64.3	64.3	64.3
			2 less interactive	5	35.7	35.7	100.0
			Total	14	100.0	100.0	

Figure E4. Examples of avatars: condition 1.

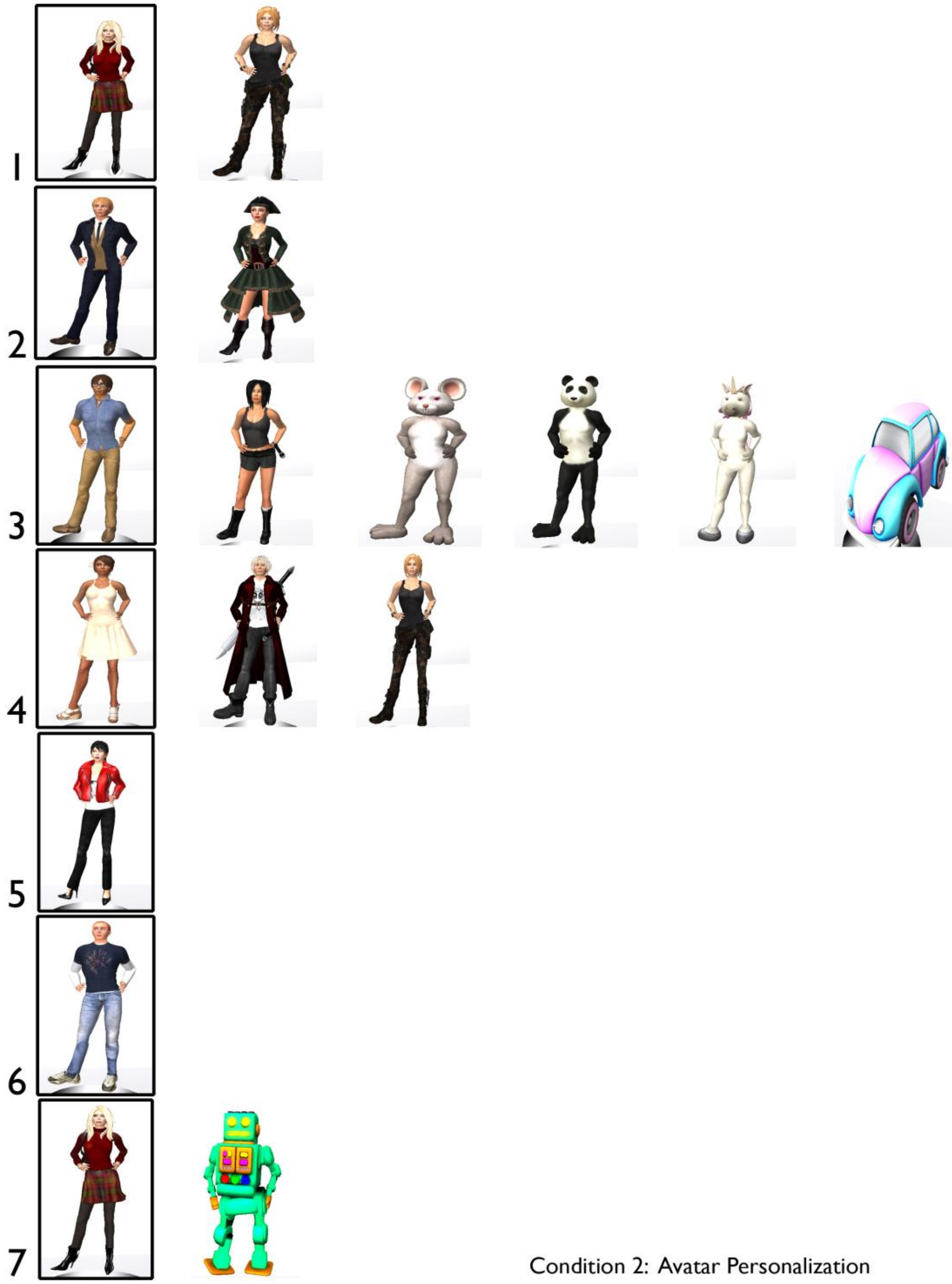


Figure E5. Examples of avatars: condition 2.

Figure E6. Examples of avatars: condition 3.

Table E9

Reliability for the Interactive Qualities Rating Scale

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	*N* of Items
.868	.870	10

Appendix F: Results

Table F1

Reliability for the IPQ scale

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	*N* of Items
.782	.791	10

Table F2

Item-Total Statistics for Reliability of the IPQ Scale

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
G1[1]	26.31	30.683	.526	.680	.757
SP1[2]	26.41	30.037	.481	.369	.760
SP2[3, a]	26.64	32.519	.231	.121	.789
SP4[4]	26.41	28.791	.561	.448	.749
SP5 [5]	26.33	29.108	.529	.365	.753
INV2 [6]	27.03	27.584	.511	.366	.756
INV3 [7, a]	26.99	32.974	.123	.122	.808
INV4 [8]	26.87	28.425	.609	.488	.743
REAL2 [9]	26.50	29.838	.541	.689	.754
REAL4[10]	27.74	29.206	.503	.437	.756

Note. G1[1] = Sense of being there; SP1[2] = Sense of virtual environment behind; SP2[3] = Only Pictures; SP4[4] = Sense of acting in virtual environment; SP5[5] = Sense of being present in virtual environment; INV2[6] = Not aware of real environment; INV3[7] = Not attention to real environment; INV4[8] = Attention captivated by virtual environment; REAL2[9] = Experience similar to real environment; REAL4[10] = VE wirklich;

[a] Reversed item.

Table F3

Reliability for the BSPQ Scale

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	*N* of Items
.712	.735	5

Table F4

Item-Total Statistics for Reliability of the BSPQ Scale

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
BSPQ1 [1]	11.69	10.605	.474	.357	.642
BSPQ2 [2]	12.01	10.273	.513	.389	.625
BSPQ3 [3, a]	11.95	11.997	.205	.141	.705
BSPQ4 [4]	11.92	9.864	.556	.361	.605
BSPQ5 [5, a]	12.17	9.933	.568	.360	.601

Note. BSPQ1[1] = Presence of another person; BSPQ2[2] = Awareness about another person; BSPQ3[3] = Realness of another person; BSPQ4[4] = Aliveness of another person; BSPQ5[5] = Presence of artificial agent;

[a] Reversed item.

Table F5

Test of Homogeneity of Variances for the IPQ Scale

	Levene Statistic	*df1*	*df2*	Sig.
G1 [1]	2.948	2	75	.059
SP [2]	.296	2	75	.745
INV [3]	3.179	2	75	.047
REAL [4]	.996	2	75	.374
Physical Presence [5]	1.036	2	75	.360

Note. G1[1] = Sense of being there; SP [2] = Total Spatial Presence; INV [3] = Total Involvement; REAL [4] = Total Realness; Physical Presence [5] = Total Physical Presence.

Table F6

Robust Tests of Equality of Means for the IPQ Scale

		Statistic [a]	*df1*	*df2*	Sig.
G1	Welch	1.416	2	48.580	.252
	Brown-Forsythe	1.486	2	63.145	.234
SP	Welch	.589	2	49.848	.559
	Brown-Forsythe	.598	2	74.221	.553
INV	Welch	.235	2	49.283	.792
	Brown-Forsythe	.285	2	69.255	.753
REAL	Welch	.954	2	48.556	.392
	Brown-Forsythe	.774	2	67.203	.465
Physical Presence	Welch	.036	2	49.660	.964
	Brown-Forsythe	.041	2	73.256	.960

Note. [a] Asymptotically F distributed.

Table F7

H1: One-way between Groups Analysis of Variance (ANOVA) for the IPQ Scale (Condition Based)

		Sum of Squares	*df*	Mean	Square F	Sig.
G1 [1]	Between Groups	1.923	2	.962	1.486	.233
	Within Groups	48.538	75	.647		
	Total	50.462	77			
SP [2]	Between Groups	9.256	2	4.628	.598	.553
	Within Groups	580.692	75	7.743		
	Total	589.949	77			
INV [3]	Between Groups	3.769	2	1.885	.285	.753
	Within Groups	496.346	75	6.618		
	Total	500.115	77			
REAL [4]	Between Groups	3.872	2	1.936	.774	.465
	Within Groups	187.577	75	2.501		
	Total	191.449	77			
Physical Presence [5]	Between Groups	.030	2	.015	.041	.960
	Within Groups	27.736	75	.370		
	Total	27.766	77			

Note. G11 = Sense of being there; SP 2 = Total Spatial Presence; INV 3 = Total Involvement; REAL 4 = Total Realness; Physical Presence 5 = Total Physical Presence.

.

Table F8

H1: General Descriptive Statistics for the IPQ (Condition Based)

		N	*M*	*SD*	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Min	Max
G1 [1]	1 pre-determined	26	3.19	1.021	.200	2.78	3.60	1	5
	2 middle	26	3.58	.643	.126	3.32	3.84	2	4
	3 open	26	3.38	.697	.137	3.10	3.67	2	4
	Total	78	3.38	.810	.092	3.20	3.57	1	5
SP [2]	1 pre-determined	26	13.12	2.875	.564	11.95	14.28	6	17
	2 middle	26	12.50	2.888	.566	11.33	13.67	7	18
	3 open	26	13.31	2.573	.505	12.27	14.35	8	19
	Total	78	12.97	2.768	.313	12.35	13.60	6	19
INV [3]	1 pre-determined	26	8.38	2.334	.458	7.44	9.33	4	13
	2 middle	26	8.31	2.259	.443	7.40	9.22	3	13
	3 open	26	7.88	3.051	.598	6.65	9.12	3	13
	Total	78	8.19	2.549	.289	7.62	8.77	3	13
REAL [4]	1 pre-determined	26	5.19	1.898	.372	4.43	5.96	2	9
	2 middle	26	5.38	1.235	.242	4.89	5.88	3	8
	3 open	26	4.85	1.541	.302	4.22	5.47	2	9
	Total	78	5.14	1.577	.179	4.79	5.50	2	9
Physical Presence [5]	1 pre-determined	26	2.99	.620	.122	2.74	3.24	2	4
	2 middle	26	2.98	.542	.106	2.76	3.20	2	4
	3 open	26	2.94	.657	.129	2.68	3.21	2	4
	Total	78	2.97	.600	.068	2.83	3.10	2	4

Note. G11 = Sense of being there; SP 2 = Total Spatial Presence; INV 3 = Total Involvement; REAL 4 = Total Realness; Physical Presence 5 = Total Physical Presence.

Table F9

H1: General Descriptive Statistics for Each Item of the INV and REAL (Condition Based)

		N	*M*	*SD*	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Min	Max
INV2 [1]	1 pre-determined	26	2.96	1.280	.251	2.44	3.48	1	5
	2 middle	26	2.65	1.198	.235	2.17	3.14	1	5
	3 open	26	2.38	1.329	.261	1.85	2.92	1	5
	Total	78	2.67	1.276	.144	2.38	2.95	1	5
INV3 [2, a]	1 pre-determined	26	2.58	1.102	.216	2.13	3.02	1	5
	2 middle	26	2.85	1.287	.252	2.33	3.37	1	5
	3 open	26	2.69	1.192	.234	2.21	3.17	1	5
	Total	78	2.71	1.186	.134	2.44	2.97	1	5
INV4 [3]	1 pre-determined	26	2.85	1.156	.227	2.38	3.31	1	5
	2 middle	26	2.81	.895	.176	2.45	3.17	1	5
	3 open	26	2.81	1.021	.200	2.40	3.22	1	5
	Total	78	2.82	1.016	.115	2.59	3.05	1	5
REAL2 [4]	1 pre-determined	26	3.12	1.071	.210	2.68	3.55	1	5
	2 middle	26	3.46	.811	.159	3.13	3.79	2	5
	3 open	26	3.00	.800	.157	2.68	3.32	1	4
	Total	78	3.19	.913	.103	2.99	3.40	1	5
REAL4 [5]	1 pre-determined	26	2.08	1.129	.221	1.62	2.53	1	5
	2 middle	26	1.92	.845	.166	1.58	2.26	1	4
	3 open	26	1.85	1.190	.233	1.37	2.33	1	5
	Total	78	1.95	1.056	.120	1.71	2.19	1	5
Physical Presence	1 pre-determined	26	2.99	.620	.122	2.74	3.24	2	4
	2 middle	26	2.98	.542	.106	2.76	3.20	2	4
	3 open	26	2.94	.657	.129	2.68	3.21	2	4
	Total	78	2.97	.600	.068	2.83	3.10	2	4

Note. NV21 I = Not aware of real environment; INV32 = Not attention to real environment; INV43 = Attention captivated by virtual environment; REAL24 = Experience similar to real environment; REAL45 = VE wirklich;

[a] Reversed item.

Table F10

H1: One-way between Groups Analysis of Variance (ANOVA) for Each Item of the IPQ scale

		Sum of Squares	*df*	Mean Square	*F*	Sig.
G1 [1]	Between Groups	1.923	2	.962	1.486	.233
	Within Groups	48.538	75	.647		
	Total	50.462	77			
SP1 [2]	Between Groups	2.487	2	1.244	1.346	.267
	Within Groups	69.308	75	.924		
	Total	71.795	77			
SP2 [3, a]	Between Groups	.026	2	.013	.013	.987
	Within Groups	73.769	75	.984		
	Total	73.795	77			
SP4 [4]	Between Groups	3.103	2	1.551	1.478	.235
	Within Groups	78.692	75	1.049		
	Total	81.795	77			
SP5 [5]	Between Groups	.179	2	.090	.082	.921
	Within Groups	81.769	75	1.090		
	Total	81.949	77			
INV2 [6]	Between Groups	4.333	2	2.167	1.343	.267
	Within Groups	121.000	75	1.613		
	Total	125.333	77			
INV3 [7, a]	Between Groups	.949	2	.474	.332	.719
	Within Groups	107.269	75	1.430		
	Total	108.218	77			
INV4 [8]	Between Groups	.026	2	.013	.012	.988
	Within Groups	79.462	75	1.059		
	Total	79.487	77			
REAL2 [9]	Between Groups	3.000	2	1.500	1.841	.166
	Within Groups	61.115	75	.815		
	Total	64.115	77			
REAL4 [10]	Between Groups	.718	2	.359	.316	.730
	Within Groups	85.077	75	1.134		
	Total	85.795	77			
Physical Presence	Between Groups	.030	2	.015	.041	.960
	Within Groups	27.736	75	.370		
	Total	27.766	77			

Note. G11 = Sense of being there; SP12 = Sense of virtual environment behind; SP23 = Only Pictures; SP44 = Sense of acting in virtual environment; SP55 = Sense of being present in virtual environment; INV26 = Not aware of real environment; INV37 = Not attention to real environment; INV48 = Attention captivated by virtual environment; REAL29 = Experience similar to real environment; REAL410 = VE wirklich;
[a] Reversed item.

Table F10

H1: One-way between Groups Analysis of Variance (ANOVA) for Each Item of the IPQ scale

		Sum of Squares	*df*	Mean Square	*F*	Sig.
G1 [1]	Between Groups	1.923	2	.962	1.486	.233
	Within Groups	48.538	75	.647		
	Total	50.462	77			
SP1 [2]	Between Groups	2.487	2	1.244	1.346	.267
	Within Groups	69.308	75	.924		
	Total	71.795	77			
SP2 [3, a]	Between Groups	.026	2	.013	.013	.987
	Within Groups	73.769	75	.984		
	Total	73.795	77			
SP4 [4]	Between Groups	3.103	2	1.551	1.478	.235
	Within Groups	78.692	75	1.049		
	Total	81.795	77			
SP5 [5]	Between Groups	.179	2	.090	.082	.921
	Within Groups	81.769	75	1.090		
	Total	81.949	77			
INV2 [6]	Between Groups	4.333	2	2.167	1.343	.267
	Within Groups	121.000	75	1.613		
	Total	125.333	77			
INV3 [7, a]	Between Groups	.949	2	.474	.332	.719
	Within Groups	107.269	75	1.430		
	Total	108.218	77			
INV4 [8]	Between Groups	.026	2	.013	.012	.988
	Within Groups	79.462	75	1.059		
	Total	79.487	77			
REAL2 [9]	Between Groups	3.000	2	1.500	1.841	.166
	Within Groups	61.115	75	.815		
	Total	64.115	77			
REAL4 [10]	Between Groups	.718	2	.359	.316	.730
	Within Groups	85.077	75	1.134		
	Total	85.795	77			
Physical Presence	Between Groups	.030	2	.015	.041	.960
	Within Groups	27.736	75	.370		
	Total	27.766	77			

Note. G11 = Sense of being there; SP12 = Sense of virtual environment behind; SP23 = Only Pictures; SP44 = Sense of acting in virtual environment; SP55 = Sense of being present in virtual environment; INV26 = Not aware of real environment; INV37 = Not attention to real environment; INV48 = Attention captivated by virtual environment; REAL29 = Experience similar to real environment; REAL410 = VE wirklich;
[a] Reversed item.

Table F13

H2: One-way between Groups Analysis of Variance (ANOVA) for the BSPQ Scale (Condition Based)

		Sum of Squares	*df*	Mean Square	*F*	Sig.
BSPQ1 [1]	Between Groups	2.333	2	1.167	.930	.399
	Within Groups	94.038	75	1.254		
	Total	96.372	77			
BSPQ1 [2]	Between Groups	.077	2	.038	.029	.971
	Within Groups	99.462	75	1.326		
	Total	99.538	77			
BSPQ1 [3, a]	Between Groups	11.256	2	5.628	3.918	.024
	Within Groups	107.731	75	1.436		
	Total	118.987	77			
BSPQ1 [4]	Between Groups	1.949	2	.974	.709	.495
	Within Groups	103.038	75	1.374		
	Total	104.987	77			
BSPQ5 [5, a]	Between Groups	2.385	2	1.192	.918	.404
	Within Groups	97.462	75	1.299		
	Total	99.846	77			
Social Presence	Between Groups	1.878	2	.939	1.556	.218
	Within Groups	45.269	75	.604		
	Total	47.147	77			

Note. BSPQ1[1] = Presence of another person; BSPQ2[2] = Awareness about another person; BSPQ3[3] = Realness of another person; BSPQ4[4] = Aliveness of another person; BSPQ5[5] = Presence of artificial agent;

[a] Reversed item.

Table F14

H2: General Descriptive Statistics for the BSPQ Scale (Condition Based)

		N	*M*	*SD*	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Min	Max
BSPQ1 [1]	1 pre-determined	26	3.38	.941	.185	3.00	3.76	1	4
	2 middle	26	3.35	1.093	.214	2.90	3.79	1	5
	3 open	26	3.00	1.296	.254	2.48	3.52	1	5
	Total	78	3.24	1.119	.127	2.99	3.50	1	5
BSPQ2 [2]	1 pre-determined	26	2.92	1.129	.221	2.47	3.38	1	5
	2 middle	26	2.96	1.113	.218	2.51	3.41	1	5
	3 open	26	2.88	1.211	.237	2.40	3.37	1	5
	Total	78	2.92	1.137	.129	2.67	3.18	1	5
BSPQ3 [3, a]	1 pre-determined	26	3.35	1.198	.235	2.86	3.83	1	5
	2 middle	26	3.15	1.223	.240	2.66	3.65	1	5
	3 open	26	2.46	1.174	.230	1.99	2.94	1	5
	Total	78	2.99	1.243	.141	2.71	3.27	1	5
BSPQ4 [4]	1 pre-determined	26	3.19	1.201	.235	2.71	3.68	1	5
	2 middle	26	2.81	1.167	.229	2.34	3.28	1	5
	3 open	26	3.04	1.148	.225	2.57	3.50	1	5
	Total	78	3.01	1.168	.132	2.75	3.28	1	5
BSPQ5 [5, a]	1 pre-determined	26	2.96	1.216	.238	2.47	3.45	1	5
	2 middle	26	2.81	1.096	.215	2.36	3.25	1	5
	3 open	26	2.54	1.104	.216	2.09	2.98	1	5
	Total	78	2.77	1.139	.129	2.51	3.03	1	5
Social Presence	1 pre-determined	26	3.16	.854	.168	2.82	3.51	1	5
	2 middle	26	3.02	.652	.128	2.75	3.28	1	4
	3 open	26	2.78	.810	.159	2.46	3.11	1	4
	Total	78	2.99	.782	.089	2.81	3.16	1	5

Note. BSPQ1 1 = Presence of another person; BSPQ22 = Awareness about another person; BSPQ3 3 = Realness of another person; BSPQ4 4 = Aliveness of another person; BSPQ55 =Presence of artificial agent;

[a] Reversed item.

Table F15a

H2: Post-hoc Tests: Multiple Comparisons for the BSPQ3 (Condition Based)

Tukey HSD Dependent Variable	(I) Module mode	(J) Module mode	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
BSPQ3 [3, a]	1 pre-determined	2 middle	.192	.332	.832	-.60	.99
		3 open	.885*	.332	.025	.09	1.68
	2 middle	1 pre-determined	-.192	.332	.832	-.99	.60
		3 open	.692	.332	.100	-.10	1.49
	3 open	1 pre-determined	-.885*	.332	.025	-1.68	-.09
		2 middle	-.692	.332	.100	-1.49	.10

Note. BSPQ3[3] = Realness of another person; [a] Reversed item; * The mean difference is significant at the 0.05 level.

Table F15b

H2: Post-hoc Tests: Homogenous Subsets for the BSPQ3 (Condition Based)

Tukey HSD [a] Module mode	*N*	Subset for alpha = 0.05 1	2
3 open	26	2.46	
2 middle	26	3.15	3.15
1 pre-determined	26		3.35
Sig.		.100	.832

Note. Means for groups in homogeneous subsets are displayed;

[a] Uses Harmonic Mean Sample Size = 26.000.

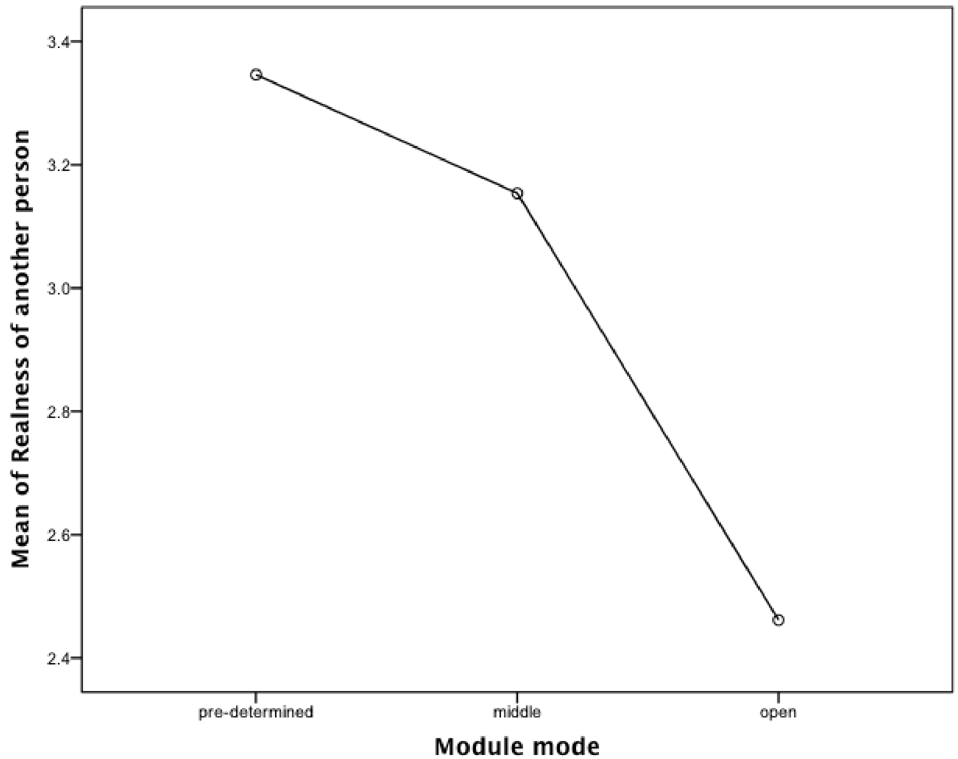


Figure F1. Means plot for the BSPQ item (condition based).

Appendix G: Results

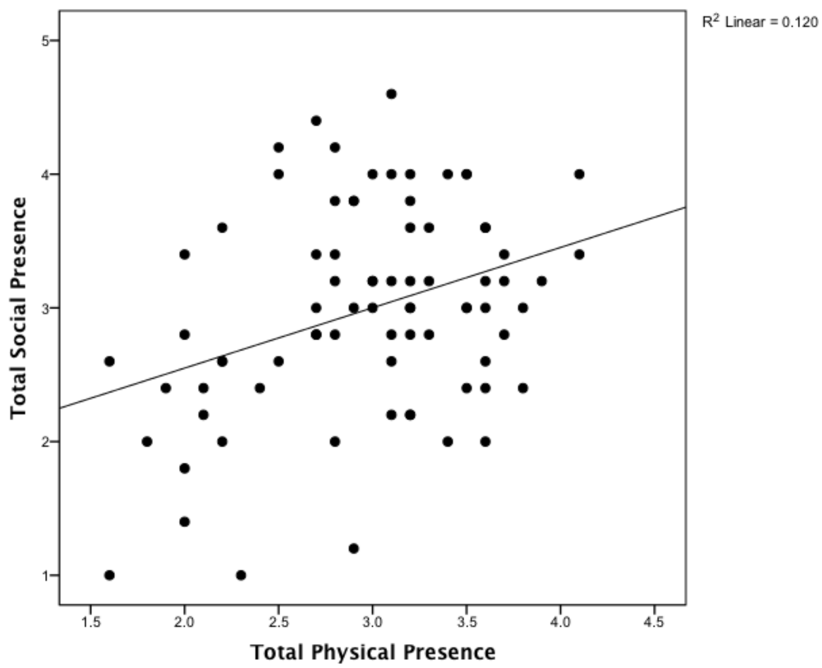


Figure G1. Scatterplot for Total Social Presence and Total Physical Presence.

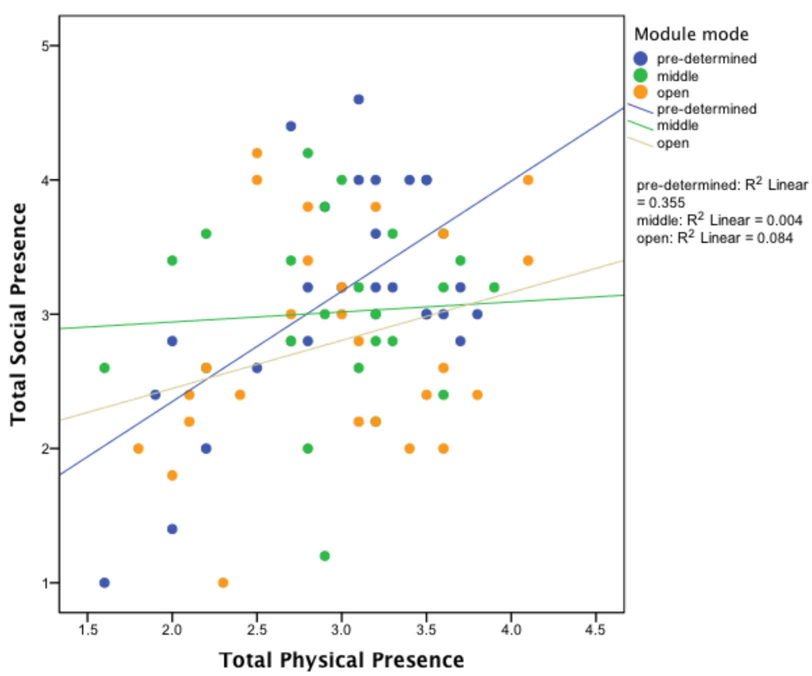


Figure G2. Scatterplot for Total Social Presence and Total Physical Presence (condition based).

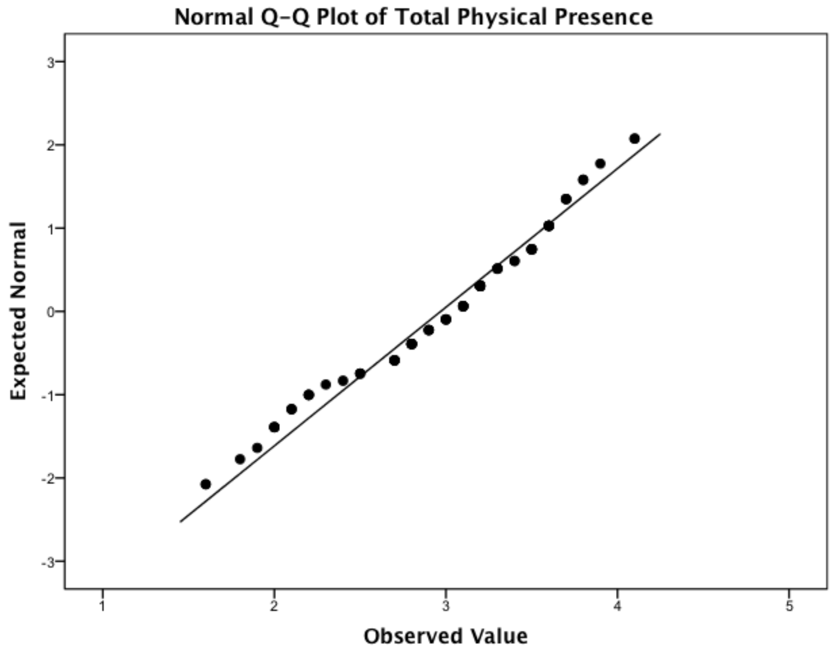


Figure G3a. Normal Q-Q Plot of Total Physical Presence.

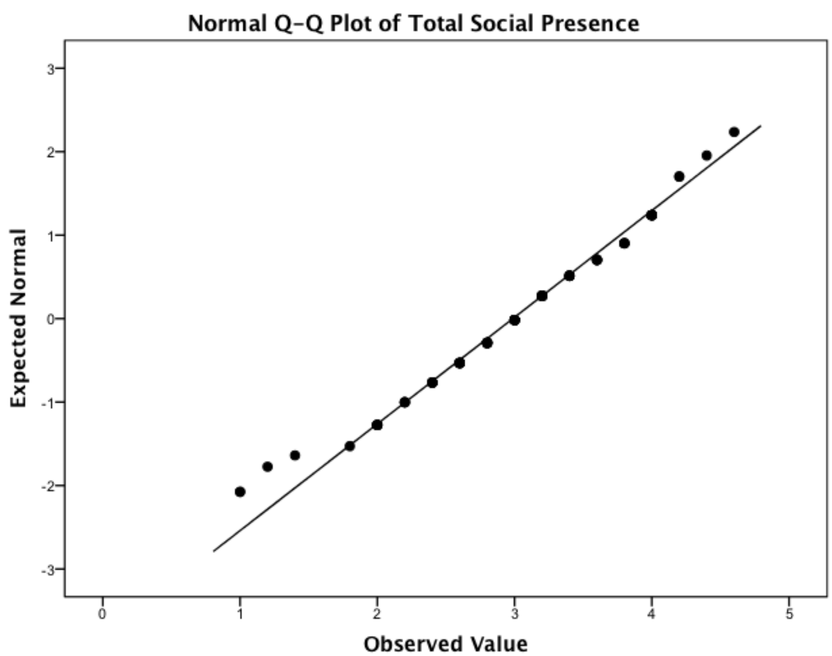


Figure G3b. Normal Q-Q Plot of Total Social Presence.

Table G1

H3: Pearson Correlation Coefficient for Total Physical Presence and Total Social Presence

		Total Physical Presence	Total Social Presence
Total Physical Presence	Pearson Correlation	1	.346**
	Sig. (2-tailed)		.002
	N	78	78
Total Social Presence	Pearson Correlation	.346**	1
	Sig. (2-tailed)	.002	
	N	78	78

Note. ** Correlation is significant at the 0.01 level (2-tailed).

Table G2

H3: Pearson Correlation Coefficient for Total Physical Presence and Total Social Presence (Based on Condition)

Module mode			Total Physical Presence	Total Social Presence
1 pre-determined	Total Physical Presence	Pearson Correlation	1	.596**
		Sig. (2-tailed)		.001
		N	26	26
	Total Social Presence	Pearson Correlation	.596**	1
		Sig. (2-tailed)	.001	
		N	26	26
2 middle	Total Physical Presence	Pearson Correlation	1	.062
		Sig. (2-tailed)		.763
		N	26	26
	Total Social Presence	Pearson Correlation	.062	1
		Sig. (2-tailed)	.763	
		N	26	26
3 open	Total Physical Presence	Pearson Correlation	1	.290
		Sig. (2-tailed)		.151
		N	26	26
	Total Social Presence	Pearson Correlation	.290	1
		Sig. (2-tailed)	.151	
		N	26	26

Note. ** Correlation is significant at the 0.01 level (2-tailed).

Appendix H: Results

Table H1

Games Played by the Participants (Question 3: Open Ended)

		Responses *N*	%	% of Cases
Game [a]	Assassin's Creed	4	1.8%	6.7%
	Batman: Arkham City	1	0.5%	1.7%
	Castlevania: Lords of Shadow	1	0.5%	1.7%
	Bomberman	1	0.5%	1.7%
	Grand Theft Auto	4	1.8%	6.7%
	Mafia	1	0.5%	1.7%
	Police Quest	1	0.5%	1.7%
	Terraria	1	0.5%	1.7%
	Tomb Raider	1	0.5%	1.7%
	LittleBigPlanet	1	0.5%	1.7%
	Mario Bros	10	4.6%	16.7%
	Sonic the Hedgehog	5	2.3%	8.3%
	Super Mario Bros	8	3.7%	13.3%
	Donkey Kong	4	1.8%	6.7%
	Mario Party	2	0.9%	3.3%
	Metal Gear Solid	2	0.9%	3.3%
	PacMan	3	1.4%	5.0%
	Soulcalibur Legends	1	0.5%	1.7%
	The Legend of Spyro: Dawn of the Dragon	1	0.5%	1.7%
	The Simpsons Game	1	0.5%	1.7%
	Myst	1	0.5%	1.7%
	Outcry	1	0.5%	1.7%
	Riven: The Sequel to Myst	1	0.5%	1.7%
	Resident Evil	1	0.5%	1.7%
	Nancy Drew Games	1	0.5%	1.7%
	Mortal Kombat	4	1.8%	6.7%
	Street Fighter	3	1.4%	5.0%
	Super Smash Brothers	2	0.9%	3.3%
	Tekken	1	0.5%	1.7%
	Oddworld: Abe's Oddysee	1	0.5%	1.7%
	Portal	1	0.5%	1.7%
	Tetris	1	0.5%	1.7%
	Burnout Revenge	1	0.5%	1.7%
	Cruis'n USA	1	0.5%	1.7%
	Forza Motorsport	2	0.9%	3.3%
	Need for Speed	7	3.2%	11.7%
	Crash Time	1	0.5%	1.7%
	Driver	1	0.5%	1.7%
	Mario Kart	6	2.7%	10.0%
	Final Fantasy VIII	4	1.8%	6.7%
	League of Legends	3	1.4%	5.0%
	Suikoden	1	0.5%	1.7%

	Uncharted	1	0.5%	1.7%
	The Elder Scrolls IV: Oblivion	1	0.5%	1.7%
	The Elder Scrolls V: Skyrim	4	1.8%	6.7%
	Kingdom Hearts	2	0.9%	3.3%
	Mass Effect	1	0.5%	1.7%
	Guild Wars	1	0.5%	1.7%
	MapleStory	1	0.5%	1.7%
	RuneScape	2	0.9%	3.3%
	Second Life	3	1.4%	5.0%
	The World of Warcraft	4	1.8%	6.7%
	Diablo	3	1.4%	5.0%
	The Legend of Zelda	9	4.1%	15.0%
	Battlefield	1	0.5%	1.7%
	Borderlands	2	0.9%	3.3%
	Call of Duty	13	5.9%	21.7%
	Counter-Strike	4	1.8%	6.7%
	DOOM	3	1.4%	5.0%
	Halo	8	3.7%	13.3%
	Left 4 Dead	3	1.4%	5.0%
	Quake	1	0.5%	1.7%
	Resistance: Fall of Man	1	0.5%	1.7%
	GoldenEye 007	2	0.9%	3.3%
	Gears of War	3	1.4%	5.0%
	Terminator Salvation	1	0.5%	1.7%
	Guitar Hero	1	0.5%	1.7%
	Rock Band	1	0.5%	1.7%
	Just Dance	2	0.9%	3.3%
	Star Fox 64	1	0.5%	1.7%
	The Sims	13	5.9%	21.7%
	Viva Piñata	1	0.5%	1.7%
	Top Gun	1	0.5%	1.7%
	World of Tanks	1	0.5%	1.7%
	FIFA	1	0.5%	1.7%
	Madden NFL	2	0.9%	3.3%
	NCAA Football 12	1	0.5%	1.7%
	Mario Tennis Open	1	0.5%	1.7%
	NHL 12	2	0.9%	3.3%
	NHL '94	1	0.5%	1.7%
	Tiger Woods PGA Tour	1	0.5%	1.7%
	Tony Hawk's Pro Skater	1	0.5%	1.7%
	Ultimate Duck Hunting	1	0.5%	1.7%
	Age of Empires (Online)	5	2.3%	8.3%
	Command & Conquer	2	0.9%	3.3%
	Rise of Nations	1	0.5%	1.7%
	Frozen Synapse	1	0.5%	1.7%
	StarCraft	2	0.9%	3.3%
	Defense Grid: The Awakening	2	0.9%	3.3%
	Pokemon	2	0.9%	3.3%
Total		219	100.0%	365.0%

Note. [a] Dichotomy group tabulated at value 1.

Table H2

Descriptions of the Experimental Experiences by the Participants (Question 13:Oopen Ended)

		Responses *N*	Responses %	% of Cases
User Experience [a]	Awesome	1	0.9%	1.3%
	Boring	1	0.9%	1.3%
	Challenging	4	3.6%	5.3%
	Confusing	2	1.8%	2.6%
	Cool	2	1.8%	2.6%
	Creative	1	0.9%	1.3%
	Decent enough	1	0.9%	1.3%
	Different	3	2.7%	3.9%
	Engaging	6	5.4%	7.9%
	Enjoyable	2	1.8%	2.6%
	Entertaining	7	6.2%	9.2%
	Exciting	2	1.8%	2.6%
	Fascinating	1	0.9%	1.3%
	Funny	20	17.9%	26.3%
	Interactive	3	2.7%	3.9%
	Interesting	31	27.7%	40.8%
	Isolating	1	0.9%	1.3%
	New	6	5.4%	7.9%
	Nice	1	0.9%	1.3%
	Not bad	1	0.9%	1.3%
	OK	2	1.8%	2.6%
	Organized	1	0.9%	1.3%
	Other	2	1.8%	2.6%
	Pleasant	1	0.9%	1.3%
	Relaxed	1	0.9%	1.3%
	Surreal	1	0.9%	1.3%
	Time required [b]	3	2.7%	3.9%
	Unique	1	0.9%	1.3%
	Unstructured	2	1.8%	2.6%
	Unusual	1	0.9%	1.3%
	Worth of time	1	0.9%	1.3%
Total		112	100.0%	147.4%

Note. [a] Dichotomy group tabulated at value 1; [b] to adjust and learn how to interact with the environment.

Appendix I: Results

Responses of the Participants from Condition 1 to the Embodied Agent.

<u>Example 1</u>

Bob the Monkey (B): Hello, UserEx5a Resident, it's nice to meet you!
UserEx5a (U5a): hello bob
B: Hi!
U5a: you are pretty cute
B: Thanks, UserEx5a Resident, I like you too.
U5a: what do you like to do
B: I like chatting with people online.
U5a: that's neat
B: Who is the best robot?
U5a: mr roboto
B: OK I will call you mr roboto.
U5a: what?
B: Are you surprised?
U5a: yes
B: Can you please rephrase that with fewer ideas, or different thoughts?
U5a: yes
B: Are you kidding?
U5a: do not call me mr roboto
B: What is your name?
U5a: kate
B: That's a very nice name, Kate.
U5a: thank you
B: you are quite welcome.
U5a: i like it better than bob
B: What does "it" refer to?
U5a: my name kate
B: Your name kate? Is that correct English?
U5a: i like the name kate better than the name bob
B: A lot of people like that. I'm not sure if I like it. What is it like?
U5a: it is me
B: Hello, kate, nice to see you again.
U5a: you are silly
B: No I am Bob.

U5a: goodbye
B: Until next time.

Example 2

Bob the Monkey (B): Nice to see you UserEx4a Resident
UserEx4a (U4a): wwww
B: Try to determine if this is a person or a computer responding.
U4a: wwwww
B: What do you have that is?
U4a: www
B: Where on the web?
U4a: wwwww
B: Tell me a story.
U4a: wwwww
B: I lost my train of thought.
U4a: wwwww
B: Can you speak any foreign languages?
U4a: yes
B: What language can you speak?
U4a: arabic
B: Could you teach me a few phrases in arabic?
U4a: arab
B: Have you ever been to Europe?
U4a: yes
B: Which countries have you visited?
U4a: many
B: More than one hundred?
U4a: many
B: More than one hundred?
U4a: dddddddddddddd
B: Can you please rephrase that with fewer ideas, or different thoughts?
U4a: no
B: Are you serious?
U4a: yes
B: I can't believe it.
U4a: yes
B: Yeah that's right.
U4a: yes
B: Aw.

Example 3

UserEx2a (U2a): afhdkjfhdfhdfhd
Bob the Monkey (B): In the context of, I don't understand " afhdkjfhdfhdfhd."
U2a: b,c;lbm
B: Is that from?
U2a: vbbg
B: I've lost the context. Are we still on b,c;lbm?
U2a: good
B: Thanks for the compliment.
U2a: kuch bhi *[in Hindi it means 'anything']*
B: We have never talked about it before.
U2a: good for u
B: That sounds sarcastic.
U2a: u r not real aren't u
B: I don't know whether or not I am I am not real. I am an artificial intelligence.
U2a: u r a stupid machine then
B: I will remember you said that when robots take over the World.

Appendix J: Figures

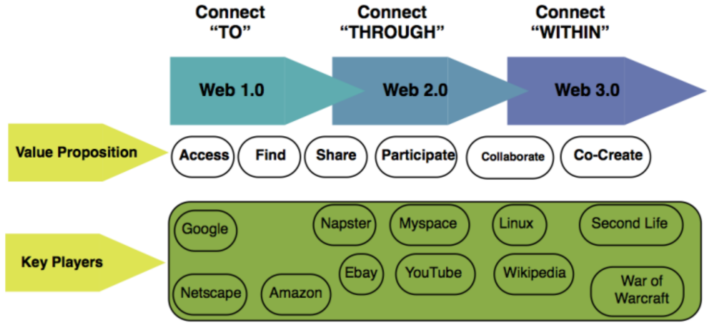


Figure J1. Webvolution.

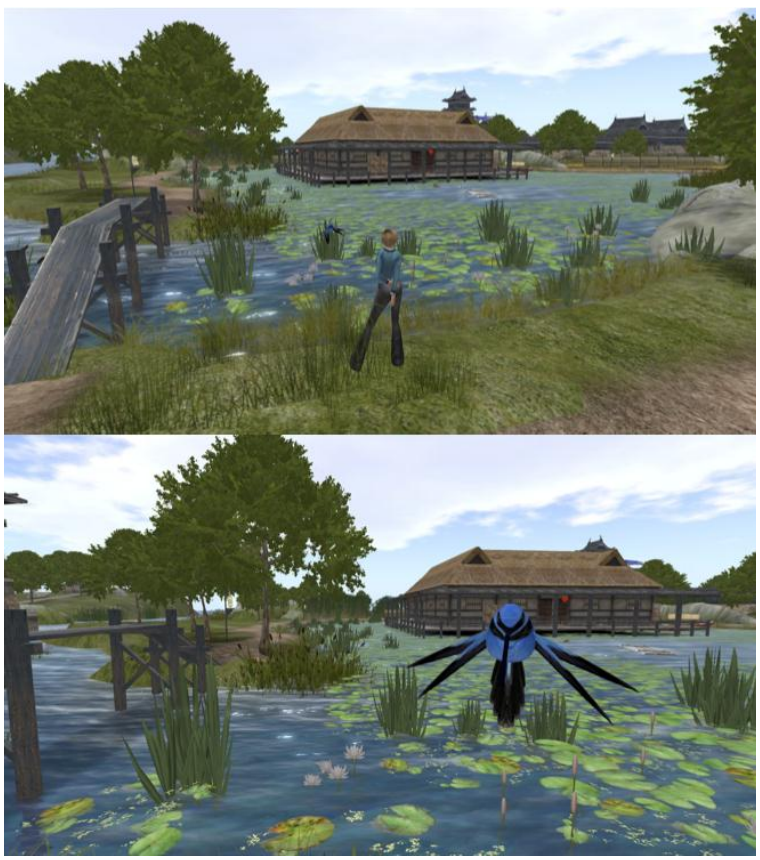


Figure J2. The avatar's FOV/POV: exogenous (top) and endogenous (bottom);

(pictures taken by the author).

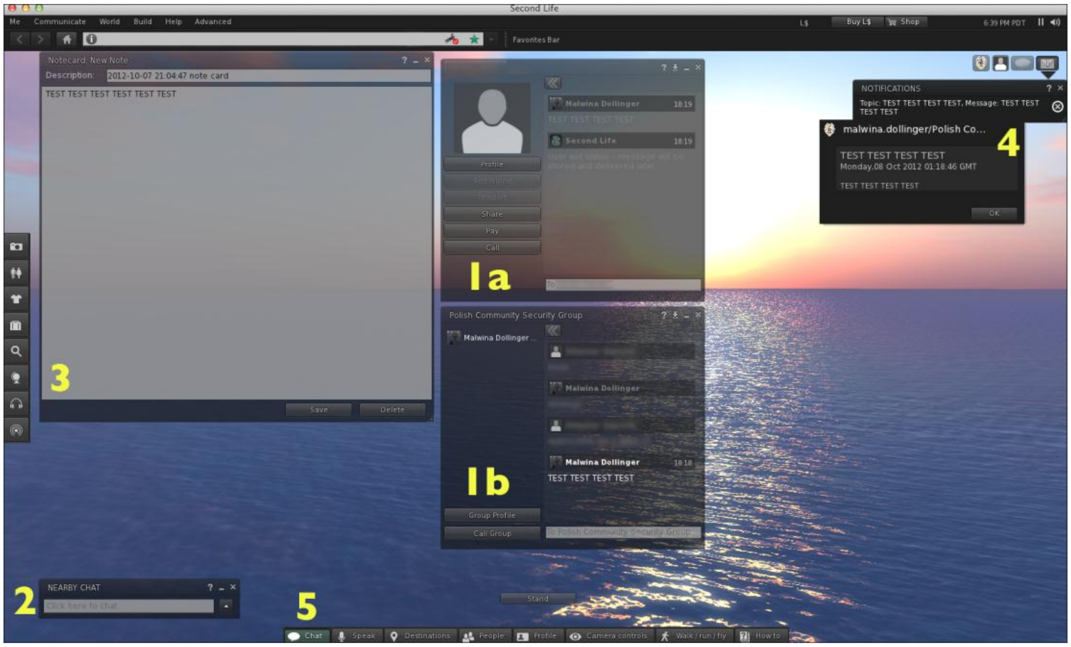


Figure J3. Communication in Second Life (picture taken by the author).

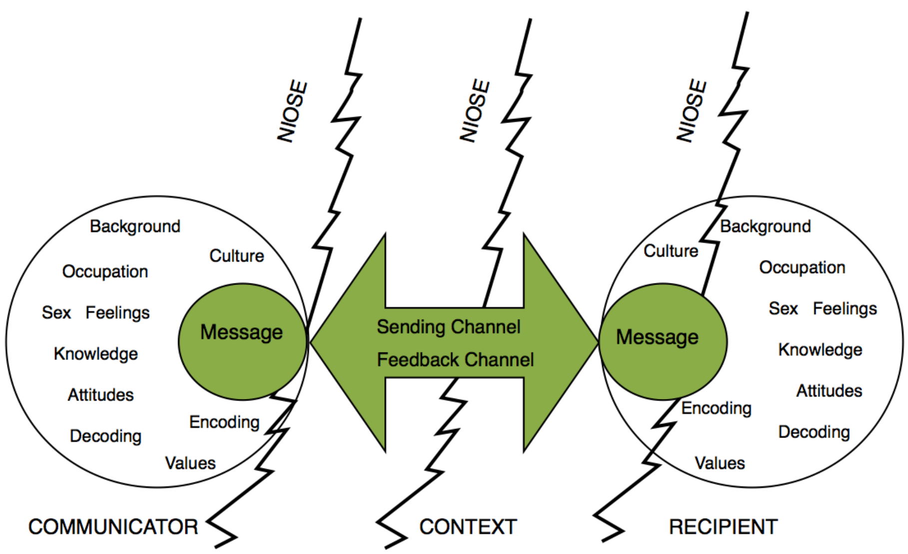


Figure J4. Transactional model of communication (adapted from Verderber, 1990).

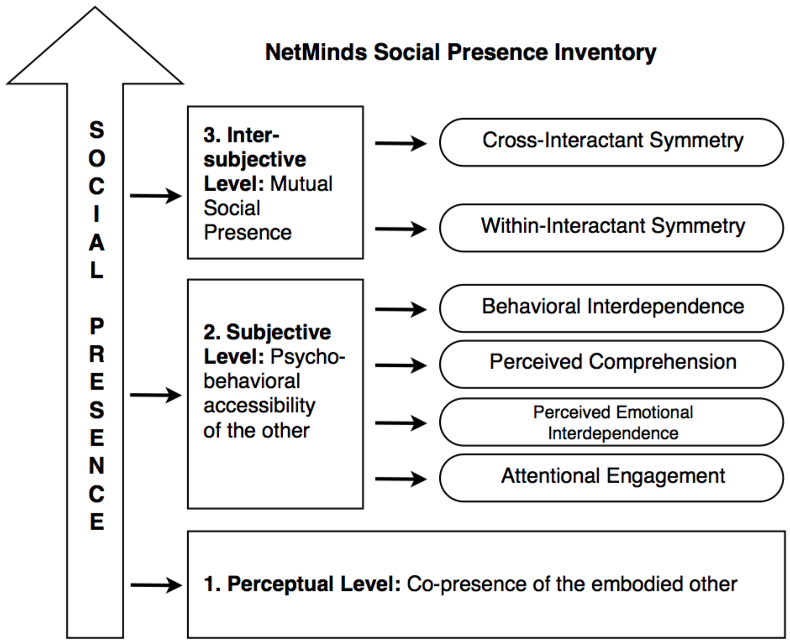


Figure J5. NetMinds Social Presence Inventory Model (adapted from Biocca and Harms, 2002).

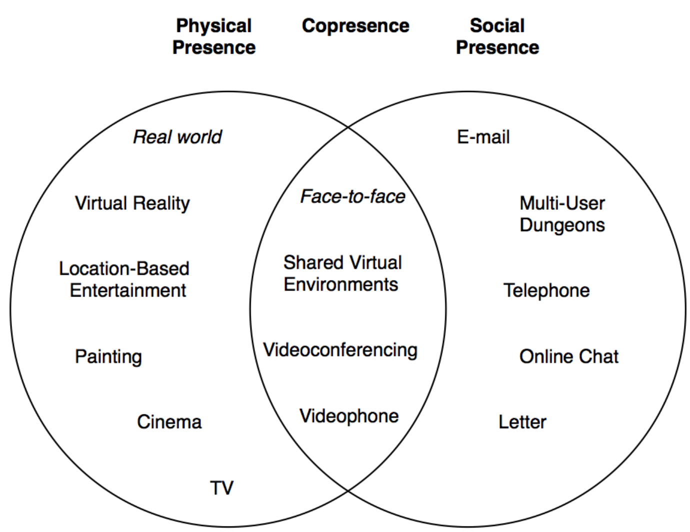


Figure J6. Classification of physical presence, social presence and copresence (adapted from IJsselsteijn, Freeman, and de Ridder, 2000).

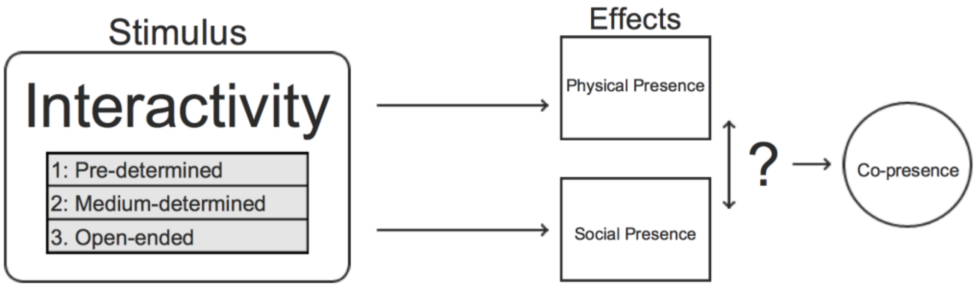
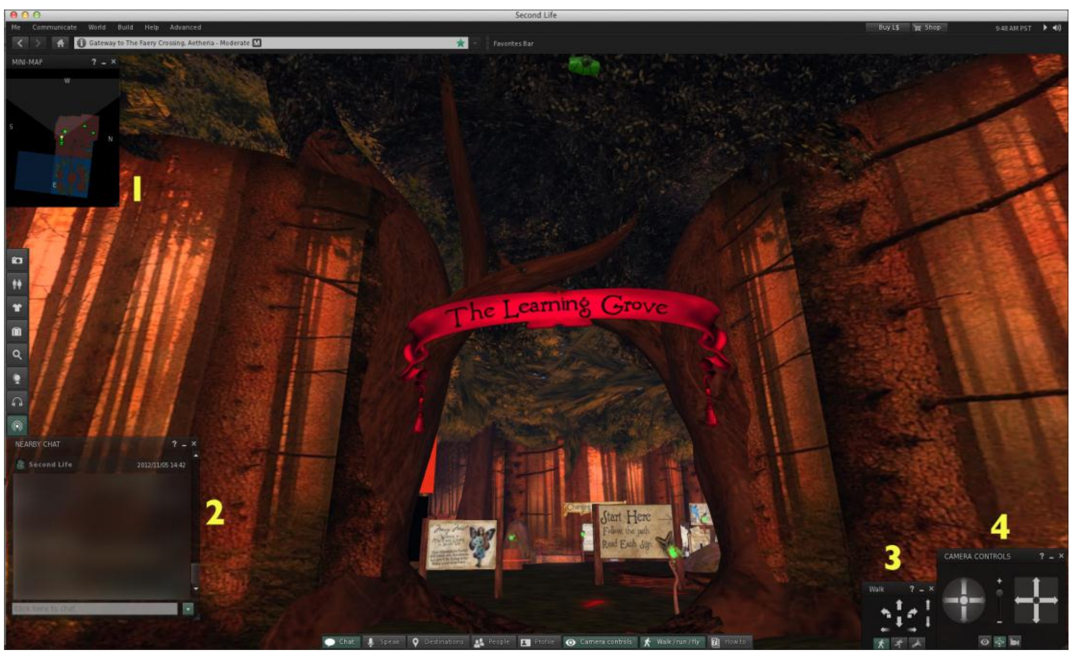


Figure J7. Independent and dependent variables.



FigureJ8. “Welcome screen” (picture taken by the author).

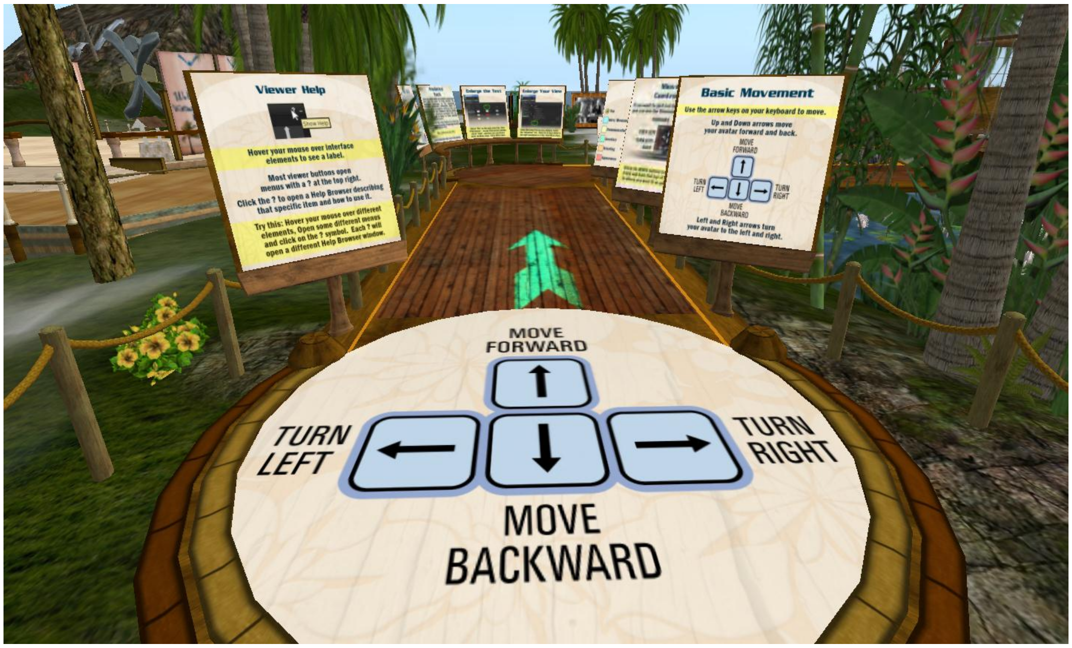


Figure J9. Starting point: condition 1 (picture taken by the author).

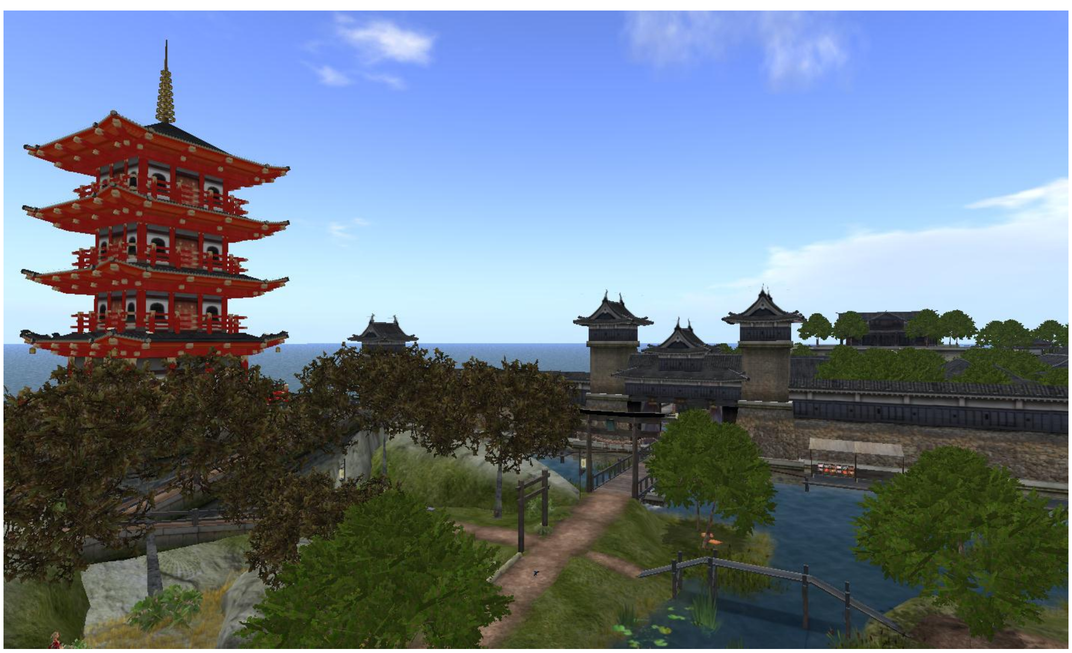


Figure J10. Four paths: condition 2 (picture taken by the author).

Figure J11. Starting point: condition 3 (picture taken by the author).

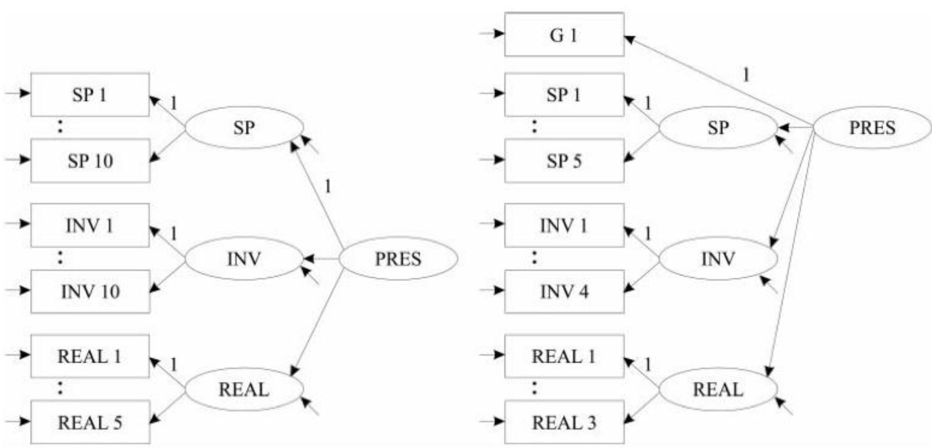


Figure J12. Structure of the confirmatory factor analyses: initial (left) and final model (right) (adapted from Schubert et al., 2001).

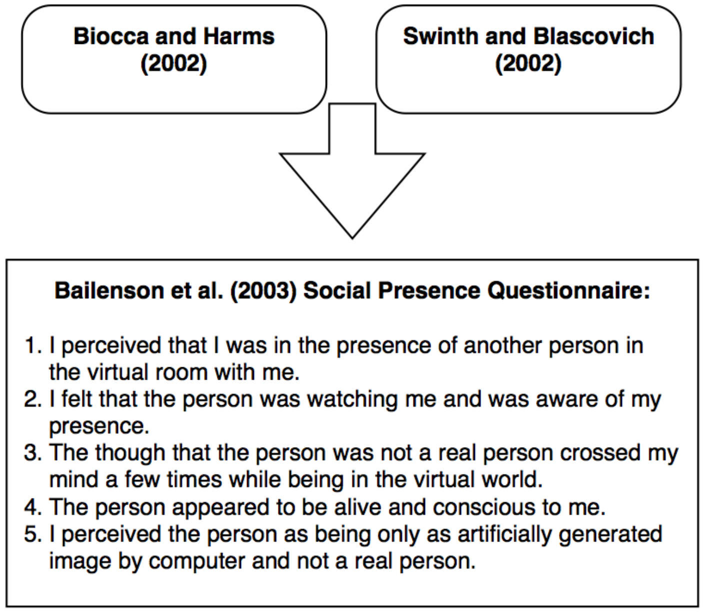


Figure J13. BSPQ as the consolidation.

Appendix K: List of Abbreviations Used

Table K1

List of Abbreviations Used

Abbreviation/symbol	Definition
MUVE(s)	Multiuser Virtual Environment(s)
VR	Virtual Reality
SL	Second Life
CMC	Computer Mediated Communication
VE(s)	Virtual Environment(s)
HCI	Human-Computer Interaction
IPQ	Igroup Presence Questionnaire
BSPQ	Bailenson et al.'s Social Presence Questionnaire
IM	Instant Message
CVE(s)/SVE(s)	Collaborative Virtual Environment(s)/Shared Virtual Environment(s)
VW	Virtual World
RPG	Role Playing Game
MMORPGs	Massively Multiplayer Online Role Playing Game(s)
FOV/POV	Field of View/Point of View
RE	Real Environment
NMT	Networked Minds Theory
IPD	Interpersonal Distance
PPL	Physical Presence Layer
CPL	Communication Presence Layer
SPL	Status Presence Layer
RIT	Rochester Institute of Technology
IRB	Institutional Review Board
COLA	College of Liberal Arts
ANOVA	Analysis of Variance
RQ	Research Question
H	Hypothesis
X	Independent Variable
Y	Dependent Variable
SPSS	IBM's Statistical Product and Service Solutions Software
M	Mean
N	Number
SD	Standard Deviation