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THE EFFECTS OF INSTRUCTOR-AVATAR IMMEDIACY IN SECOND LIFE, AN IMMERSIVE AND INTERACTIVE 3D VIRTUAL ENVIRONMENT

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by

Sabine Karine Lawless-Reljic

A Dissertation Submitted to the Faculty of

San Diego State University and the University of San Diego

in Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

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March 2010

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by

Sabine Karine Lawless-Reljic

DEDICATION

To Andrija, Dakota and Luka

Absence sharpens love, Presence strengthens it.

—Benjamin Franklin

ABSTRACT OF THE DISSERTATION

The Effects of Instructor-Avatar Immediacy in Second Life,
An Immersive and Interactive 3D Virtual Environment
by
Sabine Karine Lawless-Reljic
Ed.D. in Educational Technology
San Diego State University and the University of San Diego, 2010

Growing interest of educational institutions in desktop 3D graphic virtual environments for hybrid and distance education prompts questions on the efficacy of such tools. Virtual worlds, such as Second Life®, enable computer-mediated immersion and interactions encompassing multimodal communication channels including audio, video, and text-. These are enriched by avatar-mediated body language and physical manipulation of the environment. In this para-physical world, instructors and students alike employ avatars to establish their social presence in a wide variety of curricular and extra-curricular contexts.

As a proxy for the human body in synthetic 3D environments, an avatar represents a 'real' human computer user and incorporates default behavior patterns (e.g., autonomous gestures such as changes in body orientation or movement of hands) as well as expressive movements directly controlled by the user through keyboard 'shortcuts.' Use of headset microphones and various stereophonic effects allows users to project their speech directly from the apparent location of their avatar. In addition, personalized information displays allow users to share graphical information, including text messages and hypertext links. These 'channels' of information constituted an integrated and dynamic framework for projecting avatar 'immediacy' behaviors (including gestures, intonation, and patterns of interaction with students), that may positively or negatively affect the degree to which other observers of the virtual world perceive the user represented by the avatar as 'socially present' in the virtual world.

This study contributes to the nascent research on educational implementations of Second Life in higher education. Although education researchers have investigated the impact of instructor immediacy behaviors on student perception of instructor social presence, students' satisfaction, motivation, and learning, few researchers have examined the effects of immediacy behaviors in a 3D virtual environment or the effects of immediacy behaviors manifested by avatars representing instructors.

The study employed a two-factor experimental design to investigate the relationship between instructor avatars' immediacy behaviors (high vs. low) and students' perception of instructor immediacy, instructor social presence, student avatars co-presence and learning outcomes in Second Life. The study replicates and extends aspects of an earlier study conducted by Maria Schutt, Brock S. Allen, and Mark Laumakis, including components of the experimental treatments that manipulated the frequency of various types of immediacy behaviors identified by other researchers as potentially related to perception of social presence in face-to-face and mediated instruction. Participants were 281 students enrolled in an introductory psychology course at San Diego State University who were randomly

assigned to one of four groups. Each group viewed a different version of the 28-minute teaching session in Second Life on current perspective in psychology.

Data were gathered from student survey responses and tests on the lesson content. Analysis of variance revealed significant differences between the treatment groups (F (3,113) = 6.5, p = .000). Students who viewed the high immediacy machinimas (Group 1 HiHi and Group 2 HiLo) rated the immediacy behaviors of the instructor-avatar more highly than those who viewed the low-immediacy machinimas (Group 3 LoHi and Group 4 LoLo). Findings also demonstrate strong correlations between students' perception of instructor avatar immediacy and instructor social presence (r = .769). These outcomes in the context of a 3D virtual world are consistent with findings on instructor immediacy and social presence literature in traditional and online classes. Results relative to learning showed that all groups tested higher after viewing the treatment, with no significant differences between groups. Recommendations for current and future practice of using instructor-avatars include paralanguage behaviors such as voice quality, emotion and prosodic features and nonverbal behaviors such as proxemics and gestures, facial expression, lip synchronization and eye contact.

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I would like to express my gratitude to my dissertation chair, Dr. Brock Allen, for never failing to share his valuable expertise in time, frustration, and idea management. I now have a recipe box filled to the brim with new projects and a dissertation looking a lot sharper. I want to thank Dr. Allen also for taking so much of his time in recording and perfecting the voice acting for my four treatments. I extend my gratitude to my committee members, Drs. Susan Zgliczynski, Minjuan Wang, and Mark Laumakis for providing their support in completing this dissertation. This project would not have been possible without Dr. Laumakis facilitating my experiment in his psychology class. I would like to thank all the students who participated to the study. I would also like to thank the program directors Drs. Cheryl Mason and Jerome Ammer for believing so strongly in my successful completion of the program. This has been quite an enriching experience and I thank you for your caring guidance. Of course, I cannot forget my fellow cohort members. What a tribe we have become: from the 'When alt+delete is not an option' T-shirt of Semester 1 to the Facebook day-to-day cheerleading of my dissertation writing, the community spirit of the cohort was essential to motivate me through the wee hours toward completion. Then there are my statistics consultant, Susanne Strauss, who put order in my data chaos, and my formatter, Anne Leu, whose professionalism and quality are renowned among cohort members. I want to thank Dr. Suzanne Tilleman for her help with last statistic edits. Last but not least, I would like to express my deepest appreciation to my husband Aleks, whose support helped me complete my doctoral work.

CHAPTER 1

INTRODUCTION

> Somehow my invented self was becoming a part of my real self,
> as if I'd somehow caused a dream to breathe.
> —Mark Stephen Meadows,
> *I, Avatar: The Culture and Consequences of Having a Second Life*

This chapter introduces the avatar, the synthetic worlds, their origin and current influence as well as constructs important to this study, namely, immediacy, social presence, co-presence and cognitive learning. The purpose and significance of the study are explained and a definition of key terms is provided.

AVATAR

The etymology of 'avatar' explains the descent of a deity to earth: from Sanskrit (avatāra) (Compact Oxford English Dictionary, 2008). 'Avatar' is a spiritual concept made in flesh. Authors have revisited the concept in science fiction novels such as *Snowcrash* (Stephenson, 1992) and movies such as *The Matrix* (Wachowski, Wachowski & Silver, 1999), in which heroes are humans who can electronically transfer their mind into computer-generated bodies in cyber-worlds. The movie *Avatar* (Cameron, 2009) more recently pushes the technology advances to providing biological bodies (called avatars) operated via mental link by genetically matching humans in an effort to join the natives, the Na'Vi, inhabiting the planet Pandora. The behaviors emitted by the avatars are thus controlled by the humans. Although Neytiri welcomes Avatar Jake Sully with the Na'vi greeting "Oel ngati kameie" (I

see you), she might not have seen the human behind the hybrid body; however, she recognized the intelligence controlling the flesh. Similarly in the virtual world of Second Life, when users meet, they do not 'see' the face of the human behind the avatar, but they recognize the human presence -an intelligent user manipulating the computer-generated body. However, outside the movie industry, technology has not reached mind control over xeno-flesh capability yet: in contrast with *Avatar* users in Pandora, Second Life avatars are controlled by keyboard commands in a 3D computer-simulated world.

3D Virtual Environments

The convergence of social networking, simulation, and online gaming in recent years has led to the explosion of three-dimensional multiple-user virtual environments (MUVE) in mainstream internet activities (see Figure 1). Online gaming has become increasingly social, offering multiple-player options, integrating instant messaging applications through chat and voice, and hosting game-related forums and other collaborative spaces enhancing players' sense of community. Recent large-scale studies report on the pervasiveness and social implications of videogames (such as Mario Kart and Legend of Zelda) and social networking games (such as Final Fantasy and World of Warcraft) in the culture at large. Gartner, Inc., analysts (2007) have identified emerging trends and warned IT leaders that they must take the initiative in addressing new markets and modalities of use and interaction based on their research conclusion that "80% of internet users will be active in a virtual world by the end of 2011." The Pew Foundation reports that "fully 97% of teens ages 12-17 play computer, web, portable, or console games" (Lenhart, et al., 2008, p. i) and that their gaming experiences "include significant social interaction and civic engagement" (Lenhart, et al., 2008, title page). Furthermore, civic gaming experiences were observed to be more equally distributed

than high school learning opportunities in which primarily higher-income, higher-achieving, and white students participate more (Lenhart, et al., 2008, p. 47).

However, unlike the world representations designed for synthetic characters (i.e., web-based interactive assistants), the virtual worlds provided for the human players are rich and compelling. Recent gaming trend has also allowed for increase in user-generated content, effectively strengthening users' sense of ownership and belonging in the environment. Similarly, social virtual environments have become tabula rasa worlds which potential is actualized by users' imagination and growing knowledge of the interface.

Although Second Life was selected for this study, it was not the first 3D social virtual world to be launched. Active Worlds came online in 1997 and quickly developed Active Worlds Educational Universe (AWEDU) to support its growing educational community. Not only have more worlds been developed since Second Life, many are developed by individuals. Virtual world construction toolkits such as Unity 3D, Open Cobalt, OpenSim and Metaplace provide free tools for developing open cyberenvironments.

SECOND LIFE

Second Life® (SL™), launched in 2003, is a three-dimensional virtual world in which about 19 million residents create and interact (as of July 2009; KZero http://www.kzero.co. uk/blog/?page_id=2092). Virtual worlds' lore offered that Philip Rosedale, founder of Linden Lab, Inc., created SL after being inspired by *Snow Crash*, a cyberpunk novel written by Neal Stephenson in 1992. Rosedale confirmed that he found *Snow Crash* inspiring; however, he had been thinking and experimenting with virtual worlds for a few years before the novel

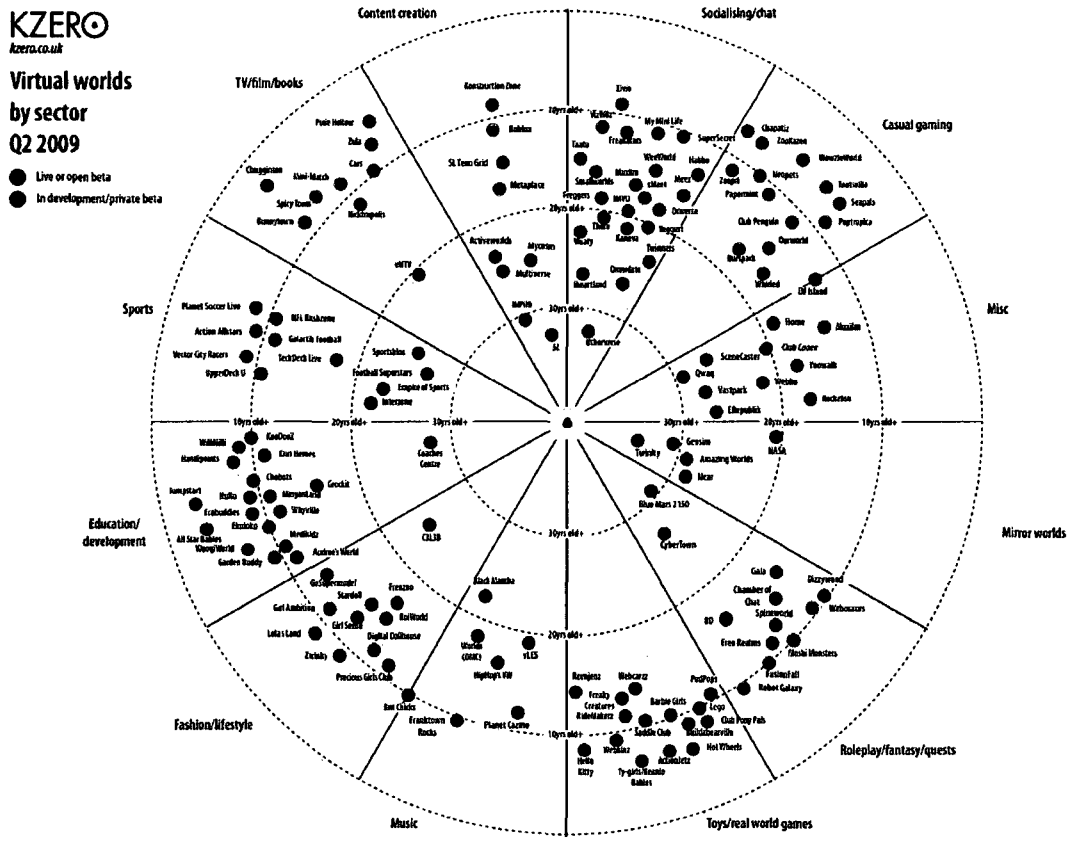


Figure 1. The radar, the universe-graph by KZero (reproduced with permission).

came out (Dubner, 2007). Whether or not SL was inspired by an entire library of primary exponents of the cyberpunk field including William Gibson, Bruce Sterling, Pat Cadigan, Rudy Rucker and John Shirley, the SL platform has been possible due to a merging of technology already in existence: social networking tools such as MySpace and Facebook and online massively multi-player video games technology such as Neverwinter Nights (first truly graphical multi-user role-playing games introduced in 1991) and EverQuest (released in 1999, credited for bringing massively multiple-user online role-playing games mainstream to the West).

Although used as a game by some users, SL was not built as a game platform, rather as a social interaction environment. Game worlds are objective-driven systems such as

EverQuest, World of Warcraft and Eve Online. Users follow prescribed rules, objectives and challenges specific to the fictional-based narrative they enter. SL, like Active Worlds and HiPiHi, is a socially-driven system. Although some scholars may disagree, Meadows has argued that users enter a completely metaphor-free environment in which rules are emergent and roles are entirely social (2008). Following the current gaming trend to increase content authoring by users, SL allows players to create content with user interface (UI) tools and modification software, and even 'hack' certain aspects of the platform's operating system to modify media and architecture, and the behavior of the avatars.

In order to *be* in SL, users must create a 3D alter ego called an avatar. Once logged in, the user has access to a UI that provides the avatar with potentials for rich sense of presence 'in world,' in the sense that SL allows people to interact via several senses. Among many presence-related affordances such as creation of objects and landscapes and the manipulation of their appearance and behaviors, the standard UI options provide a rich array of communication between user/avatars including: text-based exchanges in chat boxes, verbal input through audio channels, and body language via the avatar. This study investigates the effects of avatar social presences in the context of distance education.

Why conduct such an investigation? Past research has emphasized the importance of presence in face to face education. Recent research has underlined the importance of instructor presence in distance education. The popularity of SL has inspired colleges and universities to use SL for hybrid and distance education, and training for the past five years, but with very little research to justify the adoption. The 3D platform has graduated to the level of disruptive technology (Bower & Christensen, 1995) and many questions have arisen

regarding the educational value of the social 'presence' virtual realities enable –whether and how it might benefit institutions of higher education and their students.

VIRTUAL REALITY AND DISTANCE EDUCATION

Represented by avatars, users engage in mediated social interaction including a full range of social interaction and contacts (Schroeder, 2002). Researchers have demonstrated that computer-mediated communication (CMC) and multi-user virtual environments (MUVE) are capable of projecting social presence (Chou, 2001) and could possibly provide an online environment that surpasses other forms of CMC in regards to social presence and interactive communication (McKerlich, 2007). Indeed, Rheingold (1991) defines virtual reality as an experience in which a person is "surrounded by a three-dimensional computer-generated representation, and is able to move around in the virtual world and see it from different angles, to reach into it, grab it, and reshape it" (p. 17). More recently, Johnson and Levine (2008) describe virtual worlds as "inherently immersive" (p. 161) arguing that virtual worlds are "richly expressive environments that immerse the participant in a setting that includes sound and visual cues, rich textures, and realistic perspective . . . and vividly create a sense of place" (p. 161).

MUVEs offer more presence affordances than other forms of CMC in that they are designed to foster social interaction and the formation of groups and communities (Johnson & Levine, 2008). They have the potential to "significantly reduce the subjective feelings of psychological and social distance often experience by distance education participants" (McKerlich, 2007, p. 35). Bringing courses in SL would allow for a rich and compelling learning environment while maximizing distance learning benefits, such as reaching nontraditional students and promoting international collaborations.

The 'distance' in distance education implies that physical and geographical separation is correlated with psychological and social distance. It is therefore tempting to assume that students feel disconnected and isolated from the instructor as the physical distance grows between them. However, keeping Kozma in mind, the nature of the technology used in delivering instruction possesses its own distance rate. For example, an independent study on campus (personal tutorials) rates lower on distance than a self-directed independent reading (textbook). It may be more useful to consider distance education as pedagogical distance. Moore (1993) argues that pedagogical, or 'transactional distance' (TD) is a function of two sets of variables, structure and dialogue ('constructive interaction'). Hence, the manner in which a program is designed and conducted can result in higher or lower levels of dialog between the learner and the instructor. Saba and Twitchell (1988) consider telecommunication-based technology an essential core to distance education and elaborates on TD, using a system modeling approach. Saba (2007) defines TD as "an open system residing in a larger environment in the instructional systems level which is in turn part of a larger system in the hierarchical model" (p. 51) (See Figure 2).

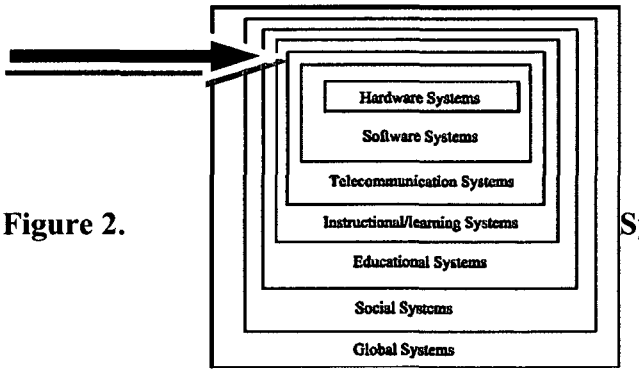


Figure 2. Systems dynamic.

While TD refers to pedagogical distance, dependent on three dimensions—structure of the program, dialogue between teacher and learner, and social presence—immediacy focuses more to the dialogue part of TD. Immediacy has been defined as the perception of physical or psychological closeness (Christophel, 1990) between communicators and is observed by approach and avoidance behaviors which include verbal and non-verbal behaviors (Mehrabian, 1966). Within this framework, immediacy is therefore a set of measures of behaviors employed in association with instructional transactions. Research on instructor immediacy suggests strongly that teachers adopting appropriate immediacy behaviors facilitate interaction and reduce psychological distance (Andersen, 1979; Christophel, 1990). New interactive and immersive technology such as SL may enable more immediate instructional transactions between teacher and learners than traditional online platforms: the instructor and the students meet face to face via an avatar in the same place and with the equal amount of physicality to be demonstrated in that space.

Immediacy is a variable of social presence, a construct that is also influenced by the amount of information transmitted, words conveyed, and the context of the communication. The experiment employed in this study manipulates immediacy behaviors to observe their effects on student perception of instructor social presence.

Social Presence

In some ways, the rise of virtual realities and allied new media reopen debates of the 1980s and 90's between Richard Clark, Robert Kosma and others (Hastings & Tracey, 2004) in which adherents of the Clark position generally claimed that media function primarily as conduits for instructional strategies and had few instructional effects in and of themselves. Clark (1983) in particular, argued that classic experimental comparisons of instructional

media were likely to confound effects associated with instructional strategies with effects associated with particular media and that this in part accounted for decades of failure of 'Media A vs. Media B' comparative research which showed no consistent pattern favoring the instructional effectiveness of any medium over another.

Kosma (1994) and his supporters argued that different media enabled different and often specific instructional strategies and that some media were more effective enablers of some strategies. More importantly, Kosma argued that emerging digital multimedia were able to approximate or stimulate many media modalities (e.g., audio, video, text, print, photos, video).

These arguments foreshadowed current debates about what a 3D persistent virtual world adds to the teaching and learning experience. We are now questioning how to achieve quality and effectiveness of presence in education when mediated in SL. Arguably, the immersiveness of SL would constitute a psychological advantage.

Social presence is generally understood to reflect the degree to which a person is perceived as 'real' in a mediated communication. Social presence theory is a seminal theory of the social effects of communication technology (Short, Williams, & Christie, 1976). It evolved from research about efficiency and satisfaction in the use of different communication media. Social presence is conceived to be a subjective quality of a medium that cannot be defined objectively. Short et al. (1976) regard social presence as a single dimension that represents a cognitive synthesis of several factors such as capacity to transmit information about facial expression, direction of looking, posture and non-verbal cues as they are perceived by the individual to be present in the medium. These factors affect the level of presence that is the extent to which a medium is perceived as sociable, warm, sensitive,

personal or intimate when it is used to interact with other people. Social presence varies between different media and it affects the nature of the interaction.

Schroeder (1996) defines virtual reality (VR) technology as "a computer-generated display that allows or compels the user to have a feeling of being present in an environment other than the one they are actually in and to interact with that environment" (p. 19). VR technology is about 'being there': presence is therefore partly to do with the technology and partly to do with the users' state of mind. This present study focuses on student perception of the social presence of instructor and student avatars in a simulated classroom lecture in Second Life.

CO-PRESENCE

Social presence is the feeling that other persons are present even though the characteristics and behaviors of those persons may be represented and observed via mediated communication rather than physical proximity and direct observation.

Co-presence, a parallel construct, is the feeling that one is in the same place as other persons and able to collaborate or cooperate with them. Schroeder (2002) suggests that more immersive VR systems enable a greater sense of presence and co-presence. However, the technology of the virtual environment can influence what the participant does: "the person using the desktop system [such as Second Life] may focus on communication, whereas the more immersed person may focus on navigating and manipulating the objects" (p. 10, brackets added). Technological affects also exist within lower-end systems such as internet-based desktop virtual worlds: bandwidth, communication capabilities, and ease of navigation (Axelsson, 2002; Becker & Mark, 2002; Nilsson, Heldal, Axelsson, & Schroeder, 2002).

Consequently, certain technology, social factors and personal skills might interfere with the creation and maintenance of interpersonal relationships and reduce co-presence.

Schroeder (2002, October) also identifies differences in co-presence variables based on short-term interaction or long-term interaction. Research on short-term interaction might investigate common foci of attention, mutual awareness and collaborative task performance whereas research on long-term interactions might investigate phenomena such as persistence of character, of groups, and of the environments; choice of social rules and conventions; and the relation between real and virtual (Schroeder, 2002, October, p. 16). The current experiment investigated issues relating to mutual awareness component of co-presence measured by the networked minds measure of social presence (Harms & Biocca, 2004) (See Appendix A).

PROBLEM STATEMENT

For decades, social scientists and other researchers have poured over questions involving effects of instructor immediacy in learning environments and elucidated phenomena foundational to this study: Research of verbal and non-verbal immediacy behaviors in traditional settings has established that instructor immediacy correlated with enhanced learning outcomes, motivation, and satisfaction (Andersen, 1979; Christophel, 1990; Gorham, 1988; Gorham & Christophel, 1990; Gorham & Zakahi, 1990; Kearney, Plax, & Wendt-Wasco, 1985; Kelley & Gorham, 1988). Research utilizing mediated environments such as videoconferencing and massively multiple-users online role-play games (MMORPGs) supports similar findings (Schutt, 2007; Schutt, Allen, & Laumakis, 2009; Steinkuehler, 2004). Other researchers have argued that social presence and media richness theories assume that a lack of social context cues make CMC ill-suited to interpersonal

interaction (see Table 1). These published arguments did not take into consideration the visually rich, contextual, manipulative and synchronous communication offered by 3D platforms.

The literature on social presence addresses several indicators, such as immersion and involvement in the environment. However, few studies have been conducted in an internet-based desktop 3D virtual environment that used avatars as presence medium, assessed cognitive learning gains during a traditional teaching session, and utilized experimental

Table 1. CMC Research on Interpersonal Interaction

Research	Authors
Technological characteristics of CMC text-based	Kisler, Siegel, & McGuire, 1984 Sproull & Kiesler, 1986
CMC v. F2F communication regarding transmission of impression-bearing data	Jones & Kucker, 2001
Non-textual characteristics as lacking in social context cues (verbal and nonverbal information)	Culnan & Markus, 1987 Schutt, 2007; Schutt, Allen & Laumakis, 2009
Teleconferencing v. CAVE-environment	Costigan, Johnson, & Jones, 2007

research design to guide their research. The present study is interested in how participants experience a greater sense of presence by proxy, that is, through avatar body dynamics.

In the context of this study, the 'avatar-instructor' is a computer-generated representation of an instructor and the 'avatar-students' are computer generated representation of students. Within virtual worlds such as Second Life, there is wide variation in the control of avatars by users. For example, basic avatars initially supplied to users engaging in a typing gesture whenever their user is typing so that other users will know they are occupied with a manual task in real-life. Other behaviors such as blinking and subtle

body movements are automatically and autonomously exhibited by the avatar regardless of any movement by the user. Other avatar movements such as hand raising or waiving, or rolling of eyes can be commanded by the user with keyboard short cuts. Users can purchase or obtain for free, hundreds of additional behaviors –both autonomous user-controlled— ranging from highly specific actions, such as cutting a ribbon at a grand opening to kissing (or hitting) another avatar, to riding a bicycle, or drinking a cup of coffee.

Second Life offers a variety of options for capturing the activity of avatars and their environs. The recordings employed in this study are accessible in cost and in skills: machinimas (motion pictures of virtual reality activities) made with Fraps ($37), in Second Life (free, basic account), and recorded sessions hosted on Veoh (free account).

PURPOSE OF THE STUDY

The study examines the relationship between perceived instructor immediacy, perceived social presence and student co-presence during a lecture given in Second Life. To explore these issues, the researcher recorded four versions of an in-world (i.e., situated in Second Life) synchronous lecture to reliably manipulate the levels of instructor and student immediacy behaviors. In each video, the instructor engages students in a lecture format with identical content while manipulating the level of verbal and nonverbal immediacy behaviors. The high- and low-immediacy conditions were established using existing immediacy behaviors derived from immediacy research. The behaviors exhibited by the avatars were chosen from a standard SL library of gestures and animations and selected based on their credible similarity with the behaviors listed in the immediacy research literature. The sessions were recorded, providing four machinimas (machine + cinema). Participants were randomly assigned to view one of the four sessions. The study replicated some of the

experimental research design elements used by Schutt (2007): (a) the rerecorded teaching sessions in which the instructor immediacy behaviors were manipulated to create high and low conditions, and (b) lesson materials and power point slides were identical and adapted to the 3D environment.

The study's four treatments employ recordings of instructor and student activity in SL that depict standard SL communication channels and displays: video, audio and text chat. The recordings also captured typical SL user representation: human avatars diverse in gender, race and dress for students, and a generic, professional male avatar for the instructor. By manipulating degrees (high and low) of immediacy behaviors, the researcher expected to observe variations in student perceptions of instructor social presence and immediacy, student perception of social presence of other students and of learning outcomes.

Research Questions and Hypotheses

This study examined the following research questions and hypotheses.

Research Question One

RQ1: Do immediacy behaviors projected by the avatar-mediated instructor influence instructor immediacy?

H1i: Students who view recordings in which an instructor exhibits high levels (more frequent use) of immediacy behaviors (Group 1 HiHi and Group 2 HiLo) will indicate higher perception of instructor immediacy than students in the low immediacy groups (Group 3 LoHi and Group 4 LoLo). The null hypothesis was that there would be no significant difference.

H1ii: Group 1 (HiHi) would perceive the highest immediacy of the four groups. The null hypothesis was that there would be no significant difference.

Research Question Two

RQ2: Do immediacy behaviors projected by the avatar-mediated instructor influence instructor social presence?

H2i: Students who view recordings in which the instructor exhibits high levels (more frequent use) of immediacy behaviors (Group 1 HiHi and Group 2 HiLo) will indicate a higher perception of instructor social presence than the students who receive the low immediacy cues (Group 3 LoHi and Group 4 LoLo), and that Group 1 would perceive the highest immediacy. The null hypothesis was that there would be no significant difference.

H2ii: There will be a positive relationship between perceived instructor immediacy and perceived instructor social presence in a 3D virtual environment. The null hypothesis was that there would be no significant relationship.

Research Question Three

RQ3: Do immediacy behaviors projected by the avatar-mediated students influence perceived students' co-presence?

H3i: Students who viewed avatar-students exhibiting high levels of immediacy behaviors (Group 1 HiHi and Group 3 LoHi) will indicate a higher perception of student presence than the students who viewed avatar-students exhibiting low levels of immediacy behaviors (Group 2 HiLo and 4 LoLo). The null hypothesis was that there would be no significant difference.

H3ii: There will be a positive relationship (correlation) between measures of student immediacy and measures of student perception of co-presence in a 3D virtual environment. The null hypothesis is that there is no significant relationship.

Research Question Four

RQ4: Do immediacy behaviors projected by the avatar-mediated instructor influence learning outcomes?

H4i: High-immediacy groups (Group 1 HiHi and Group 2 HiLo) will achieve higher scores on measures of simple recall and comprehension of the instructor's lecture than the low-immediacy groups (Group 3 LoHi and Group 4 LoLo). The null hypothesis would be that there is no significant difference in learning outcomes between the groups.

H4ii: There will be a positive relationship (correlation) between instructor immediacy and measures of simple recall and comprehension. The null hypothesis is that there will be no significant relationship between perceived instructor immediacy and recall and comprehension.

SIGNIFICANCE

Understanding the relationship between immediacy, social presence, and learning in a 3D collaborative virtual environment could contribute to the theory and practice of distance education. The possible significance of this study from a social-practical and theoretical perspective is further explicated below.

Social Significance

Studies have addressed social behaviors in virtual environments, such as the nature of turn-taking and avatar movement (Bowers, Pycock, & O'Brien, 1996), dynamics of virtual

meetings (Bowers, O'Brien, & Pycock, 1996), movement in the virtual world (Greenhalgh, 1995), experiences from a mixed-reality environment (Benford, Greenhalgh, Snowden, & Bollock, 1997), identity construction (Donath, 1998; Turkle, 1997), cultural formations (Reid, 1996), communication in online communities (Kollock, 1996), relation between social conventions and communication (Becker & Mark, in Schroeder, 2002) and even design paradigms enhancing presence (Oxman, 2004). Departing from the general use of web-based tools in online courses for information delivery, 3D virtual environment affordances emphasize dialogue and collaboration in synchronous text, graphic, audio, and video channels. This study addresses questions that may help researchers and educational developers to determine whether the capabilities of 3D platforms can be utilized to improve remote learning, immersive learning, new student outreach and peer-to-peer learning by decreasing psychological distance, increasing perception of instructor immediacy, and peer presence.

This study's findings may also have practical implications for corporate training. Virtual worlds can provide important business-related features such as expense avoidance, highly effective procedural training, collaboration and support sessions, great opportunities for effective collaboration work that are unavailable by using other technologies, expanding brand by building self-managing communities, and increasing ROI by connecting training simulations with already existing training programs and learning management systems (Heiphetz & Woodill, 2009). Nebolsky, Yee, Petrushin, and Gershman (2003) also found that using virtual training worlds for corporate training increases employees' attendance by providing low-cost training (no traveling-related expenses) and flexible schedules, and improves trainees' motivation. The important points of traditional training such as group

interaction and shared learning are present, ensuring the learning is successfully supported for each delegate no matter the geography.

Theoretical Significance

Several decades of research on instructor immediacy (Andersen, 1979; Christophel, 1990; Comstock, Rowell, & Bowers, 1995; Frymier, 1994; Gorham, 1988; Gorham & Christophel, 1990; Gorham & Zakahi, 1990; Kearney, Plax, & Wendt-Wasco, 1985; Kelley, & Gorham, 1988; Mehrabian, 1966, 1967, 1968, 1971; Richmond, Gorham, & McCroskey, 1987; Rocca, 2007; Rodriguez, Plax, & Kearney, 1996) has clearly demonstrated the potent effects of such behaviors learning outcomes and affective behaviors in the classroom. Such research can point out possibilities for enhancing the behavior of avatars to, for example, reduce psychological distance and enhance instructional effectiveness. However, current technology, as employed in virtual worlds such as Second Life, does not allow for exact or literal translation of the behaviors of human users into avatar behavior. Rather, a wide range of constraints and compromises result in loose coupling intentions and avatar behaviors.

One of the main goals of virtual reality engineers and developers is to generate an experience of being in a computer-generated environment that feels like reality (Held & Durlach, 1992; Hendrix & Barfield, 1996; Sheridan, 1992; Slater & Wilbur, 1997). Witmer and Singer (1998) define presence as the subjective experience of being in one place or environment, even when one is physically situated in another. In the context of this study, presence is the sensation of being in the simulated classroom and experiencing the computer-generated environment rather than the actual physical location. Heeter (1992) recognizes that presence is a subjective experience but divides the concept of presence into three dimensions: personal presence, social presence and environmental presence. Personal

presence is, according to Heeter, a measure of the extent to which a person feels as if she/he is in a virtual world. Social presence refers to the extent to which other beings --both living and synthetic-- exist in the virtual world and appear to react to a participant/observer. Environmental presence refers to the extent to which the environment itself appears to know that one is there and responds to one. The more complex environments that 3D virtual worlds offer compared to simpler media led Biocca, Harms, and Gregg (2001) to propose the Networked Mind Theory of Social Presence. They define social presence as follows: "Social presence in a mutual interaction with a perceived entity refers to the degree of initial awareness, allocated attention, the capacity for both content and affective comprehension, and the capacity for both affective and behavioral interdependence with said entity" (p. 246).

Studies in virtual environments have primarily addressed certain aspects of presence in relation to collaborative projects and task-based learning and rather than investigating effects of social presence in didactic events, such as presentation or lecture-type seminars that continue to be widely used in educational enterprises within virtual worlds. Although studies in virtual reality have researched multiple renditions of different aspects of immediacy and their effects and affects, this approach has not, apparently, been applied to interactions between instructors and students.

DEFINITION OF TERMS

Avatar: online proxy. In 3D interactive worlds, an avatar is a computerized representation of the user in the 3D space. The user uses the avatar to interact with other avatars and objects.

Disruptive Technology: Term used to describe a new, low-cost, often simpler technology that displaces or marginalizes an exciting sustaining technology, such as television and video recorders displacing movie theaters.

In-world: term used by MUVE users to refer to the state of being online, inside a virtual world (here refers to being in Second Life).

Machinima: [machine + cinema], real-world filmmaking technique based on computer capture of events in a virtual world.

MMORPG: Massively Multiple-User Online Role-Playing Games. Used for 3D interactive online games such as World of Warcraft (WOW), Badge of Honor, and Eve.

MUVE: MultiUser Virtual Environments. Used for 3D interactive desktop systems, accessible via the internet, allowing multiple users simultaneously. Usually used to designate the general metaverse (gaming, and social environments such as Second Life, Active Worlds, and OpenSim).

Synthetic Characters: Synthetic characters are cartoon characters -as opposed to avatars. They are usually created to resemble humans in shape and behaviors. They are often encountered as software robots used for assistance. They are also called intelligent agents and digital assistants.

Virtual World: The usage of the term 'virtual world' has changed with the evolution of social networked technology. For the purpose of this study, 'virtual world' is used exclusively to designate online three-dimensional computer-simulated environments for desktops, excluding conferencing software (e.g., Blackboard, Wimba Horizon, Elluminate, Acrobat Connect), combination of real-world and computer-generated data (i.e., Augmented Reality), and projection-based virtual reality displays (i.e., CAVE environments).

For other definitions of Second Life jargon, please visit http://secondlife.blogs.com/nwn/2005/02/glossing_it_ove.html

CHAPTER 2

REVIEW OF THE LITERATURE

Chapter 1 described the background to the study and its intended contributions. Chapter 2 provides a review of the literature related to social presence and co-presence, immediacy and learning outcomes. Those constructs are rooted in the traditional literature and expanded in the newer research in virtual environments.

SOCIAL PRESENCE

Is there a TV upstairs? I like to watch.

—Chance the Gardener,
Being There (Ashby, 1979)

Social Presence: Definitions

Social scientists, psychologists and other researchers in the behavioral and learning sciences have extensively researched the concept of social presence over the last three decades. Educational research initially focused on the role of social presence in the dynamics of traditional classroom environments in which the interaction between the instructor and the students was face-to-face and instructor-dominated. The literature on social presence offers a fairly wide range of definitions, which have been classified by Biocca, Harms, and Burgoon (2003) in categories that appear to be underlying conceptualizations of social presence (pp. 55-57; see Table 2). In their ground-breaking work Short et al. (1976) defined social presence as "the degree of salience of the other person in the interaction and the consequent salience

Table 2. Definitions of Social Presence

Classification	Definition
Co-presence: Co-Location, Mutual Awareness	
Co-presence: Sensory awareness of the embodied other (Goffman, 1959)	• (un-mediated) "experiencing someone else with one's naked senses" (p. 15) • "physical distance over which one person can experience another with the naked senses—thereby finding that the other is 'within range'" (p. 16) • "Full conditions of co-presence, however, are found in less variable circumstances: 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)
Co-Location	• "the feeling that the people with whom one is collaborating are in the same room" (Mason, 1994) • "social presence refers to the feeling of being socially present with another person at a remote location" (Sallnas, Rassmus-grohn et al., 2000) • "the degree of tangibility and proximity of other people that one perceives in a communication situation" (McLeod, Baron et al., 1997)
Apparent existence, feedback, or interactivity of the other (Heeter, 1992)	• "the extent to which other beings in the world appear to exist and react to the user" (Heeter, 1992) • "the degree to which a person is perceived as a 'real person' in mediated communication" (Gunawardena, 1995)
Sense of being together	• "the sense of being together" (Cho & Proctor, 2001; deGreef & Ijsselsteijn, 2000)
Psychological Involvement	
Perceived access to another intelligence (Biocca, 1997)	• "the minimum level of social presence occurs when users feel that a form, behavior, or sensory experience indicates the presence of another intelligence. The amoung of social presence is the degree to which a user feels access to the intelligence, intentions, and sensory impressions of another" (Biocca, 1997)
Salience of the other (Short, Williams, & Christie, 1976)	• "the degree of salience of the other person in the interactrion and the consequent salience of the interpersonal relationships . . . it is a subjective quality of the communications medium" (p. 65)

(table continues)

Table 2 (continued)

Classification	Definition
Psychological Involvement (continued)	
	• "a single dimension representing a cognitive synthesis of all the factors" (p. 65) • "attitudinal dimension of the user, a 'mental set' towards the medium" (p. 65) • "it is a phenomenological variable . . . affected not simply by the transmission of single nonverbal cue, but by whole constellations of cues which affect the 'apparent distance' of the other" (p. 157)
Intimacy and immediacy	• Immediacy as "directness and intensity of interaction between two entities" (Mehrabian, 1967, p. 325) or "psychological distance" between interactants (Weiner, 1968) • Intimacy (Argyle, 1965) is a function of "proximity, eye-contact, smiling, and personal topics of conversation etc." (Argyle, 1969, p. 95) and categorizes intimacy as a "dimension(s) of relationship" (p. 201) which conversational partners negotiate.
Mutual understanding	• "social presence; that is, the ability to make one's self known under conditions of low media richness" (Savicki & Kelley, 2000)
Behavioral Engagement	
Interdependent, multichannel exchange of behavior (Palmer, 1995)	• "VR is compatible with interpersonal communication to the extent that individuals can encounter another 'social presence' or person (Heeter, 1992) in a virtual environment, and effectively negotiate a relationship through an interdependent, multi-channel exchange of behaviors" (Huang, 1999, p. 291)

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

(and perceived intimacy and immediacy) of the interpersonal relationships" (p. 65). They argued that a medium's social effects reflect the degree of social presence which it affords to its users and that communications media afford varying degrees of social presence. Short et

al posited that the highest immediacy and social presence could be expected in face-to-face settings.

Short et al. (1976) conceptualized social presence as the salience of another person in a mediated environment. Their conceptualization became the basis for many theories on media including theories that address the effects of novel and emerging media. Other scholars have refined this approach. Russo (2001), for example, defines social presence as the degree to which a person is perceived to be real in a mediated environment. In this regard, salience can be thought of as the degree to which the communicators recognize that they are communicating with another human being and not with the technology that is between them. In the context of educational activities and learning communities, Rourke, Anderson, Archer, and Garrison (1999) have conceptualized social presence "as the ability of learners to project themselves socially and affectively into a community of inquiry" (p. 52). Biocca et al. (2001) observed that the current social presence theories had begun to lag the rapid evolution of media, specifically the increases in use of social presence technologies and the amount, frequency, and ubiquity of mediated social interactions. Notably, measures of social presence and immediacy (such as those employed in the Schutt, Allen, & Laumakis, 2009, study) were designed to elicit reports of experimental subjects regarding their perception of the behaviors of people represented by media systems but do not attempt to elicit reports from the subjects regarding their internal cognitive or affective states.

Harms and Biocca (2004) address the importance of interaction in characterizing social presence: "Social presence in a mutual interaction with a perceived entity refers to the degree of initial awareness, allocated attention, the capacity for both content and affective

comprehension, and the capacity for both affective and behavioral interdependence with said entity" (p. 246). Moreover, they remind us that:

> mediated social presence is property of people, not of technology, it is it a moment-to-moment phenomenal state facilitated by a technological representation of another being. The state of social presence varies over the course of a mediated interaction from a low level awareness that another being is co-present to more intense sense of the accessibility of psychological modeling of the other's intentional states (i.e., the attributional modeling of the other mediated mind). (Harms et al., 2004, p. 11)

This theoretical orientation led Harms and Biocca (2004) to introduce an important new measure of empathy as a tool for investigating responses to avatar presence in 3D virtual worlds. Their measure elicits data regarding the internal states of the communicators rather than merely relying on reported perceptions of behaviors of others. This approach can be traced to their early work (Biocca et al., 2001) in which they posit the concept of networked minds and propose new presence factors: co-presence (isolation/inclusion, mutual awareness), psychological involvement (expectations, empathy, mutual understanding), behavioral engagement (control, attention, assistance, dependence). In 2004, Harms and Biocca revised the factors based on the pilot test conducted to validate the measure: co-presence, attentional allocation, perceived message understanding, perceived affective understanding, perceived affective interdependence, and perceived behavioral interdependence. Harms and Biocca (2004) conceptualized and measured the sense of being with another at three levels: (a) perceptual level, (b) subjective level, and (c) intersubjective level (see Figure 3).

The co-presence of the embodied other (level 1) deals with the detection and awareness of the co-presence of other's mediated body (Harms & Biocca, 2004, p. 13). The psychobehavioral accessibility of the other (level 2) focus on the perceived accessibility of

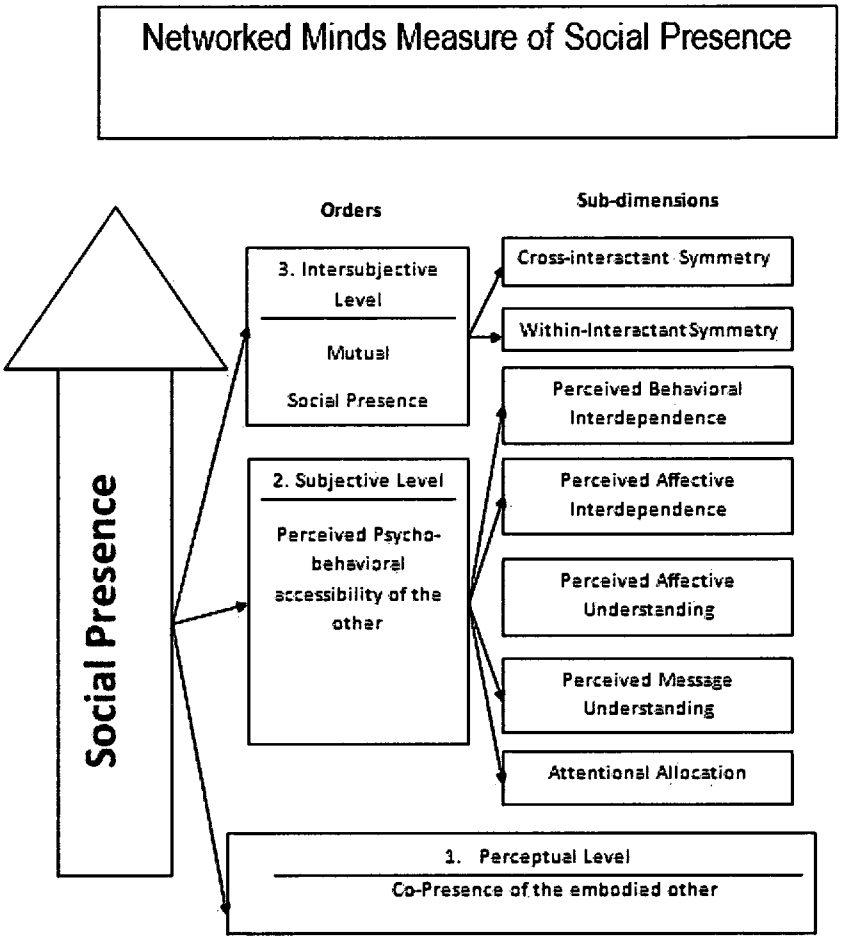


Figure 3. Networked Minds measure of social presence.

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 (p. 13).

The Networked Minds construct leverages behaviorally-based notions of presence. With a new perception and a new measure (see Appendix A), researchers are better equipped to look at what is happening in a richer environment.

Social Presence and Media

Social presence and immediacy were first researched and applied first in non-mediated learning environments including classrooms. As technology-enabled communication continued to evolve, similar research on mediated social cues were applied to different educational media tools such as television (Freitas, Myers, & Avtgis, 1998; Guerrero & Miller, 1998; Hackman & Walker, 1990), and computers (Gunawardena & McIsaac, 2004; Gunawardena & Zittle, 1997; Leh, 2001; Rourke et al., 1999; Tu & McIsaac, 2002; and many others), including videoconferencing (AlRaway, 2006; Bozkaya, 2008; Brown, Rietz, & Sugrue, 2004; Schutt, 2007; Schutt, Allen, Laumakis, 2009).

Social presence is most relevant as an explanatory framework when humans experience lapses in awareness of mediating technologies, and is replaced by illusionary perceptions of shared space ('being there'). Lombard and Ditton (1997) characterize this as a state in which "...part or all of a person's perception fails to accurately acknowledge the role of technology that makes it appear that s/he is communicating with one or more other people or entities." This model of social presence, which is anchored in telecommunication research, implies that interaction between communicators is not necessarily requisite: audio-visual media may provoke in media consumers some of the same responses that occur in non-mediated experience (Lombard, 1995).

The metaphor of interface transparency provides an alternative way to think about the implicitly pejorative notion that perception of social presence is enabled by illusions resulting from lapsed awareness of mediating technologies. As Allen, Otto, and Hoffman (2003) note, citing Heidegger, as users become expert in their use of a tool such as a hammer

or a computer mouse, their skills become highly automated and conscious awareness is then refocused on the (communication) tasks performed with that tool.

As Heidegger explains it, skilled carpenters are no more aware of their hammers than they are aware of their tendons or muscles (just as skilled readers are no more aware of actual letters in book, than they are of their eyes). This alternative concept of tool or interface transparency is widely employed by contemporary media designers as an element in a design ethic that treats awareness of mediating technologies as a symptom or source of frustration, a contributor to unwanted cognitive load, and an impediment to more complete engagement with objects or persons of interest which are perceived *through*, or by means of, the tool.

Rather than treating lapsed awareness of technology as resulting in illusions, this implies that skill in a medium opens up new realms of perception. It also implies that in early encounters with new media, awareness of technology results in an opaqueness that inhibits perceptions enabled by the technology.

Understanding the importance of social presence in media is essential in understanding the evolution of distance education research from a focus on comparison of the effects of various types of media comparison (characteristic of research on educational media in the 1960's and 70's) to a focus on the attributes of mediated representation, and increasingly to a broad focus on the integrated effects in contemporary multimedia systems, which are capable of simulating or re-representing earlier media (such as print, photos, audio, and motion pictures) as components in more comprehensive and inclusive multimedia 'ecologies.'

In an attempt to classify media used in distance education, Bates (2003) distinguishes 'media' from 'technology.' Media are the forms of communication associated with particular

ways of representing knowledge, each unique in presenting and organizing knowledge (p. 214). Bates notes that in distance education, the most important four media are text, audio, television, and computing. Media can be (re)presented by more than one technology; however, Bates recognizes that this distinction may become less meaningful with greater integration of media and technologies. Bates (2003) also distinguishes between one-way and two-way technologies. One-way technologies such as television constrain or disable interaction whereas two-way technologies provide opportunities for interaction between instructors and students and between individual students and groups of students. Telecommunication systems that permit the transmission of facial expressions and gestures create social climates that are very different from the traditional classroom. Research on social presence in online learning environments is directly related to research on immediacy behaviors. The interfaces supporting two-way technologies enable allow the transmission and exchange of immediacy behaviors such as voice tones and body language, as well as tangible and intangible factors related to social climate and organizational modalities. "Instructors who humanize the classroom climate may convey a higher degree of social presence than those who do not" (Gunawardena & McIsaac, 2004, p. 374).

In this conceptual framework, the degree of social presence is influenced by the conveyance of non-verbal cues by the media, which in turns influence how present or distant one feels from another person. A high degree of presence suggests the illusion that one is interacting with another (or alternatively a technology-augmented perception), and the medium becomes less apparent (Lombard & Ditton, 1997). It follows that the greater the ability to communicate or perceive a range of nonverbal cue in a virtual environment will enable a greater sense of social presence.

Social Presence and Second Life

Presence can be thought of as the experience of one's psychic environment; it refers not to one's surroundings as they exist in the physical world, but to the perception of those surroundings as mediated by both automatic and controlled mental processes (Gibson, 1979).

In his famous quote "The medium is the massage," McLuhan (1967) distilled his notion that media affect the society in which it plays a role merely by the content delivered through the medium, but by the characteristics of the medium itself. As media are created by minds (Münsterberg, 1916), minds is in turn shaped by the evolving media. McLuhan (1994) saw media as extensions of human perception and intelligence analogous to the ways that other tools such as the lever and wheel extended muscular strength and endurance.

In light of Munsterger, McLuhan, and Biocca's virtual worlds can be seen as 'presence machines' (Riva, Davide, & Ijsselsteijn, 2003, preface), yet

> virtual environments have less to do with simulating physical reality per se, rather it simulates how the mind perceives physical reality. Enter presence. Presence is about how the mind perceives reality, not the reality itself; not physics, but psychology; the extended mind, the place where experience, technology, and psychology meet. If virtual environments are technologies of the mind, then advanced media environments may be to the mind, like cyclotrons are to physics. The study of presence can be seen as the study of those traces of phenomenal experience that emerge when brains and bodies are whirled through virtual spaces created by media. (Riva, Davide, & Ijsselsteijn, 2003)

Co-presence

Short et al. (1970)'s definition of immediacy as a psychological distance becomes limited when applied to advanced media such as desktop 3D immersive virtual worlds. Avatar-mediated environments evolved from successive generations of social presence technologies; however, MUVEs mediate human communication in a novel fashion. Individuals experience 'being there' in and via networked environments and interfaces. But

increasingly, 'being there' in contemporary social media involves being there with others, that is, being 'co-present.'

However, definitions of co-presence are numerous and sometimes contradictory. Bailenson et al. (2005) provide a survey of co-presence definitions from Heeter (1992), who defined co-presence, calling it also social presence, as users interacting with other users or robots in the virtual world to Nowak (2001), who defined co-presence as a sense of connection with another mind. Definitions vary in identifying the other party: human (Russo, 2001; Slater, Sadagic, Usoh, & Schroeder, 2000) or embodied agents (Blascovich et al., 2002). Bailenson et al. (2005) define co-presence as the perception and response to embodied agents. Their study concluded that appearance and behavior had a combined impact on co-presence. Indeed, the appearance of the embodied agents led participants to behavioral expectations, which were met (or not) with the behavioral realism experimentation. If applied to human agents, this study would suggest that co-presence is a social and task-based event. This study defines co-presence as the perception and response to humans, specifically, fellow students in a teaching session.

Empirical studies have addressed varieties of co-presence in virtual environments, such as the nature of turn-making and avatar movement (Bowers, Pycock, & et al., 1996), dynamics in virtual meetings (Bowers, O'Brien, & et al., 1996), movement in the virtual world (Greenhalgh, 1995), identity construction (Donath, 1998), and communication in online communities (Kollock, 1996). Research on immediacy and presence suggests there must be sufficient immediacy and frequency to communicate a sense of co-presence and responsiveness to students (Boettcher, 1999; Dondlinger, 2007). Further research on

community building in virtual environments supports the positive relationship between immediacy and presence (Schroeder, 2002; Turkle, 2005; Biocca & Levy, 1995)

Co-presence can be thought of as a feeling that one is in the same place as others, and that one is collaborating with real people. Goffman (1959) grounded the concept of co-presence on the basic sensory awareness of the embodied other by sight. Students reciprocally experience each other and act according to the response they have visually received.

The concept of co-presence has been conceptualized as "consisting of two dimensions: co-presence as mode of being with others" (the physical conditions), "and co-presence as sense of being with others" (perception and feelings; Zhao, 2003, p. 445). In Zhao's taxonomy of co-presence, Zhao identifies corporeal co-presence, corporeal telepresence, virtual co-presence, hypervirtual co-presence, and hypervirtual teleco-presence. Whereas corporeal co-presence means the human-human interaction happens in each other's physical proximity (p. 447), hypervirtual co-presence requires participants to be virtually present at the electronic site through physical representations that are positioned in each other's physical proximity (Zhao, 2003, p. 449).

In virtual worlds interactions, the other is frequently embodied by an avatar -simpler representational device with some degree of agency on behalf of a user (Cassell, Sullivan, Prevost, & Churchill, 2000). In this context, it may be useful to think of co-presence of the sensory awareness of the embodied other (e.g. an avatar). Research by Reeves and Nass (1996) demonstrates that people treat computer interfaces as social actors. Consistent with McLuhan's (1964) concept of media as the extension of man and Engelbert's (1962) notion of human augmentation frameworks as media evolve, technology becomes the extended

mind, and perception is redefined as the extensions of the senses. Therefore, measures of co-presence include attentional behaviors such as eye fixation on the other, proxemic behavior (movement to or away), and physiological responses such as increased arousal (smiling, laughing, jumping, etc.).

Students' perception of others in classrooms has been reported to affect academic performance (Althaus, 1997). In fact, co-presence has been an important variable in online community building. Co-presence appears particularly important for non-traditional students—one of the largest population using online courses—whose workplace expectations include collaboration and learning constructed through discussion (Brandt, 1997). Research supports the value of the sense of community in limiting attrition rates in online courses due to the availability of support, commitment to the group, cooperation among members and availability to the information through a networked of sources (Bruffee, 1993; Dede, 1996; Gunawardena & Zittle, 1997; Picciano, 2002; Richardson & Swan, 2003; Rovai, 2002; Royal & Rossi, 1996; Wellman, 1999). In a recent learning community research, Kang and Kang (2008) demonstrated that co-presence is a predictor of the learning achievement ($F(1, 38) = 4.104$, $p < .05$), suggesting that peer presence is correlated to cognitive learning.

INSTRUCTOR IMMEDIACY

Although co-presence is essential to the creation of a sense of classroom communities or learning communities, the role of the teacher or the instructor (as a copresent agent) in virtual learning environments is not well-researched. As previously noted, early investigations the social presence of instructors focused on immediacy and immediacy behaviors.

Mehrabian (1966) introduced the concept of immediacy as an indicator of attitudes in verbal communication. He defines immediacy as the measure of the psychological distance which a communicator puts between himself and the object of his communication (Mehrabian, 1968). Finally, Mehrabian refines the concept of immediacy in terms of 'principles of immediacy,' which states that "people are drawn toward persons and things they like, evaluate highly, and prefer; and they avoid or move away from things they dislike, evaluate negatively, or do not prefer" (Mehrabian, 1971). Just as instructor behaviors or lack thereof may influence physical approach and avoidance behaviors, they can also be conceived as an influence on the psychological distance between people (Andersen, 1979; Mehrabian, 1971). Thus, immediacy can be thought somewhat metaphorically as the perception of physical and psychological closeness between communicators.

Early research characterized instructor immediacy in terms of behaviors that bring the instructor and students closer together in terms of perceived psychological distance. Such behaviors can be conveyed verbally and nonverbally. Verbal immediacy behaviors include calling students by name, using inclusive pronouns (e.g., 'we' rather than 'I'), inviting the use of one's first name, participating in unrelated small talk, using humor, providing feedback to students, and asking students for feedback. Nonverbal immediacy behaviors include gestures, vocal variety, smiling at students, displaying a relaxed body posture, moving around the classroom, speaking with outline only, removal of barriers, appropriate touch and professional casual dress (Andersen, 1979; Gorham, 1988; Richmond, Gorham, & McCroskey, 1987; see Table 3).

Table 3. Verbal and Nonverbal Immediacy Behaviors

Verbal Behaviors (Gorham, 1988)	Nonverbal Behaviors (Richmond, Gorham, & McCroskey, 1987)
Uses personal examples or talks about experiences she/he has had outside of class	Does not sit behind desk while teaching
Asks questions or encourages students to talk	Gestures while talking to class
Gets into discussions based on something a student brings up even when this doesn't seem to be part of his/her lecture plan	Does not use monotone-dull voice while talking to class
Uses humor in class	Looks at the class while talking
Addresses students by name and is addressed by his/her name by students	Smiles at the class as a whole, not just individual students
Gets into conversations with individual students before, after, or outside of class	Has a very relaxed body position while talking to the class
Refers to class as 'our' class or what 'we' are doing	Touches students in class
Provides feedback on individual student work through comments on papers, oral discussions, etc.	Moves around the classroom while teaching
Asks questions that solicit viewpoints or opinions. Only calls on students to answer question if they have indicated that they want to talk. Asks how students feel about an assignment, due date, or discussion topic	Does not look at board or notes while talking to the class
Invites students to telephone or meet with him/her outside of class if they have questions or want to discuss something	
Praises students, work actions, or comments	
Will have discussions about things unrelated to class with individual students or with the class as a whole	

Research in videoconferencing, such as Schutt's (2007), provides evidence consistent with earlier research such as Gorham and Zakahi's (1990), who found that instructors' perceptions of their immediacy and their perceptions of learning are congruent with their students' perceptions. Schutt (2007) also found that the use of video (gesturing, body position, smiling, etc.) influences student perceptions of the instructor. However, Schutt argues that the use of video in and of itself may not reduce the psychological distance if the instructor is not trained to project relevant immediacy behaviors. Her experiment demonstrated a strong, positive relationship between immediacy and social presence (r (433) = .844, p = .000). Based on this very strong and significant correlation, it seems reasonable to predict that when the perception of the instructor immediacy behaviors increases, perception of the social presence will increase as well. Schutt's experiment suggests that training online instructors to employ immediacy behaviors and enhance closeness, will also enhance instructor social presence and students' perceptions of the instructors as caring, empathetic, self-disclosing, and emotionally open.

Measures of immediacy have also been shown to correlate with satisfaction with learning and motivation, perceived learning and learning outcomes (Andersen, 1979; Christophel, 1990; Gorham, 1988; Gorham & Christophel, 1990; Gorham & Zakahi, 1990; Kearney et al., 1985; Kelley & Gorham, 1988). In a meta-analysis of 81 studies that encompassed 24,474 students, Witt, Wheeless, and Aiken (2004) review the existing research in order to examine the relationship between teachers' verbal and/or nonverbal immediacy and students' learning outcomes. "The synthesized result of the meta-analysis of the entire body of quantitative findings indicated a meaningful relationship between overall teacher immediacy and overall learning" (Witt et al., 2004, p. 15). Tables 4 and 5 (pp. 35 and 36)

Table 4. Immediacy Positive Correlations

Independent Variables	Authors
Student affect and affective learning	Gorham (1988)
Across cultures	Pogue and Ah Yun (2006)
In large classes	Messman and Jones-Corley (2001)
Even when workload demand is high	Mottet, Parker-Raley, Cunningham, Beebe, and Raffield (2006)
Student cognitive learning	Chesebro and McCroskey (2001) Christophel (1990) Kelley and Gorham (1988) Titsworth (2001)
Perceived instructor competence, caring, and trustworthiness	Thweatt (1999
Positive student evaluations	Moore, Masterson, Christophel, and Shea (1996)
Student state motivation	Christophel (1990) Christophel and Gorham (1995) Frymier (1994)
Attitude and background homophily with instructors	Rocca and McCroskey (1999)
Interpersonal attraction (task, physical, and social attraction)	Rocca and McCroskey (1999)
Perceived teacher assertiveness and responsiveness	Thomas, Richmond, and McCroskey (1994)
Student attendance and participation	Rocca (20040
Out-of-class communication between professors and students	Jasma and Koper (1999)

provide a summary of the research on relationships with affect-related variables (Rocca, 2007).

According to Witt et al.'s (2004) summary of research, teacher immediacy is positively correlated with students' perceived instructor competence, caring and trustworthiness, positive student evaluations, students' attitude and background homophily with instructors, and students' perception of teacher assertiveness and responsiveness. Rifkind (1992) argues that lack of immediacy results in a lack of social presence and leads to frustration, a critical student perception of the instructor's effectiveness, and lower affective learning. Moreover immediacy has been shown to positively correlate with cognitive learning (Gorham, 1988; Richmond et al., 1987) and information recall (Kelley & Gorham, 1988).

Table 5. Immediacy Negative Correlations

Independent Variables	Authors
Verbal aggression	Roccs and McCroskey (1999)
Student resistance	Kearney, Plax, Smith, and Sorensen (1988)
Distance education classrooms	Carrell and Menzel (2001)

Early studies of face-to-face communication by Mehrabian (1971) found that words account for 7%, tone of voice accounts for 38%, and body language accounts for 55% of the liking for the speaker. Therefore, the dominant visual characteristic of 3D virtual environments would potentially allow for a more efficient projection of body language cues, such as body posture, gestures, smiling and other nonverbal behaviors as identified by Richmond et al. (1987).

NONVERBAL IMMEDIACY IN SECOND LIFE

The simulated physicality of virtual worlds and the embodied presence of avatars as agents of users facilitate behavioral displays and the appropriate adjustment of these displays to psychological circumstances in real time. This enables user expression via the avatar of behaviors communicating internal states. The avatar may also display behaviors (as an actor would) that are appropriate to a situation, but are acted or faked. User vocal expressions can be projected almost unaltered into Second Life and appear to other observers to be collocated with the user's avatar. Body language and facial expressions are either expressed autonomously by the avatar's software routines (e.g., low-level gesturing with hands, blinking and slight smiling), Eyes generally gaze in a direction determined by cursor location, reflecting mouse position. More explicit facial displays and body movements such as laughing or frowning, hand waving, or pointing require explicit execution by the user of keyboard short cuts. Thus, with current SL technology, the appropriateness of avatar expression is to a considerable degree a practiced keyboard skill rather than a direct projection of bodily movements. One implication of this current state of the art, is that instructors might overamp expressions, or alternatively elect expressions that do not reflect their current 'true' dispositions. In any case, instructors skilled in SL technique are well equipped to control the display of immediacy behaviors of their avatars and thus potentially control the psychological distance between them and the students. In an analysis of the potential of virtual worlds for training, McKerlich (2007) concluded that MUVEs could "significantly reduce the subjective feelings of psychological and social distance often experience by distance education participants" (p. 35).

Focusing on nonverbal immediacy behaviors, Fabri, Moore, and Hobbs (1999, 2004, 2008) investigated facial expressions for avatars. Fabri et al. hypothesized that avatar-

mediated communication would be enriched by augmenting informational content with this additional emotional channel.

This study demonstrated through good recognition rates for all but one of the emotion categories. In addition, the researchers identified possibilities for technical efficiency and simplicity since a reduced feature set was found to be sufficient to build the successfully recognized core set of avatar facial expressions. This study also suggested that exact behavioral realism and the full spectrum of human facial expressions may not be necessary if the goal is to achieve believable avatar social presence and immediacy. These research results support the use of simple but distinctive visual clues to mediate the emotional and social state of MUVE users.

Viewed in a wider context, these and many other studies suggest that the humanoid representation of a user as an avatar can in principle act as the communication device. Research on mimicry in immersive virtual realities demonstrates social influence resulting from the chameleon effect (Bailenson & Yee, 2005; Chartrand & Bargh, 1999). Mimicking agents were more persuasive and received more positive trait ratings than nonmimickers, despite participants' inability to explicitly detect the mimicry. Research by Reeves and Nass (1996) suggests that under certain circumstances people will treat computer interfaces as social actors.

Continuing along the lines similar to the work of Capin, Pandzic, Magnenat-Thalmann, and Thalmann (1998) and Guye-Vuillème, Capin, Pandzic, Magnenat-Thalmann, and Thalmann (1999) on gestures, and Coulson (2002) on postures in virtual embodiment, Antonijevic (2007) conducted a microethnographic study on proxemics (space) and kinetics (body) cues as well as physical appearance, haptics (touch) and objectics

(artifacts) in Second Life. The results pointed to a significant difference between user-generated and default nonverbal behaviors. User-generated nonverbal behaviors were observed in the use of proxemics, such as interpersonal distance and body orientation. The analysis has shown that this type of nonverbal behaviors had an important role in communicating interactional intent, structuring interaction, and sending relational messages. This indicates that user-generated nonverbal behaviors have a strong potential to enhance interaction in multiuser 3D virtual environments. Garau et al. (2003) had also successfully confirmed the impact of visual and behavioral realism in avatars on perceived quality of communication in an immersive virtual environment. Intentional gaze significantly outperformed random gaze. Garau et al. conclude that aligning visual and behavioral realism were necessary to enhance avatar social presence.

Presence in immersive virtual environments has affective and cognitive consequences similar to the vital role of nonverbal communication in real-world social interactions. Grigorovici (2003) evaluated presence effects on attitude structure and information processing and concluded that any theory of presence in virtual environments must consider emotional factors.

CONCLUSION

Emerging social media, including virtual realities such as Second Life, with their multiple channels for communication, rich multimedia representations, and networks for peer interaction challenge traditional notions of traditional instructional leadership in classrooms: Whereas most research questions of the last century regarding educational implications of immediacy and social presence focused on the instructor as the person of interest, social

networking software that connects hundreds of millions of users online demands the traditional focus be broadened to all members of learning communities.

Virtual reality-based avatars challenge early paradigms for research on social presence and immediacy in two ways: the source of communication control and the dominant instructor as source of immediacy.

The Networked Minds paradigm exemplifies new lines of inquiry that emerged in the 1990's that extend beyond immediacy behaviors to measure emotional and cognitive states, and collaborative dispositions. With these new perspectives and new instrumentation, researchers will better be prepared to investigate complex communication modalities and media that integrate and filter sensorimotor, cognitive, and affective cues of communicators. In these new circumstances, immediacy will no longer be defined as a measure of the psychological distance which a communicator puts between himself and the object of his communication (Short et al., 1976) but as a function of the number, combination and intensity of immediacy behaviors relevant and appropriate to particular learning events and goals.

Prior social presence research has established that measures of social presence and community have been shown to be strong predictors of satisfaction with learning, perceived learning, and persistence (Gunawardena & Zittle, 1997; Picciano, 2002; Richardson & Swan, 2003). Research in social presence reveals it to be a vital element in influencing online interaction (Fabro & Garrison, 1998; McIsaac & Gunawardena, 1996; Rourke et al., 1999). Finally, recent studies suggest that avatars influence social presence, interpersonal trust, perceived communication quality, nonverbal behavior, and visual attention (Bente,

Ruggenberg, Kramer, & Eschenburg, 2008; Gamberini, Martino, Scarpetta, Spoto, & Spagnolli, 2007; Garau et al., 2003).

Although there is a rich body of literature exploring immediacy (instructor and student) in the traditional classroom and in computer-mediated communication, few studies have examined immediacy for teaching and learning events in 3D virtual worlds, in which the interactors (the representations of communicators) have changed (see Figure 4).

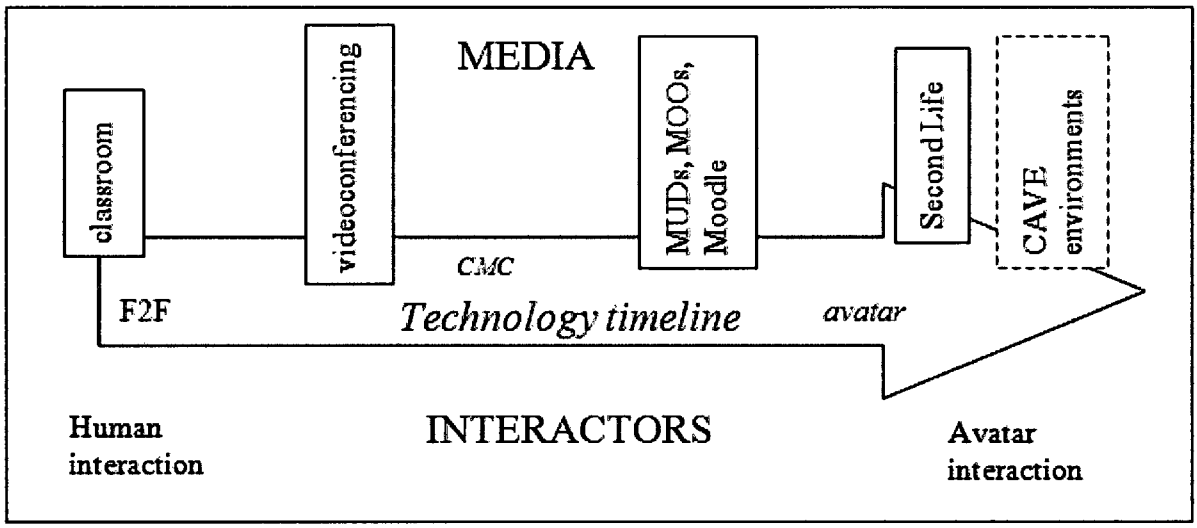


Figure 4. Progression of Technology.

'Interactors' is here defined as the representation of the human communicators. Figure 4 illustrates the change in communicators' nature, starting with flesh and blood humans in face-to-face interaction in classroom, to videos of humans (limited human interaction but still an authentic representation of the human), to finally completely computer mediated representation of the human from text-based avatars (as in MUDs, in which social contexts are completely removed) to 3D humanoid shapes (usually) in VWs (in which social contexts have been reinserted with metaphorical representations). Considering the large body of literature emphasizing the importance of nonverbal behavior in relation to teaching

effectiveness, the absence of many nonverbal behaviors usage in the MUVE 'classroom,' such as upper body movement, emphasizes the need to train educators to make maximum use of other nonverbal immediacy behaviors as well as maximizing the audio and video affordances of MUVEs.

Finally, the relevance of the Networked Mind concept is important because the new environments are more complex in ways people can interact and communicate. The number of channels for communication have expanded in such large numbers that the communication media is perceived as an environment and no longer a channel-based communicative tool. The Networked Mind measure has been developed to evaluate social presence specifically in current emerging presence technology. It allows the measure of more complex perceptions. However, this study is simplified: The researcher applies the Networked Mind measure to an instructor dominated paradigm in which the instructor acknowledges the students and in which students participate.

CHAPTER 3

METHODOLOGY

This study investigated immediacy behaviors of an avatar-mediated instructor and their effects on social presence, which has been shown in many studies to be correlated with student satisfaction and positive learning outcomes. The study employed four virtual world based treatments to examine students' perceptions of instructor immediacy, peer presence, and learning. Chapter 3 describes the research design, the study participants, and the data collection procedures.

RESEARCH DESIGN

This study replicates key aspects of Schutt's (2007) research and extends others. Schutt's design combined elements of a Pretest-Posttest Control Group Design with elements of a Posttest Only Control Group Design (Campbell & Stanley, 1963). Students assigned to the control group treatments viewed presentations by an instructor who exhibits low levels (infrequent) immediacy behaviors. In the other treatments, students view the same instructor exhibiting much higher levels of immediacy behaviors. For the present study, the researcher revised the scripts and measures to reflect immediacy behaviors in Second Life. Unlike the instructor in Schutt, portrayed as a human male addressing the camera as if speaking to a videoconference, the instructor in this study appears as an avatar in a virtual classroom, addressing avatar-students.

As in Schutt, this study employed a two-factor experimental design to investigate

relationships between the identified independent and two dependent variables. However, in this study, an additional variable was added: the immediacy behaviors of the avatar-students (see Table 6). As in Schutt, all data was collected via online computer forms employing both forced-choice and open-ended items.

Table 6. Research Variables

Independent Variable	Immediacy Behaviors
Dependent variables	1—Social presence of instructor 2—Social presence of other students 3—Perceived learning outcomes

The independent variable—the degree (level) of immediacy—was represented by two values: low and high. Each level of immediacy was represented in video recordings in the behaviors of (1) the instructor and (2) the students, establishing the study's with four treatment conditions (see Table 7).

Table 7. Experimental Groups

Group	Treatments
Group 1 (Hi-Hi)	High immediacy Instructor-High immediacy Student
Group 2 (Hi-Lo)	High immediacy Instructor-Low immediacy Student
Group 3 (Lo-Hi)	Low immediacy Instructor-High immediacy Student
Group 4 (Lo-Lo)	Low immediacy Instructor-Low immediacy Student

As in Schutt's (2007) study, immediacy behaviors displayed by the avatar-instructor were based on Gorham's (1988) verbal immediacy scale and the Richmond et al. (1987) nonverbal immediacy scale (see Appendix B). However, in this study, avatar-students portrayed in the video recordings displayed either-high or low levels of immediacy (see Figure 5). Participants were each randomly assigned one of the four groups similarly to the

structure of Schutt's groups; however, not organized in two sets. All treatments are conducted with the same communication modalities in Second Life: video,

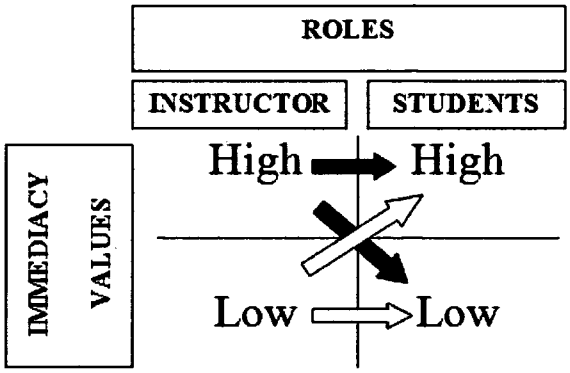


Figure 5. Conceptual framework.

text-chat, and audio. Each treatment simulates a synchronous teaching session with an avatar instructor and mock avatar students in a classroom located on San Diego State University's campus in Second Life.

In adapting the Schutt treatments for use in Second Life treatments employed in the current study add immediacy behaviors to dialogue and chat to amplify the differences among the treatments. The modifications are related to the immediacy behaviors that the researcher identified. The student avatars display classroom gestures to the extent of the treatment condition (high or low). The experiment rationale is similar to Schutt's experiment which was designed to demonstrate that high levels of instructor immediacy will increase the perception of social presence.

POPULATION AND SAMPLE

Participants were recruited from two 500-seat sections of an introductory course in psychology at San Diego State University. An email explaining the experiment was posted on the course's Blackboard site with their instructor's consent. A consent form (see Appendix C) attached to the email explained the criteria and expectations regarding participation, which was voluntary and anonymous. Respondents were asked to follow a three phase protocol for participation, all of which was completed online at times and on computers chosen by the student: (a) answer a pre-treatment questionnaire that addressed demographics factors, virtual world familiarity, and course content; (b) view one of the four 28-minute machinimas reflecting the treatment conditions; and (c) complete post treatment questionnaire regarding their perceptions of instructor immediacy behaviors, social presence, and students' co-presence.

EXPERIMENTAL TREATMENTS

The treatments employed in this experiment originated in Schutt's study. They were modified to the specific representational capabilities of the Second Life virtual 3D environment.

Criteria for Content

This study retains the criteria that Schutt (2007, pp. 51-52) considered for determining the 28-minute content for the recorded sessions (see Table 8), and modifies the instructor-related criteria to adapt it to the SL platform.

The lesson consisted of a short lecture on current psychological perspectives, which was part of the regular course content and was also included in chapter one of the textbook

used for the psychology course. The lesson included a presentation from an instructor using PowerPoint slides and a short discussion between the instructor and the participants. Four versions of the lecture were scripted and recorded to reliably manipulate the instructor verbal and nonverbal immediacy and the students' verbal and nonverbal immediacy. The four experimental conditions were created by first replicating Schutt's original script, using the basic script for the lesson, then systematically increasing and decreasing specific verbal and nonverbal immediacy cues to create the high- and low-immediacy conditions. Each session introduced the same content and the instructor performed each of the four scripts manipulating the immediacy behaviors in order to achieve the following four experimental conditions. A pretest and a posttest measured students' chapter recall and comprehension before and after the treatment.

Table 8. Criteria for Content

Criteria	Rationale
Basic, introductory content	Participants are undergraduate students taking an introductory course in psychology. Overly technical material could diminish students' attention to content and instructor immediacy.
(modified) The avatar-instructor is an instructor-persona simulated by the researcher	To maximize the differences in behaviors in each group treatments.
The avatar-instructor is affiliated with the university where the study takes place, but is not familiar to the participating students.	To maintain anonymity of participants.

Experimental Conditions

The researcher considered specific conditions regarding the nonverbal and verbal behaviors gestures, and camera conventions for the machinimas. Student-avatars were limited to text and non-verbal cues.

NONVERBAL AVATAR GESTURES

This study used and manipulated computer scripts to address the instructor's and the students' nonverbal behaviors. Gestures were selected from a standard set of gestures available to any avatar. The study activated those gestures to animate the instructor-avatar to exhibit high-immediacy behaviors. Some of these standard gestures were autonomous (such as lip synchronization and hand movement), automatic (such as eye blinking), and on-demand (such as smile and laugh). These standard gestures are available to all avatars; however, they must be activated to animate the avatar (except the eye blinking which is an automatic avatar behavior).

The default inventory was augmented with gestures scripted in an animation-overrider (an object that animates the avatar with personalized behaviors) to provide supplemental on-demand proxemics (such as body lean and pointing to others) –listed under 'scripted gestures' in Table 9.

The researcher specifically chose the gestures for the acting avatars to project the desired degree of immediacy (high and low). The sequence of gestures was logical and followed an organic acting of body movements and facial expressions.

Table 9. Second Life Nonverbal High-Immediacy Gestures

Second Life Gestures	Instructor	Students
Standard gestures		
afk (away from keyboard)	No	Yes-(avatar falls asleep after timed inaction)
Bored	No	Yes
Eye blinking	Yes -automatic	Yes-automatic
Lip synchronization	Enabled when instructor spoke	No-students did not speak
Look around	Yes	Yes
Move head up/down	Yes	Yes
Point to self & other	Yes	No
Shake head yes/no	Yes	Yes
Shrug	Yes	Yes
Sitting position	No	Yes
Smile	Yes	Yes
Speech gestures	Yes	No
Standing position	Yes	Yes
Walk	Yes	No
Wave hello/goodbye	Yes	No
Scripted gestures		
Body lean	Yes	No
Cross arms thinking	Yes	No
Different standing positions	Yes	No
Point to screen	Yes	No
Illustrator gestures (numbers)	Yes	No

VERBAL BEHAVIORS

Additionally, the researcher selected high- and low-immediacy behaviors among behaviors offered in SL which compared reasonably to the established verbal immediacy behaviors (Gorham, 1988) and the nonverbal immediacy behaviors (Richmond et al., 1987). Accordingly, item 7 ('Touches students') in Richmond et al's (1987) list of nonverbal immediacy behaviors (see Appendix B) was replaced by the instructor-avatar moving across

the room or coming closer to student-avatars thereby indicating interactional intent. A summary of the overall instructor behaviors in the high and low conditions is presented in Table 10. A summary of the overall student behaviors in the high and low conditions is presented in Table 11.

Table 10. Instructor-Avatars Immediacy Behaviors

High-immediacy	Low-immediacy
Moves upper body and head while teaching	Does not move upper body/head while teaching
Inclusive language ('our' 'we')	Not inclusive language; uses 'your' 'you'
Smiles in response to individual students' comments and to class	Does not smile. Continues lecture as if uninterrupted
Uses gestures	No use of gestures
Uses humor	No use of humor
Asks students to address him by his first name	Introduces himself to students as Dr. Allen
Enthusiastic voice while talking to class—varied vocal expressions	Monotone voice. Dull
Uses personal examples and talks about experiences he has had outside class	No personal examples
Addresses students by first name	Does not address students by name
Asks how students feel about topic	Does not ask how students feel about topic
Asks questions/encourages students to talk	Does not encourage students to talk
Solicits viewpoints or opinions	Does not solicit viewpoints or opinions
Praises students' comments	Does not praise students
Does not appear to read notes	Appears to read notes
Shows emotion	Shows no emotion
Gets into discussions based on student questions which are not part of his plan	Does not get into discussions about questions that were not part of his lecture plan
Touch students: was replaced by moving across the classroom	Does not touch students –does not move across the classroom

Table 11. Student-Avatars' Immediacy Behaviors

High-Immediacy	Low-Immediacy
Address instructor by first name	Does not address instructor by first name
Initiate conversations with instructor before, after, or outside of class	Does not initiate conversations with instructor
Share personal comments, provide self-disclosure	Does not share personal comments, does not provide self-disclosure
Reply to other students' statements	Does not reply to other students' statements
Show emotion (use emoticon in text, varied tone of voice)	Shows boredom, fall asleep
Ask questions, clarification	Does not ask questions or clarification

MACHINIMA AND CAMERA CONVENTIONS

The researcher simulated a didactic/lecture style instructional event with some question and answer time, which was appropriate to group events (large student population and conferences). All treatments were filmed with identical camera work. The researcher is introducing some film editing conventions such as cutaway shots. The treatments are recorded in machinima format and posted online. Screenshots of the interface of these lessons and the links to the URLs where they are hosted will be available in Appendix D.

FIELD, CLASSROOM, AND LABORATORY PROCEDURES

The recorded sessions were posted on Veoh, a website hosting user-generated videos. The questionnaires were posted on surveymonkey.com, a tool for creating and hosting surveys online. Four versions of a website, corresponding to the four groups, were created to hold the online lessons and questionnaires. Upon receiving participants' consent form, the researcher emailed back a url link to the participants, randomly assigning them to

one of the four treatments. The websites were identical with the exception of the link which led to one of the four pre-recorded sessions. The email included direction on how to access and view the session on their own time on their personal computers. Students were given one week to complete the assignment. Before viewing the recorded sessions, they were asked to complete a short questionnaire which included demographic items, questions assessing their prior knowledge on the content of the lesson (pretest), and questions about their prior experience with the online courses and virtual worlds. After completing the questionnaire, the respondents viewed one of the versions of the lesson and then completed a questionnaire consisting of three parts, each designed to measure instructor and student immediacy, social presence, and learning outcomes (posttest). In addition, nine open-ended questions asked students to describe their experience with the treatment (See Appendix E). The procedures are summarized in Appendix F.

INSTRUMENTATION

The following instruments were used to measure immediacy, social presence, co-presence and learning.

Immediacy

Gorham's (1988) verbal immediacy scale and Richmond et al.'s (1987) nonverbal immediacy scale dictated the choices for high and low immediacy behavior representations (see Appendix B for both scales). The verbal immediacy behavior scale consists of 20 items and the nonverbal immediacy behavior scale consists of 14 items. Both instruments use a 5-point Likert scale, ranging from 0 (never) to 4 (often). Freitas et al. (1998) report that reliability coefficients have ranged from .77 to .94 for the verbal immediacy and from .76 to

.82 for the nonverbal immediacy scale. In this research, the reliability coefficient for immediacy measure is .95.

Social Presence

Part three of the questionnaire measuring social presence was based on an instrument developed and validated by Schutt (2007), itself based on Garrison et al.'s (2004) tool to assess students' role adjustment in online community of inquiry (see Appendix G). Schutt's instrument measures students' predicted adjustment to online learning (including social, cognitive and teaching presence). The social presence scale consists of 10 items with a reported alpha reliability of .92. In this research, the alpha coefficient for social presence measure is .95.

Co-presence

This study sought to pilot the Networked Mind Social Presence (Harms & Biocca, 2004). The Networked Mind Social Presence inventory uses retrospective self-report scales. Networked Mind social presence inventory consists of 38 items (see Appendix A). Cronbach alpha reliability levels range from .69 to .87 (Biocca et al., 2001). The instrument uses a 7-point Likert scale, ranging from 1 (not at all) to 7 (absolutely). Items were reworded to meet the needs of this study; for example, "My partner paid close attention to me" became "Other students paid close attention to me." In this research, the Cronbach alpha reliability levels range from .95 to .97.

Learning

The pretest collected student prior knowledge on content. The instructor of this course reviewed the multiple-choice questions to assess their content validity. The posttest included the same multiple-choice questions as the pretest and assessed student recall and

comprehension as a result of viewing the machinimas. The researcher doubted that any differences would be found. Schutt (2007) did not pick up any difference in pretest and posttest except one contrast that suggested that the audio treatment with high immediacy behaviors rated higher than a still-image with less immediacy behaviors. Also based on the literature which agrees that effects are difficult to evaluate after a short one-shot treatment. Finally, students had their textbook chapters to which to refer instead of relying completely on the treatment content. This research question is added nonetheless because it is a conventional inquiry for this experiment.

Demographic Survey and Pretest

The researcher used Schutt's self-report questionnaire. The survey provided demographic information and the pretest collected student prior knowledge on content (Appendix H). The instructor of this course reviewed the multiple-choice questions to assess their content validity. The survey was also complemented with a short section on virtual world familiarity. These questions were selected from a previously validated survey conducted by the Social Research Foundation (2003), on Second Life user characteristics.

Posttest and Survey

The researcher used the same posttest and survey used by Schutt. The posttest included the same multiple-choice questions as the pretest and assesses student learning, defined as recall and comprehension of the lesson content as a result of viewing the machinimas. The survey provided students with open-ended items to comment on students' perception of the instructor. The survey was slightly modified to include open-ended

questions on students' perception of other students and potential environmental distractions not identified in the surveys.

DATA PROCESSING AND ANALYSIS

Descriptive statistics provided the overall demographic description of the participants (average age, gender, ethnicity, prior knowledge, and experience with online tools). Measures of central tendency and frequency distributions were used to summarize and describe student responses. An alpha level of .05 was set for all statistical tests. Table 12 provides an overview of the research questions and the hypotheses. The quantitative data was analyzed to provide evidence regarding the influence of perceived instructor immediacy on instructor social presence, instructor avatar immediacy, students' avatar co-presence, and learning outcomes. Statistical analysis was done via SPSS Grad pack. Selected questions on the immediacy scale are reverse coded, including items 9, 16, 18, 21, and 23 which are presumed non-immediate (see Appendix I for questionnaire).

Table 12. Overview of Research Questions and Methods

Research Questions	Hypotheses	Summary of Methods
RQ1: Do immediacy behaviors projected by the instructor avatar influence perceived instructor immediacy?	H_{1i}: Students who view recordings in which an instructor exhibits high levels (more frequent use) of immediacy behaviors (Group 1 HiHi and Group 2 HiLo) will indicate higher perception of instructor immediacy than students in the low immediacy groups (Group 3 LoHi and Group 4 LoLo). $H_{1i\,i}$: Group 1 (HiHi) would perceive the highest immediacy of the four group. H_0: There is no significant difference.	ANOVA

(table continues)

Table 12 (continued)

RQ2: Do immediacy	H_{2i}: Students who view recordings in which the	ANOVA

behaviors projected by the instructor avatar influence perceived instructor social presence?	instructor exhibits high levels of immediacy behaviors (Group 1 HiHi and Group 2 HiLo) will indicate a higher perception of instructor social presence than the students who receive the low immediacy cues (Group 3 LoHi and Group 4 LoLo), and that Group 1 would perceive the highest immediacy. H_o: There is no significant difference. H_{2ii}: There will be a positive relationship between perceived instructor immediacy and perceived instructor social presence in a 3D virtual environment. H_{oii}: There is no relationship.	+ correlation
RQ3: Do immediacy behaviors projected by student-avatars influence perception of students'co-presence?	H_{3i}: Students who viewed student-avatars exhibiting high levels of immediacy behaviors (Group 1 HiHi and Group 3 LoHi) will indicate a higher perception of student presence than the students who viewed student-avatars exhibiting low levels of immediacy behaviors (Group 2 HiLo and 4 LoLo). H_o: There is no significant difference. H_{3ii}: There will be a positive relationship (correlation) between measures of student immediacy and measures of student co-presence in a 3D virtual environment. H_o: There is no relationship.	ANOVA + correlation
RQ4: Do immediacy behaviors projected by the instructor avatar influence learning outcomes?	H_{4i}: High-immediacy groups (Group 1 HiHi and Group 2 HiLo) will achieve higher scores on measures of simple recall and comprehension of the instructor's lecture than the low-immediacy groups (Group 3 LoHi and Group 4 LoLo). H_0:There is no significant difference. H_{4ii}: There will be a positive relationship (correlation) between instructor immediacy and measures of simple recall and comprehension H_0: There is no relationship.	ANOVA + correlation

The researcher used analysis of variance (ANOVA) to examine questions 2, 3, and 4. ANOVA provided results to compare perceived instructor immediacy, perceived social presence, co-presence and learning outcomes in the four groups. Correlation analyses were used to identify the type of relationship between independent and dependent variables.

Before calculating the ANOVA, the data was examined for meeting the ANOVA assumptions: The dependent variable (i.e., immediacy) is a continuous variable that is normally distributed.

Qualitative Data

The qualitative data was handled according to Wolcott's (1994) analytic strategy. After looking at the answers to the open-ended items, information was highlighted in the descriptions to sketch ideas. Then the information was organized in categories (such as avatar realism and participation), displaying the data per themes that were identified (such as proxemics and verbal cues). Categories and themes were reduced to identify patterns in accordance with the list of verbal and nonverbal immediacy behaviors provided by Gorham (1988) and Richmond et al. (1987).

CHAPTER 4

RESULTS

The purpose of this study was to investigate the effects of instructor immediacy behaviors (verbal and nonverbal) in a 3D interactive and immersive virtual environment on student perception of instructor immediacy and perception of instructor social presence. In addition, the study examined the effects of instructor immediacy on student learning outcomes and student co-presence. The main hypothesis was that the use of immediacy behaviors to animate an instructor's avatar would result in higher perception of instructor immediacy and social presence, and higher perception of student co-presence and learning outcomes.

Chapter 3 described the research design, data collection, and analysis methods used in this study to explore the research questions. The hypotheses were:

Hypothesis 1: Students who view recordings in which an instructor exhibits high levels (more frequent use) of immediacy behaviors (Group 1 HiHi and Group 2 HiLo) will indicate higher perception of instructor immediacy than students in the low immediacy groups (Group 3 LoHi and Group 4 LoLo). Group 1 (HiHi) would perceive the highest immediacy of the four groups.

Hypothesis 2: Students who view recordings in which the instructor exhibits high levels of immediacy behaviors (Group 1 HiHi and Group 2 HiLo) will indicate a higher perception of instructor social presence than the students who receive the low immediacy cues (Group 3 LoHi and Group 4 LoLo), and that Group 1 would perceive the highest

immediacy. There will be a positive relationship between perceived instructor immediacy and perceived instructor social presence in a 3D virtual environment.

Hypothesis 3: Students who viewed student-avatars exhibiting high levels of immediacy behaviors (Group 1 HiHi and Group 3 LoHi) will indicate a higher perception of student presence than the students who viewed student-avatars exhibiting low levels of immediacy behaviors (Group 2 HiLo and Group 4 LoLo). There will be a positive relationship (correlation) between measures of student immediacy and measures of student co-presence in a 3D virtual environment.

Hypothesis 4: High-immediacy groups (Group 1 HiHi and Group 2 HiLo) will achieve higher scores on measures of simple recall and comprehension of the instructor's lecture than the low-immediacy groups (Group 3 LoHi and Group 4 LoLo). There will be a positive relationship (correlation) between instructor immediacy and measures of simple recall and comprehension.

This chapter presents the demographic makeup of the sample population and the findings of the research questions.

PARTICIPANTS

Participants in the study were undergraduate students enrolled in two 500-seat sections of an introductory psychology course (PSY 101). Upon receipt of their emailed signed concept form, participants were randomly assigned to one of four treatment groups which they accessed at a time and from a place of their choosing. The treatments were identical in all respects except for variations in the content of the 28-minute video recording. All four versions of this recording were presented as a video (640x480) of the simulated classroom environment. Elements varied across the treatments and included the instructor's

avatar, students' avatar, PowerPoint slides behind the instructor's avatar, audio, and text chat. Detailed differences between the videos were summarized earlier:

The four treatment groups were as follows:

1. Group 1 (HiHi, $n = 68$): instructor's avatar and students' avatars exhibited high-immediacy behaviors.
2. Group 2 (HiLo, $n = 74$): instructor's avatar exhibited high immediacy behaviors and students' avatars exhibited low immediacy behaviors.
3. Group 3 (LoHi, $n = 69$): instructor's avatar exhibited low immediacy behaviors and students' avatars exhibited high immediacy behaviors.
4. Group 4 (LoLo), $n = 70$): instructor's avatar and the students' avatars exhibited low immediacy.

A total of 370 students participated, however, after removing incomplete and duplicate responses, 281 surveys were used for analysis. The sample consisted of 179 female students (63.7%) and 102 male students (36.3%). The average age of the participants was 19 with 68.7% of the students being 18 and 19 years old (mean = 19.34; $SD = 2.79$); 29.6% were ≥ 20 and ≤ 26 years old. Only three students (1.2%) were ≥ 30 years old. Although the majority of students were white (42%), the population sample represented a mix of race/ethnicity, as shown in Table 13. The data suggests that the sample is representative of undergraduate students.

Students were also asked about their familiarity with online learning and virtual worlds in the survey prior to watching the video. A majority of students (67.3%, $n = 189$) indicated they had never taken courses in which the instructor used online conferencing tools to chat with them. This sample also demonstrated low computer-screen time in online

Table 13. Self-Identified Ethnicity

Ethnicity	Frequency	Percentage
White	118	42.0
Mexican American	46	16.4
Asian/SE Asian	40	14.2
Filipino	25	8.9
Other Hispanic	16	5.7
Other/Not stated	16	5.7
African American	12	4.3
International	6	2.1
Pacific Islander	2	0.7
Total	281	100.0

communities (see Table 14) with half of the students going online for study purposes (see Table 15). Sixty-nine responses identified text-based social networking platforms such as Facebook and MySpace.

Table 14. Indicated Frequency of Online Participation

Hours/Week	Population	Percentage
Under 1	88	31.3
1-5	105	37.4
6-10	40	14.2
11-15	24	8.5
16-20	14	5.0
20+	10	3.6
Total	281	100.0

Table 15. Indicated Types of Participation in Online Communities

Online Communities	Population	Percentage
Study	141	50.2
Hobby	100	35.6
Social Network	69	24.6
Forum	58	20.6
Role-Play/Game	44	15.7

Consequently, results to the question related to virtual world familiarity showed a high frequency in reported lack of usage of social-based virtual worlds. Most students (75.1%, $n = 211$) indicated they had never been in a virtual world. Others indicated they have either been visiting virtual worlds for more than one and two years (18.2%). Ten students indicated they have been visiting virtual words for more than three years (identified as 'gamers' from now on). Gender distribution was equal among the gamers (female = 5; male = 5) with a mean age of 19 for both sexes. Distribution of 'non gamers' (n = 271) across groups was not significantly different ($\chi^2 = 1.598, df = 3, p = 0.66$).

RESEARCH QUESTIONS

This section presents the results to the research questions.

Research Question One: Immediacy

RQ1: Do immediacy behaviors projected by the instructor avatar influence instructor immediacy?

The hypothesis was that participants viewing the high-immediacy instructor behaviors exhibited by the instructor avatar (Groups 1(HiHi) and 2 (HiLo)) would indicate higher levels of perceived immediacy than participants exposed to the low-immediacy behavior treatments (Group 3 and 4). To test this proposition, a one-way between-groups analysis of variance (ANOVA) was conducted. There was a statistically significant difference at the $p < .05$ level: $F(3, 113) = 6.5, p = .000$ (see Table 16).

Students who viewed the high-immediacy machinimas (Group 1 HiHi and Group 2 HiLo) rated the immediacy behaviors of the avatar more highly than the students who viewed

Table 16. One-Way ANOVA of Perceived Instructor Immediacy

	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	11894.990	3	3964.997	6.527	.000
Within Groups	68639.780	113	607.432		
Total	80534.769	116			

the low-immediacy machinimas (Group 3 LoHi and Group 4 LoLo). Interestingly, the mean for Group 4 (LoLo, $M = 45.12$) was higher than for Group 3 (LoHi, $M = 36.64$). This strongly suggests that an instructor who implements immediacy behaviors through his/her avatar during formal instruction is likely to be perceived as more immediate, attentive and empathetic than an instructor who does not.

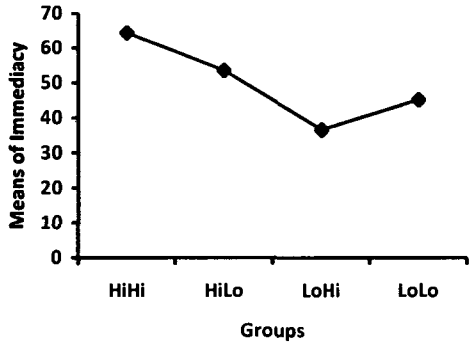


Figure 6. Means Plot for Perceived Instructor Immediacy

Further analysis revealed some differences between two groups. Post-hoc Scheffé comparisons indicated that the mean score for Group 1 HiHi ($M = 64.39$, $SD = 19.39$) was significantly different from Group 3 LoHi ($M = 36.64$, $SD = 22.80$, $p = .001$) and Group 4 LoLo ($M = 45.12$, $SD = 32.23$, $p = .032$). Post-hoc Scheffé did not did not register a mean difference between Group 1 HiHi and Group 2 HiLo and between Group 3 LoHi and Group 4 LoLo (see Table 17).

Table 17. Post-Hoc Multiple Comparisons: Instructor Immediacy Ratings

Treatments		Difference between Means	*p*
1.HiHi	2.HiLo	10.94	0.426
	3.LoHi	27.75	0.001
	4.LoLo	19.26	0.032
2.HiLo	3.Lo-Hi	16.80	0.091
	4.LoLo	8.32	0.630
3.LoHi	4.LoLo	-8.48	0.623

A surprising finding was that participants in Group 4 who watched a low- immediacy instructor's avatar and low-immediacy students' avatars perceived higher immediacy of instructor than Group 3, low-immediacy instructor and high-immediacy students. This result could possibly indicate that when students' avatars exhibit high immediacy while the instructor's avatar does not, participants perceive students' avatars' immediacy as distracting or inappropriate in the teaching context (lecture).

In summary, participants in this experiment appeared to perceive the instructor as psychologically close when the instructor's avatar displays high immediacy behaviors. The findings also suggest that psychological closeness in a virtual environment may be influenced by other variables than instructor behaviors alone, such as the number and frequency of relevant and appropriate immediacy behaviors exhibited by instructor and students in concert with or in response to each other. However, these variables were not part of this study.

The findings also imply that behaviors depend on roles (instructor and students) as well context (e.g., the style or pedagogical model of teaching). Further studies are necessary to confirm the roles and context of behaviors in learning immersive environments.

Research Question Two: Social Presence

RQ2: Do immediacy behaviors projected by the avatar-mediated instructor influence instructor social presence?

The researcher hypothesized that participants exposed to high immediacy behaviors displayed by the instructor's avatar (Groups 1 HiHi and 2 HiLo) would rate the instructor more highly on a measure of social presence than students exposed to low immediacy instructor behaviors (Groups 3 LoHi and 4 LoLo). A one-way ANOVA indicated a significant difference between group means: $F(3, 229) = 35.79$, $p = .000$ (see Table 18).

Table 18. One-Way ANOVA of Perceived Instructor Social Presence

	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	10319.764	3	3439.921	35.759	.000
Within Groups	22029.017	229	96.197		
Total	32348.781	232			

The results show that Group 1 (HiHi) ratings of avatar-instructor social presence was the highest ($M = 29.79$, $SD = 6.67$), followed by Group 2 (HiLo; $M = 20.36$, $SD = 8.98$), Group 3 (LoHi; $M = 14.15$, $SD = 10.89$), and Group 4 (LoLo; $M = 13.68$, $SD = 11.85$). These results indicate that participants exposed to high immediacy instructor behaviors in the instructor's avatar did perceive higher instructor social presence than the low immediacy groups.

Post-hoc comparison of ratings for social presence revealed significant differences for 5 out of 6 possible pairs: Groups 1 (HiHi) and 2 (HiLo), Groups 1 (HiHi) and 3 (LoHi), Group 1 (HiHi) and 4 (LoLo) (all $p = .000$), Groups 2 (HiLo) and 3 (LoHi) ($p = .013$),

Groups 2 (HiLo) and 4 (LoLo) ($p = .005$). Group 3 (LoHi) did not differ significantly from Group 4 (LoLo) ($p = .995$; see Table 19).

Table 19. Post-Hoc Multiple Comparisons: Social Presence

Treatments		Difference Between Means	p
1.HiHi	2.HiLo	9.42	.000
	3.LoHi	15.63	.000
	4.LoLo	16.10	.000
2.HiLo	3.Lo-Hi	6.21	.013
	4.LoLo	6.67	.005
3.LoHi	4.LoLo	-0.46	.995

These results strongly suggested that instructor avatar immediacy behaviors influenced avatar- instructor social presence.

These findings were supported by item 1 in the open-ended section: "Did you perceive the instructor in this lesson as a real person?" 'Real person' was defined as an instructor perceived as warm, personal, sensitive and sociable. In Group 1 (HiHi), 82% of students reported perceived instructor social presence, followed by Group 2 (HiLo) (62%). Interestingly, Group 4 (LoLo) indicated more instructor social presence (28%) than Group 3 (LoHi) 24%. This unexpected result might be explained by a few Group 4 students' confusion with the given definition of 'real.' For example, one student commented that "he [the instructor-avatar] could be perceived as a 'real person' since some teachers really are like that." A student who was assigned to Group 4 (LoLo) said: "I perceived the professor as non sociable although [sic] I did proceive [sic] him as a real person." These findings suggest that the level of immediacy behaviors displayed by the avatar instructor influenced the students' perception of instructor social presence and are consistent with the strong positive

correlation between avatar immediacy and instructor social presence ($r = .769$, $n = 111$, $p < .0005$; see Figure 7).

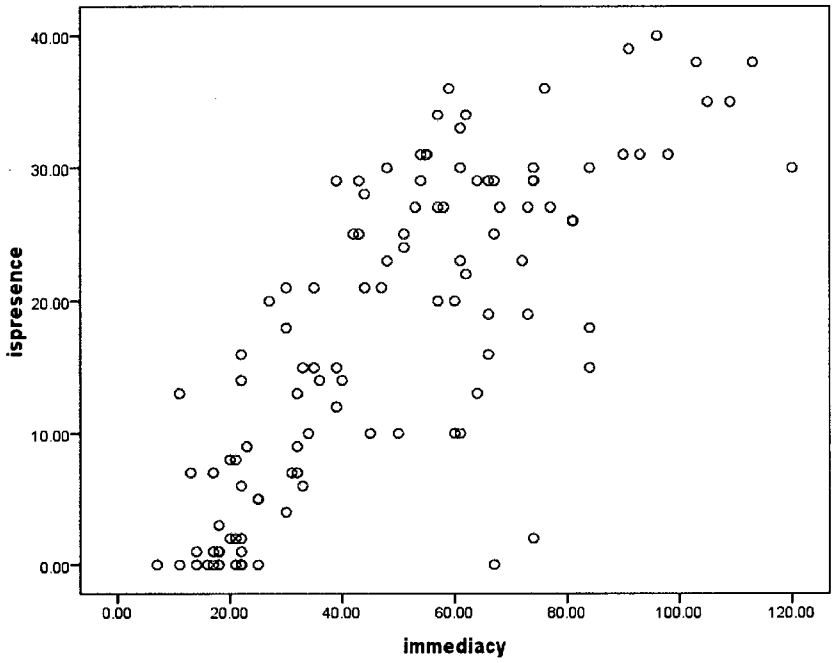


Figure 7. Correlation of Instructor Social Presence and Immediacy.

As the immediacy of the instructor avatar increases, students' perception of instructor social presence increases.

Research Question Three: Co-presence

RQ3: Do immediacy behaviors projected by avatar-mediated students influence perceived students' co-presence?

The researcher hypothesized that participants exposed to the high immediacy behaviors displayed by the students' avatars (Group 1 HiHi and Group 3 LoHi) will rate the student-avatars more highly on a measure of co-presence than students exposed to low immediacy students behaviors (Group 2 HiLo and Group 4 LoLo). An ANOVA analysis of the data collected by the Networked Mind Social Presence scale did not provide any

significant differences between the groups (F (3, 170) = 1.53, SD = .208) (see Table 20) although the mean scores of the groups reported a minimally higher co-presence with Group 2 HiLo (M = 30.56, SD = 21.53), followed by Group 1 HiHi (M = 29.53, SD = 24.19), Group 4 LoLo (M = 28.71, SD = 22.68) and Group 3 LoHi (M = 21.53, SD = 19.44).

Table 20. One-Way ANOVA of Perceived Student Co-Presence

	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	2196.647	3	732.216	1.531	.208
Within Groups	79890.313	167	478.385		
Total	82086.959	170			

The null hypothesis was not rejected. The ANOVA findings suggest that the level of immediacy behaviors projected by the student avatars do not influence peer presence. However, the mean scores—although with minimal differences—show a reverse effect in which groups exhibiting low immediacy student-avatar behaviors showed higher co-presence than their higher immediacy counterparts.

However, these results do not align with the open-ended question that asked students to describe the behaviors of avatar students which positively influenced their perception of the avatar students. All four groups reported factors with student high immediacy groups leading with Group 1 HiHi (81%) and Group 3 LoHi (75%), followed by Group 4 LoLo (71.5%) and Group 2 HiLo (63%). These results suggest that student-avatar immediacy behaviors influence perceived student co-presence. Table 21 presents the categories summarizing the students' descriptions of student-avatar behaviors that made the students seem real. These findings are congruent with the co-presence literature that argues that the

notion of co-presence shares properties with physical presence and implies behavioral engagement and interaction.

Table 21. Overall Aspects That Made Students Seem Real

Aspects of the Machinima	Number of Responses
• Interactive participation: Could comment on each other, chat with teacher and could ask questions	45
• Acted like real students	39
• Were attentive	28
• Used gestures	22
• Did not feel alone	07
• Used humor	05
• Appeared like students (diversity)	04
• Participated in activities	02

In light of the findings in research question one on immediacy, these findings might suggest that immediacy behaviors displayed by student-avatars do not influence perceived student co-presence in the treatment's context, a didactic, lecture-style teaching, in which students are usually not expected to participate. As suggested in RQ1's summary as well, further studies are needed to analyze the influence of immediacy behaviors in a pedagogical model better suited to the environment, such as social constructivism in which student interaction is expected.

Research Question Four: Cognitive Learning

RQ4: Do immediacy behaviors projected by the avatar-mediated instructor influence learning outcomes?

The researcher hypothesized that participants exposed to high immediacy instructor avatar behaviors (Group1 HiHi, and Group 2 HiLo) would outperform students in the low immediacy treatments (Group 3 LoHi and Group 4 LoLo) on this measure of learning

outcomes. Learning outcomes were identified as recall and comprehension of the lesson content and were measured with the immediate posttest. Furthermore, the researcher hypothesized that Group 1 (HiHi) would score higher than all other groups. A Chi-Square was run to determine goodness of fit (Table 22).

Table 22. Chi-Square Between Group Treatments and Pretest Scores

	Pretests								
Treatments	0	1	2	3	4	5	6	7	Total
HiHi	0	6	11	16	15	10	6	4	68
HiLo	3	4	8	17	16	15	9	2	74
LoHi	2	4	11	7	9	18	13	5	69
LoLo	2	6	9	21	12	12	6	2	70
Total	7	20	39	61	52	55	34	13	281

Pearson chi^2 (21) = 21.9326 Pr = 0.403

A one-way analysis of variance demonstrated no significance between treatment means in the pretest condition as measured by the pretest scores (F (3, 277) = 1.809, p = .146) (see Table 23, Table 24, and Table 25).

Table 23. Summary of Pretest Results

Summary of pretest			
Treatments	Mean	Std. Dev.	Freq.
HiHi	3.376	1.624	68
HiLo	3.756	1.645	74
LoHi	4.144	1.849	69
LoLo	3.5	1.612	70
Total	3.768	1.692	281

Bartlett's test for equal variances: chi^2 (3) = 1.754 Prob>Chi^2 = 0.625

Table 24. Comparison of Pretest by Treatment

Row Mean Col Mean	HiHi	HiLo	LoHi
HiLo	.080 .994		
LoHi	.468 .451	.388 .595	
LoLo	-.176 .945	-.256 .841	-.644 .168

A one-way analysis of variance demonstrated no significant difference between the groups as measured by the immediate posttest scores (F (3, 277) = 1.379, p = .249) (see Table 25).

Table 25. One-Way ANOVA of Pretest and Posttest

		Sum of Squares	*df*	Mean Square	*F*	*p*
Pretest	Between Groups	15.410	3	5.137	1.809	.146
	Within Groups	786.555	277	2.840		
	Total	801.964	280			
Posttest	Between Groups	16.348	3	5.449	1.379	.249
	Within Groups	1094.592	277	3.952		
	Total	1110.940	280			

An ANCOVA was run to determine a difference between pre and post tests (see Table 26). There is a significant relationship between posttest scores and pretest scores but not between posttest scores and treatment. The number of observations used equaled 281, the p value = 0.000 and the F (4, 276) = 10.97. Group 3 (LoHi) achieved the highest test scores

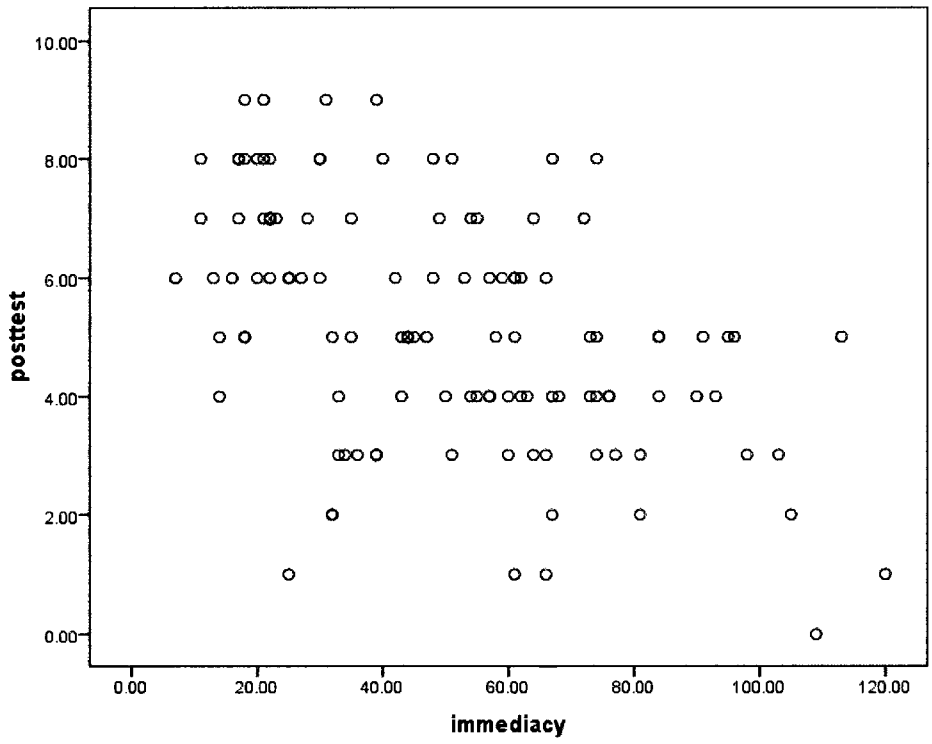
(M = 5.63, SD = 1.917), followed by students in Group 1 (HiHi; M = 5.57, SD = 1.879), Group 4

Table 26: ANCOVA Pretest and Posttest Scores

Source	Partial SS	Df	MS	F	Prob > F
Model	151.652	4	37.913	10.91	0.000
Treatment	13.841	3	4.613	1.33	0.265
Pretest	135.304	1	135.304	38.93	0.000
Residual	959.287	276	3.475		
Total	1110.939	280	3.967		

Number of obs = 281 R-squared = 0.136
Root MSE = 1.864 Adj. R-squared =0.124

(LoLo; M = 5.35, SD = 2.133), and Group 2 (HiLo; M = 5.02, SD = 2.006). Based on those results, a correlation analysis confirmed a negative relationship between avatar immediacy and learning outcomes (r = -.50, n = 117, p = .000): as the avatar instructor immediacy



increases, posttest scores decrease. This result suggests that avatar immediacy is a distraction to learning (see Figure 8).

Figure 8. Correlation of Immediacy and Posttest

Yet, at the end of the survey, when students were asked if they were distracted by the environment and to elaborate on their answer, both high immediacy student avatar groups (Group 1 HiHi and Group 3 LoHi) reported no distraction (74%), compared to the low immediacy student groups of whom 50% reported being distracted by the 3D environment. Table 27 provides a list of concerns reported by the students to item 7 of the open-ended section ("Were you distracted by the 3D environment? If yes, please explain").

Table 27. Reported Distracting Factors

Aspects of the Machinima	Student Concerns
• I can't control the camera.	24
• The 3D was distracting because: weird, strange, awkward, hard to focus, not real.	18
• It's not real. It's a game. It's just a video.	15
• I want to participate. I am not in the room myself.	12
• The 3D was distracting because: awesome, new, cool, so real, so much to see.	10
• It's not what I am used to. I like power point and teacher talking only. Camera should focus on teacher and screen only.	9
• It was bland. Boring. Voice was dull.	6
• I don't care about other students. Other avatars are distracting.	6
• Trees were moving. Professor moved a lot.	4
• It's online. I can surf something else.	4
• It's online. I get distracted by my house/roommate.	3
• I felt dizzy. I had to take my contact lenses off.	3

OPEN-ENDED ITEMS

The last part of the survey asked students 9 questions in order to support the research questions. The first 2 questions related to instructor's social presence and asked students if

they perceived the instructor's avatar as a 'real' person and to identify aspects of the session that made them feel like the instructor avatar was a real person (warm, personal, sensitive, and sociable) (See Table 28).

Table 28. Number of Students Who Indicated They Perceived the Instructor Avatar as Real

Perceived Instructor as 'real'	Group 1 (n = 65)	Group 2 (n = 67)	Group 3 (n = 67)	Group 4 (n = 64)
Yes	53	41	16	18
No	12	26	51	46

The results were expected with the higher immediacy instructor avatar session recording the most positive answers and significantly lower count of yes responses in the low immediacy instructor sessions.

Students reported impressions and perceptions that echoed the general issues identified by the literature on instructor immediacy. These are organized by categories in Table 29, with a few items specific to the virtual environment. Students valued seeing and hearing the instructor above all. Specifically, participants appreciated that the instructor avatar's voice showed human qualities (not computerized and modulated). Participants also responded to the use of body and head gestures such as turning to the board to point at slides or toward students to look at them in the eyes.

The next two questions asked participants to describe the student avatars' behaviors which positively and negatively influenced their perception of the students (see Table 30). Interestingly, participants would note a specific behavior and interpret it differently. For example, while some participants considered the student avatars' gestures as showing engagement, other participants interpreted those gestures as irrelevant and distracting.

Further studies would benefit from evaluating participants' reaction to student avatars after an orientation session in Second Life.

Table 29. Categories of Aspects of the Machinima That Made the Instructor Avatar Seem Real

Aspect of the Machinima	Number of Responses
It was a real voice (pitch, tone, stutters)	79
Used gestures, facial expressions, moved body	44
His character looked like a real person/teacher/professional	32
He was accessible (personal info, caring, used 'us,' showed emotions, office hours)	29
Interacted with students, called students by first names	27
Encouraged students to be involved, asked questions	21
He responded to students' comments and questions	16
Taught same as in real class	12
He looked at me (body orientation)	9
Used humor	7
Seemed knowledgeable	6
Used visuals, powerpoint, clicker	5
Used examples	4

Table 30. Positive/Negative Student Avatars' Behaviors

Positive Behaviors	Negative Behaviors
• Participated in class (text chat their comments, asked intelligent questions, clicker activities) • Felt together like a classroom/did not feel alone • Used humor • Were different and unique • Interacted with instructor • Were friendly • They were sitting attentive to the instructor/not disruptive to participants' learning • Were like real students • Moved realistically (look down, check watch, eyes blink) • Showed engagement (clapped hands, nodded with head, laughing, raising hands) • Behaved like real students	• They did not do anything/no answer • They looked bored/falling asleep • It's fake anyway/cartoon/game • Their diversity was distracting • They were ridiculous, dressed weird, hippies • Did not interact/slowed down instructor • They were sitting looking bored/looked depressed • The students did not look realistic at all • Did not talk, just type in chat • They were not taking notes • Their gestures distracted me • They can't see me. No connection • No communication

The next question asked participants if they were distracted by the 3D environment in general (see Table 31), and if so to explain. Findings resulted in inconsistencies between the answers above and this question. Further analysis would be recommended at each participant's level to identify possible variables not considered in this study.

Table 31. 3D Environment Is Distracting

	Group 1 (n = 64)	Group 2 (n = 66)	Group 3 (n = 60)	Group 4 (n = 66)
Yes	24	31	31	15
No	40	35	29	41

CHAPTER 5

DISCUSSION

This study investigated an immersive and interactive 3D virtual environment medium and avatars such as depicted in Second Life. The researcher predicted that projection of instructor immediacy behaviors through an avatar in the context of didactic instruction would positively influence perception of the instructor immediacy, instructor social presence, and student' co-presence. Since the constructs of immediacy and social presence were proposed in the middle of the last century there has been a dearth of experimental work done to investigate these issues in classroom setting. No causal-comparative or experimental studies other than Schutt, Allen, and Laumakis (2009) have been published on the effects of instructor immediacy behaviors on social presence in the context of synchronous instructional interactions or simulations of same.

The researcher collected data related to the hypothesis that avatar-based immediacy behaviors would positively influence cognitive learning outcomes. However, because the treatments were not specifically designed to effect differences across treatment groups with regard to learning outcomes, and because all participating students Psychology 101 students in all groups, were expected to review content similar to the content presented by the avatar instructor, the research viewed this hypothesis as a probe, not a prediction. Several key patterns emerge from the experiment. First, consistent with previous research examining instructor immediacy, the findings of this study demonstrate that immediacy behaviors, both verbal and nonverbal, can be conveyed successfully through avatars in Second Life and that

participants exposed to higher levels (more frequent and more diverse) immediacy instructor avatar behaviors perceived higher instructor immediacy and higher instructor social presence than those exposed to low-immediacy instructor avatar behaviors. However, findings point to the need for additional research on variables not investigated in this study that might be likely to interact with student perception of co-presence and that might influence achievement of cognitive learning outcomes.

RESULTS RQ1: IMMEDIACY

RQ1: Do immediacy behaviors projected by the instructor's avatar influence instructor immediacy?

Results of this experiment demonstrated significant differences between treatments groups: Students who viewed the high immediacy instructor avatars (Group1 HiHi and Group 2 HiLo) rated the immediacy behaviors of the instructor-avatars more highly than students who viewed the low immediacy instructor avatars (Group 3 LoHi and Group 4 LoLo). This difference confirms that avatars in Second Life are capable of projecting effective immediacy behaviors and that such behaviors can be perceived by viewers representing undergraduate college students. This finding extends to avatar-mediated instruction in immersive environments previous studies of immediacy behaviors in classroom settings, and more recently simulated video-based instruction (Schutt, 2007; Schutt, Allen, & Laumakis, 2009). These differences student ratings of immediacy behaviors are consistent with a dynamic model in which an avatar-instructor who uses verbal and nonverbal immediacy behaviors reduces student perceptions of psychological distance and enhances perceptions of emotional closeness and interaction. Verbal behaviors include using students' names, feedback, praise and humor (Gorham, 1988). Nonverbal behaviors such as eye

contact, body posture, gestures, facial expressions, and vocal qualities (Andersen, 1979; Richmond et al., 1987) can be easily implemented in Second Life. Eye contact is obtained by orienting one's avatars so that they face each other (PC shortcuts such as Alt+click on object will allow one's avatar to orient toward the object of interest, then Alt+orientation key (or camera control) allows for zooming onto one's face). Relaxed body posture currently comes as a default setting for every avatar; however, the current setting also initiates an 'afk' (away from keyboard) animation with which the avatar 'drops asleep' after several minutes of physical inactivity. Solutions range from use of text chat to animation overriders (AO; user-specific scripts that animate avatar automatically). Gestures and facial expressions can be selected from dropdown menus, user inventory, or AO, although lipsynching can be enabled for automatic lip movement triggered by voice (Go to Advance Menu, Character, Enable Lipsynch). Voice qualities include clear enunciation, soft and friendly tone, enhanced by using a variety of pause, pace, inflection and a slower speech when in large rooms (Martin & Darnley, 2004). Since instructor and students are interacting via avatar, immediacy communication might benefit from training educator and students in these user interface skills.

On a more practical level applicable to management of instructional programs, this finding suggests that instructors who employ Second Life as a tool for delivering didactic instruction should be prepared (either by screening or by training) to select appropriate verbal and nonverbal immediacy behaviors and to implement them technically through the means provided by the virtual medium--if student satisfaction is one of the goals of the instructional enterprise.

RESULTS RQ2: SOCIAL PRESENCE

RQ2: Do immediacy behaviors projected by the avatar-mediated instructor influence instructor social presence?

Whereas an experimental design with true random assignment was employed to address Research Question 1, and therefore supports causal inferences, Question 2 was addressed with descriptive methods focused on the correlation of student ratings of avatar instructor immediacy behaviors with social presence, that is, the perception of students that the avatar instructor was a 'real,' 'caring', 'empathetic' figure.

The correlation of the measures of immediacy behaviors and social presences, (r = .769, p = .000) indicates that 59% of the variance in the social presence of avatar instructors in this study can be accounted for by students' perception of instructor immediacy behaviors. Consistent with this finding are students' reports on how 'real' they perceived the instructor to be (Groups 1 HiHi and 2 HiLo > 60% vs. Groups 3 LoHi and 4 LoLo < 25%). As noted before, no previously published studies have confirmed a significant relationship between instructor immediacy behaviors and social presence other than Schutt, Allen, and Laumakis (2009). Results for Research Questions 1 and 2 offer new support for theorists pursuing theories and models of social presence in instructional contexts. A follow up for future research using data from this study would be to conduct an ANOVA to determine whether there are differences between the treatment groups when social presence is treated as a dependent variable in a manner analogous to immediacy in the investigation of R1.

One a more practical level, findings for both Research Question 1 and 2 strongly suggest that instructors and others who employ avatars in virtual environments benefit from

appropriately employing immediacy behaviors, especially when students might be new to Second Life, given predictions such as Gartner's (2007) forecast which stated that "80% of internet users will be active in a virtual world by the end of 2011". Only a minority of students in this study (32.7%; $n = 92$) indicated they had previously taken courses where the instructor used online conferencing tools. Some participants (37.4%; $n = 105$) reported spending only between 1 to 5 hours a week in an online community, while 31.3% ($n = 88$) spent under an hour. Most students in this study (75.1%; $n = 211$) have reported they had not participated in a socially based virtual world. Only 11.5% ($n = 33$) had been visiting virtual worlds for over a year or more. A follow-up study might help explain the disparity between this population sample's lack of familiarity of virtual world and global research forecast.

RESULTS RQ3: CO-PRESENCE

RQ3: Do immediacy behaviors projected by the avatar-mediated students influence perceived student co-presence?

The Networked Minds measure results showed no significant relationship and the mean scores held no significant differences. This might seem to suggest that student immediacy behaviors do not influence peer presence. However, observing students in Psychology 101 reported that, for better or worse (see Table 26, p. 79), they were aware of avatar-students through the simulated activities of these avatar students such as participation in text-chat, in world activities, as well as overt avatar-behaviors. Indeed, participation and interactivity of students were aspects of the machinimas that students reported most frequently regarding their perceptions of students in Group 1 and 3 (see Table 18; e.g., "The students were into it and were asking questions and making comments").

These inconsistencies between the quantitative data and the qualitative data may have been influenced by the study's heavy emphasis on didactic, instructor-dominated communications. The researcher decided to replicate this aspect of Schutt's study not because it is preferred, but because lecturing is still a prominent style of teaching, training and presenting in Second Life. Another possible explanation for the failure to confirm Hypotheses 3i, and 3ii is that it employed the Networked Mind measure (Harms & Biocca, 2004) to investigate constructs such as trust, and empathy is focused on internal characteristics, dispositions, and attitudes. In this study the Networked Minds measure was employed to collect data from students participating in the experiment as these internal states might be influenced by the avatar students. This RQ3 addresses a very locus of attribution than the instrument employed to investigate RQ2 which focused on the social presence of 'the other' (the instructor) rather than the internal states of the experimental subjects. It is possible that students were not comfortable in disclosing such information, or that it did not have enough time to develop such attitudes and dispositions, or that such attitudes and disposition require some kind of direct interaction with avatar-peers (rather than observation of a recording).

RESULTS RQ4: COGNITIVE LEARNING

RQ4: Do immediacy behaviors projected by the avatar-mediated instructor influence learning outcomes?

No significant difference was detected and a negative relationship was reported. The no-significant difference in cognitive learning outcomes between the groups is consistent with Schutt's (2007) short-term recall measure results which findings were also inconclusive. The lack of difference in cognitive learning outcomes between the groups might also identify

a limitation to this study. Participants observed the recording of a simulated lesson. They were not able to interact directly with the avatar instructor and avatar students. The results might have been different had they been allowed to participate directly. With the lack of participating opportunity to the learning process, participants to the study disengaged and paid more attention to the environment than the lesson content. Therefore, it might be recommended not to use machinimas for asynchronous lecturing.

The negative relationship between the variables is consistent with Titsworth's (1999) experiment in which the treatments were also scripted and recorded. Titsworth reports that "higher levels of immediacy appeared to distract students from recalling organizational points from the lecture even when explicit organizational cues were provided" (p. 142) and that this was "consistent with the distraction theory articulated by McCaleb and White (1980)" (p. 178) which states that a highly immediate instructor would distract students from learning the lecture material. In fact, Comstock, Rowell, and Bowers' (1995) study indicates that student learning is higher when the instructor displays moderate amounts of immediacy. It is therefore recommended that instructors monitor the number and level of intensity of immediacy behaviors displayed by their avatars. Research on the relationship between instructor immediacy and cognitive learning (assessed with a test) in online courses has yet to be conclusive (Gorham & Zakahi, 1990). Furthermore, the relationship might not be linear: students' attitudes about the topic can influence their affective learning which influences their perception of the instructor immediacy which influences cognitive learning (Rodriguez et al., 1996). Student motivation can also influence perceived immediacy, influencing in turn affective and cognitive learning (Frymier, 1994).

Among other factors potentially related to cognitive learning that have not been explored in this study, such as motivation and attention allocation, is the participants' lack of familiarity with the virtual worlds (75.1% have never been in a social-based virtual world). Responses ranged from the negative (e.g., "I couldn't get into it, but I don't really enjoy 'second realities'" and "The whole thing creeped me out so it made it hard for me to pay attention") to the enthusiast (e.g., "it was a little distracting because I was thinking how cool it was" and "I was searching for anything that didn't match objects in real life"). Only a few participants who were familiar with gaming platforms expressed frustration at the digital quality (e.g., poor graphics, poor animations). Most participants identified as gamers were satisfied with the experience (e.g., "not distracted. Then again, I have been playing MMORPGs since fifth grade," "not distracted, because I am used to 3D environments through playing games").

LIMITATIONS OF THE STUDY

This study is limited by its design:

1. The instructional sessions were scripted and pre-recorded. Participants were not able to interact with the instructor and the other students. They only viewed the interactions between them. Perceptions and learning outcomes may vary if participants can directly engage with the instructor and their peers.

2. The prerecorded sessions were 28 minutes in length. Study findings might be different if the sessions were longer or closer to a regular lecture length.

3. The experiment was a one shot exposure. Results might be different with semester long exposure.

4. Participants were recruited from two sections of the same undergraduate course. Findings might be different if students were recruited from other disciplines and other degrees.

5. The recording used a bespectacled and bearded Caucasian male avatar to represent the instructor. A different choice of gender, age, race, dress or other variables could produce different results.

Furthermore, future researchers might be warned that the creation of the machinimas was not simple. First, the researcher selected gestures from the default library in order to match Richmond et al's nonverbal items list to create animation scenarios: the gestures are organized in an organic manner, following the natural rise and fall of the instructor voice and matching intentions (e.g., questioning students). Matching a voice prompt, a selected key (called a trigger key) is pressed to trigger the series of gesture, hence animating the avatar in the order and timing of the programmed gestures until the animations run through or repeated via a loop depending on the need of the instructional script. Furthermore, an animation overrider was also programmed with gestures not provided by the default library to supply the researcher with added immediacy behaviors matching the instructional context. Programmed gestures were tested until the resulting animation was satisfying.

Second, colleagues in SL were recruited to play the role of students. The researcher provided them with a list of gestures appropriate to each immediacy behavior type (high and low) and directed the actors to display certain behaviors during recordings.

Finally, the machinimas were created in several takes and edited in post-production to provide a natural connection between avatar behaviors and the instructional voice-over. The voice-over was created in Audacity. The machinimas were created with Fraps®, edited in MovieMaker® where the audio was added to the video, converted from WMV to AVI with AVS Video Converter ®, then posted on Veoh –Veoh is the only free online video host that allows videos longer than 15 minutes to be posted- all programs being used were free download.

Future Research

This study confirmed that instructor immediacy behaviors can be communicated through an avatar in Second Life; however, new challenges arise in the importance given to specific immediacy items as well as other variables such as prior familiarity with a virtual environment, design of an orientation session for students as well as training for instructor, and instructional design of the lesson for more student participation to the learning process.

Some online instructor certification programs offer modules on building learning communities with a heavy emphasis on instructor social presence. However, if modules focus on how an instructor creates social presence in a text-based asynchronous environment (in which nonverbal behaviors are absent) or in videoconferencing (in which the communicating medium is a one-way video transfer of the instructor's real person), they are likely to ignore important factors that may contribute to student satisfaction and engagement. They also do not take into consideration the issue of using a simulated proxy for the instructor's physical presence and how the virtual platform used for the instructor accommodates the display of immediacy behaviors. How does one train on immediacy behaviors to provide an effective social presence in 3D? Before even considering this type of training and curriculum creation, instructional researchers and manager should consider this important question: Is such training worth the time and effort? Research suggests that social presence impacts online interaction (Tu & McIsaac, 2002), user satisfaction (Gunawardena & Zittle, 1997), depth of online discussions (Polhemus, Shih, & Swan, 2001), online language learning (Leh, 2001), critical thinking (Tu & Corry, 2002), Chinese students' online learning interaction (Tu, 2001), and more.

Current systems such as Second Life still impose a high cognitive lead on instructors who want to employ a broad range of realistic immediacy behaviors: an instructor must 'script' his lecture ahead of time as an actor would prepare appropriate behaviors for the instructional event (either by organizing shortcut keys or creating behavior scenarios). The instructor would also have to scroll down a list of gestures, creating potential awkward time lag between content and behavior. In order to provide users with continuous control of avatar gestures, Barrientos (2000) developed a system that tracks hand motion and transmits it to the avatar. The goal of such 'programming' is to provide the avatar with the movements of the arms and hands that accompany speech when people speak face to face. Additional global efforts to obtain full body motion to the avatar in ways that are ergonomically efficient are still in early states of dissemination. CamTrax Technology, for example, has developed a software-only solution that already recognizes any object as an interactive controller via a common webcam (http://www.camtraxtechnologies.com/). Although the CamSpace® has potential for full body motion impacting objects inworld, the software is still limited. More promising is the Kapor Enterprise's Hands Free 3D. Kapor and Bossut designed a prototype for a full body tracking application in Second Life (http://www.kei.com/news.html) for a hand-free 3D experience. Focusing on head movement first, Cassassovici at VR-Wear developed an application using a webcam to trigger head motion in his avatar (http://www.mobitrends.com/2008/08/27/head-tracking-in-second-life/) and would reveal full body motion solution in 2009. Unfortunately, all three efforts were limited and have yet to be released to the public.

Project Natal, however, is expected to be released in December 2010 as a new development in the gesture-based game market. Project Natal, by Microsoft, is an external

sensor device that responds to voice commands or presented objects and images, and recognizes 48 joint points on the human player. It analyzes and transfers the facial and body movements to the avatar. The natural user interface effectively enables the user to control and interacts in-game without the need to touch a controller. The researcher suggests that such technology be available as a simple webcam plugin and software download, and used to control ones avatar in a platform of choice. Currently, Project Natal is limited to the Xbox 360 console.

When Linden Lab launched Second Life in 2003, speech gestures were included in the library of gestures provided as default to users. Whether these functions were inspired by Barrientos' work is unknown. However, based on the discussions in the development wiki in which Linden developers report their progress on digital puppeteering, Linden Lab has focused efforts for gestures and other immediacy cues to provide users with a more autonomous avatar (http://wiki.secondlife.com/wiki/SLDev-Traffic_1#Lip_Sync_and_Gesture_Motions). Gestures address user expectations of natural speech and are an important part of communication. In the release of the Second Life client, SL 1.20, lip-synch capability was set as default in the character trait, adding to the list of avatar user-generated nonverbal behaviors.

More research is needed to analyze social presence and immediacy in different educational contexts. Also, researchers must extend investigations of immediacy effects to more specific classes or types of gestures in order to offer better guidance regarding evidence-based practices. Although the use of Second Life was employed as the virtual world for this experiment, the results of this study appear broadly applicable as a general

paradigm for research in other virtual platforms that use similar communication modalities such as avatar's gestures, audio, and text. This study contributes to a growing literature on strategies and methods for such integration as well as an example of the value of research on potential evidence-based practices.

What does this all mean? Universities have used web-based learning management systems such as BlackBoard to develop their online courses, facilitating instructors' re-use of class materials and augmenting the global reach of educational activities. Considered a disruptive technology displacing certain multiple-media two-way technologies, virtual worlds such as Second Life provide solutions synchronous and asynchronous teaching and learning events: to archive activities and lesson contents, to access web materials and interact with other web-based tools (e.g., moodle, blogs, and emails), to interact in a simulated face-to-face communication, and create and manipulate glossed-over and content-embedded objects. VW raise the issue of relative difficult of implementing certain immediacy behaviors. At the current state of technology, SL has to accommodate to a number of constraints such as the choice of platform (e.g., laptop, PC, Mac, whiteboard, smart phones) and low level machines' processing facilities all the while providing access and satisfying in-world experience to a maximum number of users on a global market scale. Further studies such as looking into user satisfaction based on the different systems used by users or if or which immediacy behaviors are perceived important by ordinary users would not only be useful to users but provide informed suggestions to Linden Lab regarding what users want. Indeed, this present study determined that the avatars seemed more real when users used more gestures. Customers would ask LL to provide an easier puppeteering solution.

Virtual worlds are likely to figure heavily in next generation of online systems employed by educational institutions that seek to integrate more options for human interaction. Indeed what is an avatar anyway? An 'avatar' can be defined as a collection of observable behaviors. This study suggests that gestures are important in teaching settings. If we want this sense of humanity in computer interaction, we have to find an easy solution to integrate the artificial avatar with a gesture-processing user interface (UI). Currently solutions lie in the training of the current platform's UI to help maintain humanity in the VW-based computer mediated communication (CMC). What does it mean to be human in computer? Internalizing immediacy behaviors help increase trust and empathy. It would also be more helpful to augment other media for capturing human interaction in CMC. In the last century, systems have allowed human behaviors to transpire. Positive emotional displays were possible only one-way, in a teacher-focused perspective. Now the avatar allows a two-way emotional display in a more integrated system and forces education to rethink human interaction and consequently pedagogies.

This study is indeed only a fragment belonging to a more general research on the impact of VW in Education.

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APPENDIX A

NETWORKED MINDS SOCIAL PRESENCE MEASURE

Co-presence
1 I noticed my instructor.
2 My instructor noticed me.
3 My instructor's presence was obvious to me.
4 My presence was obvious to my instructor.
5 My instructor caught my attention.
6 I caught my instructor's attention.
Attentional Allocation
7 I was easily distracted from my instructor when other things were going on.
8 My instructor was easily distracted from me.
9 I remained focused on my instructor throughout our interaction.
10 My instructor remained focused on me throughout out interaction.
11 My instructor did not receive my full attention.
12 I did not receive my instructor's full attention.
Perceived Message understanding
13 My thoughts were clear to my instructor.
14 My instructor's thoughts were clear to me.
15 It was easy to understand my instructor.
16 My instructor found it easy to understand me.
17 Understanding my instructor was difficult.
18 My instructor had difficulty understanding me.
Perceived Affective Understanding
19 I could tell how my instructor felt.
20 My instructor could tell how I felt.
21 My instructor's emotions were not clear to me.
22 My emotions were not clear to my instructor.
23 I could describe my instructor's feelings accurately.
24 My instructor could describe my feelings accurately.
Perceived Emotional Interdependence
25 I am sometimes influenced by my instructor's moods.
26 The instructor was sometimes influenced by the students' moods.
27 My instructor's feelings influenced the mood of our interaction.
28 My feelings influenced the mood of our interaction.
29 The instructor's attitudes influenced how the student felt. (should be referenced to subject of experiment rather than observation)
30 My attitudes influenced how my instructor felt.
Perceived Behavioral Interdependence
31 My behavior was often in direct response to my instructor's behavior
32 The behavior of the instructor was often in direct response to the student's behavior.
33 I reciprocated my instructor's actions.
34 My instructor reciprocated my actions.
35 My instructor's behavior was closely tied to my behavior.
36 My behavior was closely tied to my instructor's behavior.

APPENDIX B

VERBAL AND NONVERBAL IMMEDIACY

BEHAVIOR SCALES

Verbal items (Gorham, 1988)

Uses personal examples or talks about experiences she-he has had outside of class
Asks questions or encourages students to talk
Gets into discussions based on something a student brings up even when this doesn't seem to be part of his-her lecture plan
Uses humor in class
Addresses students by name
Addresses me by name
Gets into conversations with individual students before or after class
Has initiated conversations with me before, after, or outside of class
Refers to class as 'our' class or what 'we' are doing
Provides feedback on my individual work through comments on papers, oral discussions, etc.
Calls on students to answer questions even if they have not indicated that they want to talk*
Asks how students feel about an assignment, due date, or discussion topic
Invites students to telephone or meet with him/her outside of class if they have questions or want to discuss something
Asks questions that solicit viewpoints or opinions
Praises students' work, actions, or comments
Will have discussions about things unrelated to class with individual students or with the class as a whole
Is addressed by his/her name by the students

Nonverbal items (Richmond, Gorham, & McCroskey, 1987)

Sits behind a desk while teaching*
Gestures while talking to class
Uses monotone-dull voice while talking to class*
Looks at the class while talking
Smiles at the class as a whole, not just individual students
Has a very tense body position while talking to the class*
Touches students in the class
Moves around the classroom while teaching
Looks at board or notes while talking to the class*
Stands behind podium or desk while teaching
Has a very relaxed body position while talking to the class
Smiles at individual students in the class
Uses a variety of vocal expressions while talking to the class

*Presumed to be nonimmediate. Items reverse coded for analysis.

APPENDIX C

CONSENT FORM

San Diego State University

Consent to Act as a Research Subject

The Effects of Instructor Immediacy in Immersive and Interactive 3D Virtual Environments

You are being asked to participate in a research study. Before you give your consent to volunteer, it is important that you read the following information and ask as many questions as necessary to be sure you understand what you will be asked to do.

Investigators: Sabine Reljic, doctoral candidate at San Diego State University and the University of San Diego. Dr. Brock Allen, professor in the Department of Educational Technology at San Diego State University, supervises the research.

Purpose of the Study: The study is designed to investigate avatar-mediated communication between instructor and students during a lecture in Second Life, a 3D virtual world. Specifically, I will analyze the avatar-mediated instructor immediacy (the number and frequency of relevant and appropriate behaviors) and social presence (the degree to which a person is perceived as 'real' in mediated communication) and the students' perception of the avatar-instructor's immediacy and social presence in the synthetic world of Second Life (SL). Furthermore, I will examine the influence of avatar-mediated instructor immediacy on student perceived co-presence and perceived learning.

2 sections of Psychology 101 will be recruited for this study. To qualify as participant, you must be enrolled in a 500-seat section of an introductory, undergraduate psychology course at San Diego State University. You also must have participated or agree to participate in coursework or other instructional opportunities delivered online.

Description of the Study: The experiment requires certain procedures to be followed. First, you will be asked to complete a short survey and pretest. Second, you will be provided with a link to a webpage to view a video (the treatment). Third, after viewing the video, you will be asked to answer a three-part questionnaire.

The research is entirely conducted online. The questionnaires are posted on dedicated sites and the video are hosted on separate websites. The expected duration of your participation does not exceed one afternoon day. The first questionnaire has 23 questions divided in 3 sections: demographics (e.g., 'Age'), virtual world familiarity (e.g., 'Do you participate in online multi-user games such as World of Warcraft?') and course content (e.g.,' _____ is considered the founder of the psychodynamic perspective.'). Some survey course-content items will be on your mid-term exam. The video is 20 minute long. The post survey questionnaire has 3 parts: instructor social presence (10 questions, such as 'Rate this statement 1 through 5: The instructor was open and disclosed personality'), instructor immediacy behaviors (30 questions, such as 'Rate this statement never, sometimes, often: the

instructor asks questions that solicit viewpoints or opinions'), and co-presence (35 questions, such as 'Rate this statement: 'My instructor was often aware of me in the room.'). Finally, a few weeks after the treatment, you will take your mid-term exam and those results will be collected.

What is Experimental in this Study: None of the questionnaires used in this study are experimental in nature. The only experimental aspect of this study is the environment used to deliver the lecture that you are asked to observe and report on.

Risks or Discomforts: Because of the unfamiliar nature of the medium (3D simulated environment) used to deliver the lecture, you might experience some disorientation. If you begin to feel uncomfortable, you may discontinue participation.

Benefits of the Study: Your responses will be used to evaluate the instructional effectiveness of the virtual world activities. Evidence of successful instructional communication will benefit teacher preparation programs, curriculum development, and student learning, as well as potential better interfaces from 3D virtual world developers. Participating in this study might **potentially** improve your performance on the mid-term exam since some course content that are reviewed in the treatment will be in the test. **I cannot guarantee, however, that you will receive any benefits from participating in this study**.

Alternative Methods of Treatment: There is no alternate method of treatment. The goal of the study is to evaluate the effectiveness of instructional communication in a 3D socially-oriented virtual environment.

Confidentiality: If you decide to participate, your responses will be confidential: meaning that your name will be stored in a secure location separately from your surveys and exam. I will use a code to link your name to your surveys and exam. This code will be destroyed once the data has been analyzed. Your course instructor will not know how you responded to the online surveys and your identity will not be revealed in any publications or presentations. **Confidentiality will be maintained to the extent allowed by law.** The research files will be stored for the minimum of 3 years as required by the IRB, on a separate Maxtor® external drive. Only I will have access to the files.

Incentives to Participate: You will earn an extra credit toward your course grade for your participation of the entire study (agree to complete surveys, view video-treatment, and grant permission to use mid-term exam results).

Costs and/or Compensation for Participation: There is no cost associated with participation.

Voluntary Nature of Participation: **Participation in this study is voluntary. Your choice of whether or not to participate will not influence your future relations with San Diego State University and with the University of San Diego. If you decide to participate, you are free to withdraw your consent and to stop your participation at any time without penalty or loss of benefits to which you are allowed.**

Questions about the Study: **If you have any questions about the research now, please ask. If you have questions later about the research, you may contact me at sabine@reljic.com. If you have any questions about your rights as a participant in this study, you may contact the Division of Research Administration San Diego State University (telephone: 619-594-6622; email: irb@mail.sdsu.edu) or the Institutional Review Board at USD at, Office of the Vice President and Provost, University of San Diego, 5998 Alcala Park, San Diego, CA 92110, 619-260-4553 to report problems or concerns related to this study.**

Consent to Participate: **The San Diego State University Institutional Review Board has approved this consent form, as signified by the Board's stamp. The consent form must be reviewed annually and expires on the date indicated on the stamp.**

Your signature below indicates that you have read the information in this document and have had a chance to ask any questions you have about the study. Your signature also indicates that you agree to be in the study and have been told that you can change your mind and withdraw your consent to participate at any time. You have been given a copy of this consent form. You have been told that by signing this consent form you are not giving up any of your legal rights.

_____

Name of Participant (please print)

_____ _____

Signature of Participant Date

_____ _____

Signature of Investigator Date

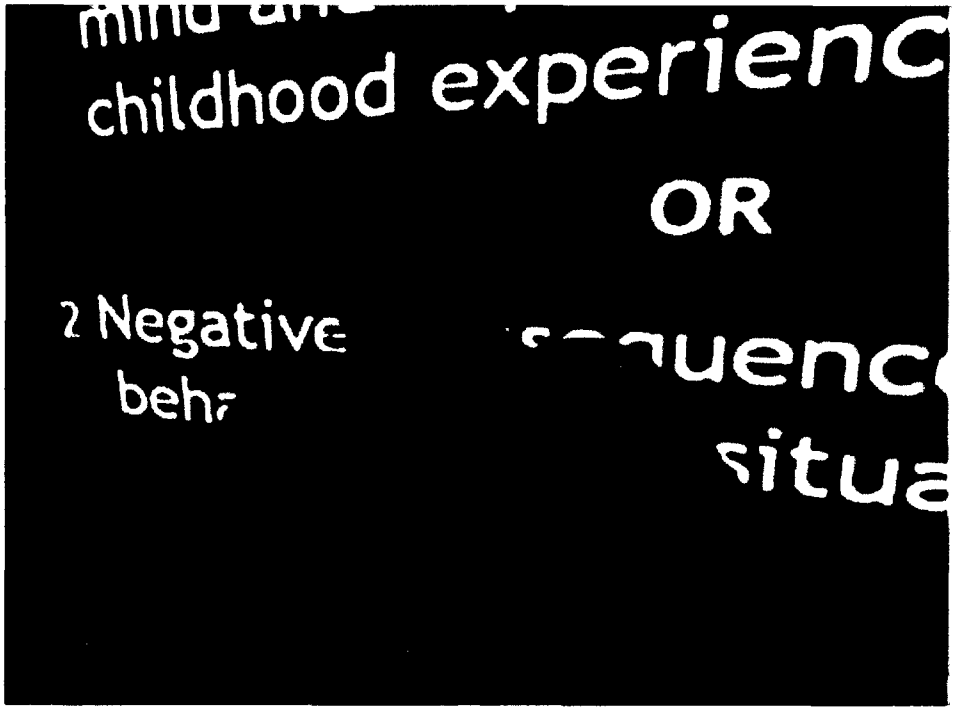
APPENDIX D

SCREENSHOTS OF 3D SESSIONS

GROUP 1: HiHi

(HIGH IMMEDIACY INSTRUCTOR-

HIGH IMMEDIACY STUDENTS)



Available at: http://www.veoh.com/search/videos/q/
instructor+immediacy#watch%3Dv174386787s9CThmd

GROUP 2: HiLo

(HIGH IMMEDIACY INSTRUCTOR-

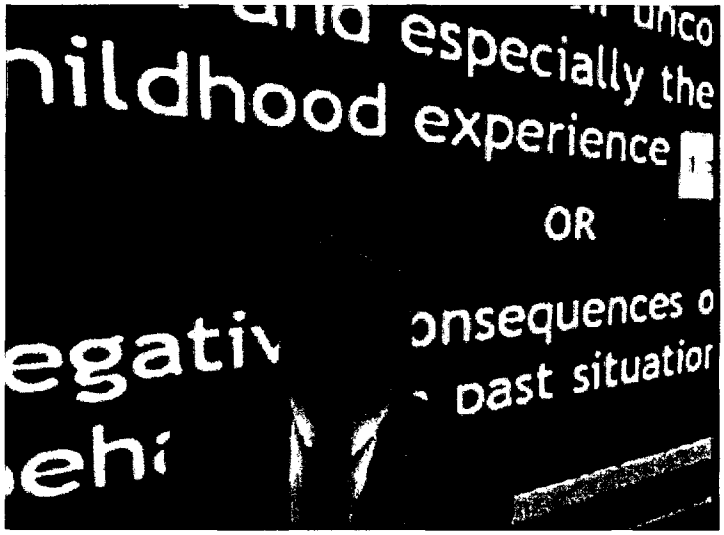
LOW IMMEDIACY STUDENTS)

Available at: http://www.veoh.com/search/videos/q/
instructor+immediacy#watch%3Dv17449540JpreaxDW

GROUP 3: LoHi

(LOW IMMEDIACY INSTRUCTOR-

HIGH IMMEDIACY STUDENTS)

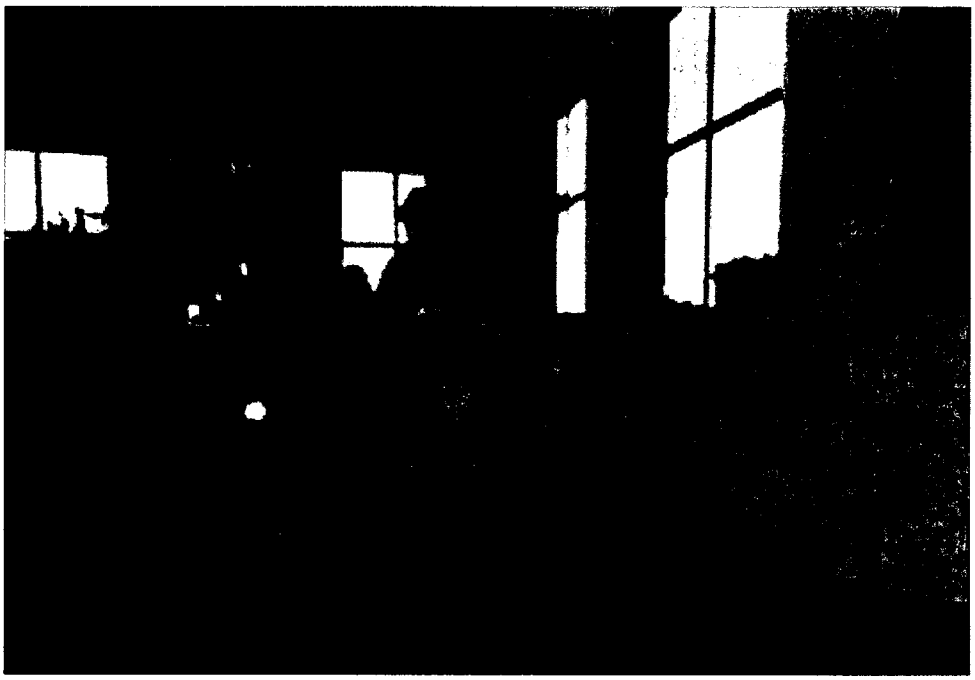


Available at: http://www.veoh.com/search/videos/q/
instructor+immediacy#watch%3Dv17458177w7e2jcpg

GROUP 4: LoLo

(LOW IMMEDIACY INSTRUCTOR-

LOW IMMEDIACY STUDENTS)



Available at: http://www.veoh.com/search/videos/q/
instructor+immediacy#watch%3Dv17455912F3e62FCd

APPENDIX E

OPEN-ENDED ITEMS

1. Did you perceive the instructor in this lesson as a 'real' person? By 'real person' we mean that you perceived the instructor to be warm, personal, sensitive, and sociable.
2. What aspects of the online lesson made you feel like the instructor was a 'real' person?
3. Describe the instructor-avatar's behaviors, which positively influenced your perception of the instructor. (may include appearance, gestures, voice, etc.)
4. Describe the instructor-avatar's behaviors negatively influenced your perception of the instructor.
5. Describe the student-avatar behaviors, which positively influenced your perception of the students.
6. Describe the student-avatar behaviors, which negatively influenced you perception of the students.
7. Were you distracted by the 3D environment? If yes, please explain.
8. Were the avatar distracting? If yes, explain in which way(s).
9. Please, tell us in a few words what you think of your experience watching the video.

APPENDIX F

PROCEDURES

Random assignment	Week 1	Week 2
Group 1: High immediacy instructor –High immediacy students (Hi-Hi)	1-Receive email with URL to questionnaire and URL to website #1 2-Complete part #1 of questionnaire (pretest and demographics) 3-Go to URL and click play button to view machinima with high immediacy instructor and high immediacy students. 4-Complete part 2, 3 and 4 of questionnaire (posttest, instructor immediacy and social presence, and student immediacy and co-presence scales and survey)	1-Complete delayed posttest
Group 2: High Immediacy Instructor-Low immediacy students (Hi-Lo)	1-Receive email with URL to questionnaire and URL to website #2 2-complete part 1 of questionnaire (pretest and demographics) 3-Go to URL and click play button to view machinima with high immediacy instructor and low immediacy students. 4-Complete part 2, 3 and 4 of questionnaire (posttest, instructor immediacy and social presence, and student immediacy and co-presence scales and survey)	1-Complete delayed posttest
Group 3: Low Immediacy Instructor –Low immediacy students (Lo-Low)	1-Receive email with URL to questionnaire and URL to website #3 2-complete part 1 of questionnaire (pretest and demographics) 3-Go to URL and click play button to view machinima with high immediacy instructor and low immediacy students. 4-Complete part 2, 3 and 4 of questionnaire (posttest, instructor immediacy and social presence, and student immediacy and co-presence scales and survey)	1-Complete delayed posttest

APPENDIX G

SOCIAL PRESENCE INSTRUMENT

INSTRUCTOR SOCIAL PRESENCE

For each of the following statements please select the response which best represents your experience with the lesson you just watched. The instructor in this lesson…

1 = strongly disagree 2 3 4 5 = strongly agree

1. Engaged in exchange of ideas.
2. Confirmed students' understanding of concepts.
3. Expressed his emotions.
4. Was open and disclosed personality.
5. Asked questions.
6. Responded to others' comments.
7. Sustained discussion.
8. Created the feeling that students were part of a class community.
9. Referred to others by name.
10. Made students feel comfortable engaging in discussion.

APPENDIX H

DEMOGRAPHIC SURVEY AND PRETEST

1. Last name
2. First name
3. Age
4. Gender:
    - Female
    - Male

5. Ethnicity:
    - American Indian
    - African American
    - Mexican American
    - Other Hispanic
    - Asian
    - SE Asian
    - Pacific Islander
    - Filipino
    - White
    - Other/Not Stated
    - International

6. Have you previously taken courses where the instructor used online conferencing tools to have chats with the course participants?
    1. Yes
    2. No

7. Have you read the Current Psychological Perspectives section in the first chapter of your textbook?
    1. Yes
    2. No

The following items measure your prior knowledge of current perspectives in psychology. There is often some overlap in the views of psychologists representing different perspectives. In responding to these items, select the person or ideas most associated with the particular perspectives.

8. Which perspective views behavior as influenced by instinctive forces, inner conflicts, and conscious and unconscious motivations?
    - Psychodynamic
    - Behaviorist
    - Humanistic
    - Biological

9. Which perspective is most associated with the view that behavior is shaped by external stimulus conditions?
    - Psychodynamic
    - Behavioristic

- Humanistic
- All of the above

10. _____ is considered the founder of the psychodynamic perspective.
    - B. F. Skinner
    - John Watson
    - Carl Rogers
    - Sigmund Freud

11. The term psychoanalysis refers to:
    - A method for treating patients by training them to avoid negative reactions to disturbing stimuli and by emphasizing positive rewards.
    - 'Talk therapy' in which patients share their thoughts and feelings and analyze them with the therapist.
    - An approach to psychology which emphasizes the logical analysis of past associations between stimuli and consequences.
    - None of the above.

12. During a recent plane trip you met a psychologist who says her current project involves analyzing the way killer whales at Sea World respond to fish fed to them after they perform acrobatic maneuvers. Her perspective is mostly likely to emphasize methods associated with the:
    - Psychodynamic perspective
    - Evolutionary perspective
    - Behaviorist perspective
    - Biological perspective
    - None of the above

13. 'Operant conditioning' is most often associated with theories that emphasize that behavior is influenced by:
    - Consequences of past actions and behaviors.
    - Childhood conditions and relationships with parents or family members.
    - Innate tendency of humans to search for ways to realize their full potential whatever their conditions.
    - Inherited psychological traits operating in fixed conditions.
    - None of the above.

14. According to the psychodynamic perspective, behavior is:
    - Guided by rational analysis of stimulus or environmental dynamics.
    - Dependent on abilities to consciously recognize how consequences are related to environmental conditions or stimuli
    - Influenced by unconscious wishes and desires.
    - Shaped by the dynamics of natural selection.
    - None of the above.

APPENDIX I

IMMEDIACY INSTRUMENT

INSTRUCTOR IMMEDIACY

For each of the following statements please select the response, which best represents your experience with the lesson you watched. The instructor in this lesson...
0 = never 1 2 3 4 = often

1. Uses personal examples or talks about experiences he has had outside of class.
2. Asks questions or encourages students to talk.
3. Gets into discussions based on something a student brings up even when this doesn't seem to be part of his lecture plan.
4. Uses humor in class.
5. Addresses students by name.
6. Invites students to have conversations before or after class.
7. Refers to class as 'our' class or what 'we' are doing.
8. Provides feedback on student work, comments, discussions, etc.
9. Calls on students to answer questions even if they have not indicated that they want to talk.*
10. Asks how students feel about an assignment, due date, or discussion topic.
11. Invites students to telephone or meet with him outside of class if they have questions or want to discuss something.
12. Asks questions that solicit viewpoints or opinions.
13. Praises students' work, actions, or comments.
14. Has discussions about things unrelated to class with students.
15. Is addressed by his name by the students.
16. Sits motionless-still while teaching.*
17. Gestures while talking to class.
18. Uses monotone-dull voice while talking to class.*
19. Looks at the class while talking.
20. Smiles at the class as a whole, not just individual students.
21. Has a very tense body position while talking to the class.*
22. Moves upper body while teaching.
23. Appears to read notes while talking to the class.*
24. Has a very relaxed body position while talking to the class.
25. Smiles at individual students' comments in the class.
26. Uses a variety of vocal expressions while talking to the class.

*Presumed to be nonimmediate. Items reverse coded for analysis.