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Synthesizing Presence: A Multidisciplinary Review of the Literature

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Abstract

This multidisciplinary literature review analyzed one hundred and eight peer-reviewed journal articles focusing on presence from four academic disciplines: Mass Communication, Human-Computer Interaction, Education, and Psychology. It was conducted because there was a need for a comprehensive, integrated understanding of presence. Results strongly indicate that presence includes both objective and subjective criteria, and thus should be measured in both ways. Results also showed that the different academic disciplines approach the concept in similar, yet distinct ways. These similarities and differences also gave the researchers the necessary content to create a presence ontology. Future researchers are encouraged to use these results and ontology as a starting point for formulating research questions that advance an understanding of presence.

Keywords: Presence; Mass Communication; Human-Computer Interaction; Education; Psychology

Synthesizing Presence: A Multidisciplinary Review of the Literature

Motivation

A multidisciplinary approach can help integrate knowledge of a concept, especially when the topic is considered too vast and complex to be dealt with by the knowledge and tools of a single discipline. Literature reviews on presence have tended to arise from within single disciplines, giving the perspective of just that particular area (Biocca, Harms, & Burgoon, 2003; Gaver, 1996; Klimmt & Vorderer, 2003; Lee, 2004; Lombard & Ditton, 1997; Nash, Edwards, Thompson, & Barfield, 2000; Riegelsberger, Sasse, & McCarthy, 2005; Shin, 2002; Thurmond & Wambach, 2004; Tu, 2000; Wallace, 2003). These reviews provide a good overview of the breadth and depth of the literature on presence in their specific academic fields. However, there is a need for a review of the presence literature that synthesizes the perspectives on presence within multiple disciplines. We reviewed research on presence in these fields to synthesize the definitions, theoretical foundations, and applications of presence. Through this synthesis, we offer new observations on presence from a multidisciplinary perspective.

Related Research on Presence-based Ontologies

There have been a small number of approaches to generating a shared conceptual knowledge framework (i.e. ontology) for presence. Sheridan (1999) examined the philosophical aspects of the experience of virtual and "real" reality and specifically from the perspectives of Descartes, Heidegger, and Gibson. He then applied estimation theory to answer the question: "How much happens in the head and how much is 'out there'?" (Kalman, 1960). He reaches a single conclusion: When looking at the concept of presence, there is ambiguity of causality between humans and the environment. As a result, we should focus on studying the feedback loop between humans and the environment, not what caused what. In reality, this is not really the creation of an actual ontology, but an attempt to apply the theory of estimation, an information processing technique, to the concept of presence.

Another discussion of ontology was put forth by Mantovani and Riva (1999; 2001). The main thrust of their piece was how different ontologies generate different criteria for presence. They compare and contrast ingenuous realism (Zahoric and Jenison, 1998), Heidegger, Gibson,

and social constructionism (Vygotsky, 1978). Mantovani and Riva define reality as a "relational space, a place held in common by both environment and mind" (2001). They also argue for a social constructionist position, and state that presence means that individuals can perceive themselves, objects, and other people not only as situated in an external space but also as immersed in a socio-cultural web connecting objects, people, and their interaction (1999).

Floridi (2005) attempts to further develop the ideas put forth by Mantovani and Riva (1999; 2001), suggesting that the common way of understanding presence is primarily Cartesian in nature and what really matters in looking at the concept of presence is the occurrence and flow of information. He suggests that something is present if it is successfully observed in a remote space of observation, either as a passive bearer of specific properties (for example, like a cement block), or as a dynamic source of action/interaction. The suggested ontology changes the perspective of presence from a subjective assessment of an experience (Sheridan, 1999; 2001), to an external and objective evaluation. Adopting this methodology also allows for a more specific development of ontology, while avoiding any qualitative description based on subjective experience.

These attempts at ontology development were crucial to the development of our own ontology of presence. We have taken an inductive approach to an ontology based on a survey of the presence literature. While surveying this literature, we build an ontology whose nodes and links are formed as a direct result of the review process. The next section describes our methods in doing so.

Method

Following Boote and Beile (2005) who recommend a thorough understanding of past studies prior to any new research, as well as Rogers' directive to scholars to periodically assess the status of research in their respective fields (1985), we conducted a comprehensive literature review to advance a multidisciplinary understanding of presence. We compared and contrasted the definitions of presence, identified commonalities, synthesized these definitions, and produced an ontology presented here. Following the sampling and selection of articles, a 'propositional inventory' was constructed (Rogers, 1985) in order to synthesize general conclusions from the written conclusions of original studies (Rogers, 1981). This propositional inventory aided in the

examination of the state of presence from a multidisciplinary perspective.   A spreadsheet was developed to record data from every article on author, title, journal name and issue, theory used, method, dependent and independent variables, measures utilized, findings, and definitions used and derived. After gathering this information, a search was conducted for common ground as well as gaps in the literature, to identify what methods were or were not being used, and where future contributions might lie. This method aligned with the principle Rogers posited that researchers spend too little time examining the state of their fields as a whole.

Sample

The academic fields of Human-Computer Interaction, Mass Communication, Psychology, and Education were selected for this literature review on the subject of presence, primarily because of the large number of research studies and theory-based discussions published in each field. Narrative psychology was selected as a subset of psychology because of the roots of discussions of presence and related theoretical concepts that predate virtual environments. Studies of presence found in other fields were consolidated into one of the fields mentioned above. For example: studies on presence from Sociology and Business were consolidated into the Psychology discipline based on connections to social psychology. Studies from the disciplines of Theatre, video, and film were consolidated into the Mass Communications discipline because of their common affinity.

An extensive search was carried out to locate journal articles in the fields of Mass Communication, Human-Computer Interaction (HCI), Education, and Psychology. Terms used to search for these articles were combinations of the following: presence, social presence, physical presence, cognitive presence, education, learning, teaching, mass communications, psychology, sociology, literature, and narrative. Databases searched were Education Full Text, ERIC, EBSCOHOST, PsychInfo, Academic Search Premier, Business Source Premier, Google Scholar, JSTOR, OmniFile Full Text Mega (WilsonWeb), and Web of Knowledge. Studies that resulted from this search were narrowed down by using the following criteria: a) They had to be published no earlier than 1990, b) Journal articles had to have gone through a peer-review process and c) Articles should be of impact to others. Impact was defined as peer-reviewed journal articles that have been cited at least 20 times and books that have been cited at least 100

times were selected, and the articles and books must have been published between 1990 and 2010. This time range was selected because the investigation of the topic of presence has grown rapidly from around 1990 to the present. A few peer-reviewed journal articles with fewer citations were selected if they were written by a well-known researcher on the topic of presence and published towards the end of the sampling frame (2009 or 2010). A well-known researcher was defined as a person who has published five or more peer-reviewed articles on presence research, with each article having been cited more than twenty times. Dissertations and unpublished papers were excluded, with some noted exceptions that were included due to the high number of citations (over 100). The authors of these articles examined different audiences and presented widely differing approaches to the meaning, measurement, and study of presence among these different subject groups. From this selection process, 97 articles were chosen which dealt substantively with presence (see Table 1 for a breakdown by academic field). An article was assigned to a particular field based on first author affiliation. The criteria stated above assured that the works reviewed were a) representative of works in the different fields, b) have been central or pivotal to the topic area, and/or c) initiated a line of investigation or thinking.

Table 1. *Breakdown of Articles by Academic Field*

Academic Field	Number of citations
Mass Communications	24
HCI	27
Education	22
Psychology	24
Total	97

Definitions of Presence across Disciplines

Mass Communication and Presence

Mass communication is the academic discipline that studies how individuals and groups convey information through mass media to sizeable portions of the population. Presence research in this academic discipline falls under effects research. Seminal descriptions of presence in mass communications define it as "…an experience in a virtual world that comes from feeling like you exist within but as a separate entity from a virtual world that also exists'' (Heeter, 1992, p. 263;

2003) and as a "perceptual illusion of no mediation" that occurs "when a person fails to perceive or acknowledge the existence of a medium in his/her communication environment and responds as he/she would if the medium were not there" (Klimt & Vorderer, 2003; Lombard & Ditton, 1997; Lombard et al, 2000). In other words, presence is a subjective, personal measure of the extent to which and the reasons why one feels like he/she is in a virtual world.

Presence is described subjectively through a focus on the different sensations a virtual environment (VE) provides to convince people that they are "present" (Heeter, 1992). Engagement (Lessiter et al, 2001), cognitive involvement (Vorderer et al., 2004), attention (Ravaja, 2004), and a phenomenal sense of "being there" (Biocca et al, 2001; Schneider, 2004; Vorderer, 2001) have all been described as important contributors to a subjective description of presence in this field. Reiner (2004) provides a technical explanation of this subjective experience by defining presence as a sense of resonance between an individual's cognitive system and the VE.

A focus of presence research in the field of mass communications is its sentient aspect. Sentient presence (SP) is the sense of "being there" with animate objects (people, cartoon characters, anything that pretends to have feelings and possesses intelligence at some level). In contrast, a general definition of non-sentient presence (NSP) is the "sense of being there" within an environment. In communication theory, SP is defined as the "degree of salience of the other person in a mediated communication and the consequent salience of their interpersonal interactions" (Short, Williams & Christie, 1976, p. 65). A minimum level of SP occurs when users feel that a form, behavior, or sensory experience indicates the presence of a different intelligence. The amount of SP experienced depends upon the degree to which a user feels access to the intelligence, intentions, and sensory impressions of another (Biocca, 1997).

Human-Computer Interaction

HCI is the study of interaction between people and computers (Sears & Jacko, 2007). With its focus on the design and creation of technology interfaces as well as their impact on society and individuals, HCI has concentrated research on the technical aspects of presence in both SP and non-sentient presence. A general definition of non-sentient presence (NSP) is the "sense of being there" within an environment. Early HCI definitions describe NSP simply as the sense of being

there, or the degree to which participants feel that they are somewhere other than where they physically are when they experience the effects of a computer-simulation (Bystrom, Barfield & Hendrix, 1999; Durlach & Slater, 2000; Meehan, 2002; Schuemie et al, 2001; Witmer & Singer, 1998). Presence is a sense of being that individuals receive from the perception of their physical environment through automatic and controlled mental processes (Barfield & Weghorst, 1993; Barfield, Sheridan, Zeltzer, & Slater, 1995; Isgro et al, 2004; Nash et al, 2000; Steuer, 1992). Presence in HCI has also evolved to include the concept of phenomenological transference, yet possessing a more concrete nature. Presence became characterized as transportation: people are considered present in a VE when they report a sensation of being inside the virtual world (Schuemie et al, 2001).

The other side of the sensation or experience of presence for HCI is the quantifiable aspect of immersion (Schubert, Friedmann & Regenbrecht, 2001). Slater and Wilbur (1995) defined immersion via aspects of display technology consisting of the following constructs:

1. Inclusiveness: The degree to which the stimuli from the real world are excluded from the user (Meehan, 2002 – measures of stress; Slater & Steed, 2000 - attention).
2. Extensiveness: The number of sensory modalities accommodated by the system. This includes tactile (Basdogan et al., 2000), olfactory and audio (Dinh et al., 1999), body movement (McCarthy & Maringelli, 1998) and emotions (Nasoz, et al., 2004).
3. Surrounding: Increasing the field of view to create a panorama
4. Vividness: The resolution of the displays (Ijsselsteijn et al, 1998)

HCI's main contribution to an understanding of NSP has been a thorough exploration of the multitude of technological factors that contribute to immersion. This has been accomplished through multiple studies of how different technologies affect presence.

In the field of HCI, SP is often reserved for the sense of being together with others in a virtual world (Isgro et al, 2004; Pertaub, Slater, and Barker, 2002; Riegelsburger et al., 2005). HCI borrows from Mass Communications, defining SP as the "degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships" (Short et al., 1976, p. 65). It is also defined by Casanueva and Blake (2001) as the user's sense that (1)

there are other participants existing in the VE, and (2) he or she is having interaction with real people (Nasoz et al, 2003).   HCI research focuses on the exact configuration of technical conditions that can be used to achieve optimal presence and SP in a particular simulation, as well as attempting to measure any quantifiable effects of presence on individuals and groups. Applications of presence research in HCI often focus on the relationship between presence and task performance (i.e. Dorval & Pepin, 1986; Greenfield, Brannon & Lohr, 1994; Mania et al, 2003; Mania & Chalmers, 2001).   HCI definitions of presence emphasize the technical aspects of the environment that can be used to produce the subjective sensation of being in another place, with other people.

Education

Education includes the teaching and learning of knowledge and skills to a wide variety of audiences and the field's scholars pursuing research that benefits the training of teachers and learning of students.   In defining presence, the discipline borrows broadly from Mass Communications and Psychology. The resulting definition describes NSP as occurring when we are immersed in a very high bandwidth stream of sensory input, organized by our perceiving systems, and out of this "bath of sensation" emerges our sense of being in and of the world (Jelfs & Whitelock, 2000; Roussos et al, 1999; Whitelock et al, 2000).   Education primarily focuses on the construct of SP in its research and writings.   SP has been found to be a factor of both the medium and the participants (Moreno & Mayer, 2004; Wallace, 2003). Different media afford different opportunities for intimacy and immediacy, and participants take up those opportunities differently.   For example, Tu (2000) examines the significance of social factors that affect communication and learning in online environments (Feenberg, 1989; Hackman & Walker, 1990; Lea, 1992; Sanders & Wiseman, 1990; Walther, 1992, 1996).   He explores the role of SP in distance education, and discovered that increased SP in online distance education environments will lead to an increase in learning (see also Richardson & Swan, 2003).   The feeling of community that a learner experiences in an online environment is described as a sense of intimacy and immediacy (Tu & McIssac, 2002).   Some scholars (Kimmerle & Cress, 2008; Kreijns, Kirschner, Jochems, and Buuren, 2004; Thurmond & Wambach, 2004) converge on the aspect of sense of awareness of other individuals in the learning environment as "real" physical

people.   It is the ability of participants in a community to project themselves socially and emotionally, as "real" people, through the medium of communication being used (Garrison et al., 2000).   As such, SP is evidenced in critical, practical inquiry that focuses on higher order thinking processes as opposed to specific individual learning outcomes (Garrison et al., 2004; Wallace, 2003).

SP has also been characterized as a sense of being in a place and belonging to a group (Picciano, 2002). It is a student's sense of being in and belonging in a course and the ability to interact with other students and an instructor, although physical contact is not available. Shin (2002) terms this "transactional presence," or the degree to which a distance student perceives the availability of, and connectedness with, other parties involved in a given distance education setting. The concept of presence has been discussed in education before the popularization of the Internet, although not always using the exact terminology. Moore (1993) researched what he called "transactional distance" or the cognitive space between learners, teachers and content in a distance education setting. Transactional distance is a function of dialogue and structure in distance learning. Distance decreases with dialog and increases with structure so that a classroom with high interaction and less rigid format will be more engaging to learners. SP, or the sense of being together in an online learning environment, decreases this transactional distance by increasing dialogue (sense of togetherness). NSP (sense of being there physically) acts to decrease structure and thus transactional distance.

Education-related presence research focuses on determining the effect of presence on retention, transfer, and task performance. Romano and Brna (2001) found a direct relationship between increased presence in a VE and an increase in spatial learning. Additionally, increased presence appears to be related to an increase in cultural learning in terms of vocabulary, listening skills, and cultural sensitivity (O'Brien & Levy, 2008). The field of Education focuses primarily on SP and defines it in terms of its effects on learning outcomes.

Psychology

Psychology is the study of mental functions and behavior (Gray, 2010). In this field, researchers of presence began with roughly the same definition as those in other fields (i.e. a sense of being there; Vincelli, 1999; Loomis, 1999), describing presence as the experience of "being there," in a

particular environment by means of a communication medium (Draper, Kaper & Usher, 1998; Riva, 1999, 2000, 2002).   Presence roughly measures how real an individual perceives a mediated environment to be in terms of nonverbal behaviors, physiological responses, and other measures (Yee, Bailenson, Urbanek, Chang & Merget, 2007).   Two key characteristics of VEs are disappearance of mediation—a level of experience where both the VE system and the physical environment disappear from the user's phenomenal awareness—and the sense of community developed by interaction, leading to increased sensation of presence (Riva, Molinari & Vincelli, 2002).

Psychological researchers primarily focus on determining the psychological processes that underlie presence.   For example, Rothbaum, Hodges, Watson, Kesslerb and Opdyke (1996) and Rothbaum et al. (1999) found that in order for virtual reality (VR) exposure therapy to be effective, it must activate the fear structure and elicit fearful responses – which require a sense of presence (see also Rothbaum & Hodges, 1999).   Additionally, Waterworth and Waterworth (2001) attempt to determine the direct perceptual processes involved in the experience of presence.   They explicate three dimensions of NSP: the focus of attention (between presence and absence), the locus of attention (the virtual vs. the physical world), and the sensus of attention— the level of arousal determining whether the observer is highly conscious or relatively unconscious while interacting with the environment (Waterworth et al., 2001).   NSP is defined as "a psychological state in which virtual objects are experienced as actual objects in either sensory or nonsensory ways" (Lee, 2004).   Also, this means that individuals can perceive themselves, objects, and other people not only as situated in an external space but also as immersed in a socio-cultural web connecting objects, people, and their interactions (Mantovani & Riva, 1999).

SP seems to concentrate on the psychological processes inherent in the moment-by-moment awareness of the presence of another individual accompanied by a sense of engagement (Bailenson et al, 2008). Bailenson et al (2005) and Bailenson, Blascovich, Beall and Loomis (2001) further this definition by explaining that SP can be experienced with both people and embodied agents.   Embodied agents are "digital representations of computer programs that have been designed to interact with, or on behalf of, a human" (Bailenson et al, 2005, p. 379).   They explain that an indicator of SP is when people treat embodied agents as if they were actually real. As anthropomorphism of these agents or avatars increases, SP increases (Bailenson, et al., 2001).

Additionally, as rendered head movement increases, looking at another avatar's head, affection for each other, and SP all increase (Bailenson, Beall & Blascovich, 2002).

Psychology appears to cultivate an understanding of SP in terms of its impact on human behavior and interaction. Indeed, it appears to define SP by the mental or behavioral "impressions" or marks left by others in interactions (Ahmed, 2004). SP occurs when, in each other's presence, individuals share a joint focus of attention, perceive that they do so, and are metacognitive of their perceptions (Goffman, 1983). SP is defined here as consisting of two dimensions: a) as a mode of being with others, and b) as a sense of being with others (Zhao, 2003).   This line of research examines social interactions and impressions in order to determine their nature and persistence. It also seems to place an emphasis on mutual awareness between individuals such that we live "in the minds of others, resulting in a single focus of thought and attention" (Scheff, 2007). SP, then, is dependent on mutual awareness, as well as what is defined as "reciprocity," or "the reciprocal influence of individuals upon one another's actions when in one another's immediate physical presence (Waksler, 2006).

The saliency of others is a characteristic that is much discussed in the field of psychology. According to social facilitation theory, when we are alone, we tend to be more relaxed, less concerned with our behavior, and are basically ourselves (Guerin, 1993). Research has found that when others are present, our level of arousal is increased (Zajonc, 1965) and because of this, we tend to perform better at tasks that are well learned or simple (Guerin, 1993). Various explanations exist for social facilitation effects. A meta-analysis of over 240 studies concluded that the presence of others increases performance on simple tasks and decreases it on complex tasks (Hall & Henningsen, 2008; Bond & Titus, 1983). The meta-analysis supports SP as the primary explanation for social facilitation.

Psychology-related presence research appears to focus on determining the psychological processes which underlie physical and SP. It defines presence as the experience of "being there" in an environment by means of a communication medium, and SP in terms of its impact on human behavior and interaction.

Narrative Psychology

Narrative Psychology is, "…a viewpoint or a stance within psychology which is interested in the "storied nature of human conduct" (Sarbin, 1986) -- how human beings deal with experience by constructing stories and listening to the stories of others." (Hevern, 2004).The concept of presence has been discussed in stories for centuries, although often under different terminology such as transportation, immersion, and engagement (Gerrig, 1993). Modern discussions speak of how a reader of a book can be phenomenally transported to the narrative environment created by the medium (Gaver, 1996; Gerrig, 1993). Specifically, Gerrig's theory of "being transported" includes the following propositions:

1. Someone ("the traveler") is transported
2. By some means of transportation
3. As a result of performing certain actions
4. The traveler goes some distance from his or her environment of origin
5. That makes some aspects of the environment of origin inaccessible.
6. The traveler returns to the environment of origin, somewhat changed by the journey. (Gerrig, 1993, pp. 10-11).

This emphasis on the story, plot, or content being experienced is a unique contribution of the field of narrative psychology to the concept of presence. This sense of being transported is present in most media yet varies in strength from medium to medium (i.e. books, movies, VEs). For example, VEs tend to involve a much more active immersion than the suspension of disbelief and surrender of a traditional narrative experience (Bizzocchi & Woodbury, 2003).

Additionally, narrative psychology examines how the addition of others into an environment with an individual transforms solitary action into "situated" conduct (Goffman, 1983; Smith, 2006). Smith (2006) suggests that interaction is at the heart of SP (see also Wellman et al, 1996). He also suggests that SP can only be defined through the lens of interaction. Bregman and Haythornthwaite (2003) explore the contribution of interaction-based SP to the building of an online, distributed learning community. Their conversation analysis reveals that understanding local patterns of communication purpose and form was a key to learning how to operate in this environment. They conclude that SP acts to enhance the

transportation aspect of presence by bringing participants together into a shared space. They also suggest that SP gives a sense of immediacy and an enhanced sense of community for students. Zitzen and Stein (2004) explore the extent to which older literature genres or text types exist across media boundaries, and the conditions of SP that occur in new forms of media. While it is clear that there are new types of Internet-based communication like Multi User Virtual Environments (MUVEs) or Massively Multi Player Online Role Playing Games (MMORPGs), it is less clear whether there is continuity between traditional spoken and written genres. The authors explore the question for spoken conversation and the text chat. They examine the degree to which pragmatic, social, and discourse properties typical of oral conversation are present or not in chat. They also discuss the way the specific shape of these dimensions is explained by the physical and technical circumstances, and the SP conditions following from Internet chat. In particular, they examine parameters such as turn taking, the notion of speaker-hood, the role of silence, and nascent norms in these areas.

Narrative psychology-related presence research appears to focus on the content, plot, or story being experienced. It defines presence as transportation into the content, plot, or story and focuses its attention on the interactional nature of SP. Now having presented the varying definitions of presence across disciplines, a synthesis of the literature is offered.

Synthesizing the Literature: Reaching a Common Definition of Presence

Two things were accomplished when conducting this literature review. First, we learned that presence is treated differently depending on discipline, and, second, that these differences and some similarities can be combined into an ontology to form a new multidisciplinary understanding of presence. The following sections address each of these concerns.

Synthesis of Literature concerning Non-Sentient Presence

Due to the interdisciplinary nature of this research and of the concept of Non-Sentient Presence (NSP), our synthesized definition will include both measurable and non-measurable (i.e. philosophical) aspects. Leaving out the philosophical parts would eliminate entire academic fields from consideration, which would make the point of this literature review moot. As a result, although it is impossible to create a concise definition that comprises all of the above explication,

the following is our attempt. NSP is a subjective, personal measure of the extent to which and the reasons why one feels like he/she is in a virtual world (Communications). It is the "sense of being there" within an environment, or the degree to which participants feel that they have been transported to somewhere other than where they physically are when they experience the effects of a computer-simulation (HCI; Bystrom, Barfield & Hendrix, 1999; Durlach & Slater, 2000; Meehan, 2002; Schuemie et al, 2001; Witmer & Singer, 1998). NSP occurs when a person is immersed in a very high bandwidth stream of sensory input, organized by our perceiving systems, and out of this "bath of sensation" emerges our sense of being in and of the world (Education; Jelfs & Whitelock, 2000; Roussos et al, 1999; Whitelock et al, 2000). It is also, "a psychological state in which virtual objects are experienced as actual objects in either sensory or nonsensory ways" (Psychology; Lee, 2004, p. 27).

In the field of HCI, NSP has been thoroughly explored through the multitude of technological factors that contribute to immersion. In education, it has been examined in relation to how it acts to decrease structure and thus transactional distance in online learning.   In psychology, NSP roughly measures how real an individual perceives a mediated environment to be in terms of nonverbal behaviors, physiological responses, and other measures (Yee, Bailenson, Urbanek, Chang & Merget, 2007), and psychological researchers primarily focus on determining the psychological processes that underlie presence.   Additionally, narrative psychology emphasizes the story, plot, or content being experienced.

Synthesis of Literature concerning Sentient Presence

With the above discussion about the interdisciplinary nature of this research in mind, the following is our attempt at a definition that comprises the preceding explication of sentient presence. Sentient presence (SP) is defined as the "degree of salience of the other person in a mediated communication and the consequent salience of their interpersonal interactions" (Communications; Short, Williams & Christie, 1976, p. 65). Therefore, the amount of SP is the degree to which a user feels access to the intelligence, intentions, and sensory impressions of another (Communications; Biocca, 1997). SP is also reserved for the sense of being together with others in a virtual world (HCI; Isgro et al, 2004; Pertaub, Slater, and Barker, 2002; Riegelsburger et al., 2005). It has also been characterized as a sense of being in a place and

belonging to a group (Education; Picciano, 2002).   It is a student's sense of being in and belonging in a course and the ability to interact with other students and an instructor, although physical contact is not available (Education). Psychology appears to cultivate an understanding of SP in terms of its impact on human behavior and interaction.   Indeed, it defines SP by the mental or behavioral "impressions" or marks left by others in interactions (Ahmed, 2004).   In other words, SP focuses on the saliency of others (Goffman, 1983).

HCI research focuses on the exact configuration of technical conditions that can be used to achieve optimal presence and SP in a particular simulation, as well as attempting to measure any quantifiable effects of presence on individuals and groups.   In Education, SP has been found to be a factor of both the medium and the participants (Moreno & Mayer, 2004; Wallace, 2003). It is also evidenced in critical, practical inquiry that focuses on higher order thinking processes as opposed to specific individual learning outcomes (Garrison et al, 2004; Wallace, 2003), decreases the transactional distance between instructor and student by increasing dialogue (Education). SP seems to concentrate on the psychological processes inherent in the moment-by-moment awareness of the presence of another individual accompanied by a sense of engagement (Bailenson et al, 2008). Narrative psychology focuses on interaction, examining how the addition of others into an environment with an individual transforms solitary action into "situated" conduct (Goffman, 1983; Smith, 2006).

Toward a multidisciplinary understanding of presence: An Ontology

The second result of this literature review was the following ontology of SP and NSP (see Figures 1(a) and 1(b)). The concepts of SP and NSP are better comprehended from a discussion of immersion and interaction. There are two kinds of immersion: physical and mental (Sherman & Craig, 2003). Physical immersion is passive involvement with physical human-computer interface software or hardware devices (Basdogan et al, 2000; Biocca et al, 2001; Biocca et al, 2003; Cho et al, 2003; Garau et al, 2005; Gerhard et al, 2001; Ijsselsteijn et al, 1998; Isgro et al, 2004; Nasoz et al, 2004; Larsson et al, 2001; Mania & Chalmers, 2000; Mania et al, 2003; Meehan, 2000, 2002; Nichols et al, 2000; Schneider, 2004; Slater et al, 2004; Schuemie et al, 2001; Scott & Timmerman, 1999; Turner et al 2003). Mental immersion is a feeling of transportation or "going there". Examples of "pure" mental immersion would be a dream, pure

imagination, and a divine experience (Gadamer, 2000; Lee, 2004; Mania & Chalmers, 2001; Nash et al, 2000; Reiner, 2004; Schubert et al, 2001; Slater & Steed, 2000). Mental immersion and physical immersion are complemented by each other (Sherman & Craig, 2003). Thus, in an experimental sense, physical and mental immersion represents both the independent and dependent variables respectively.

There are also two kinds of interaction: physical and mental. Physical interaction is the actual movement of the body within the virtual space: typing, moving a mouse, moving one's head, touching a physical surface, walking, driving, cycling, flying, etc. (Biocca, 1997; Jelfs & Whitelock, 2000; Klimmt & Vorderer, 2003; Li et al, 2003; Lessiter et al, 2001; Lombard et al, 2000; Ravaja, 2004; Romano & Brna, 2001; Riva, 1999, 2000, 2002; Riva et al, 1997; 2002; Slater, 2004; Tamborini & Skalski, 2005; Vorderer, 2001). Viewing a painting is a weak form of physical interaction (eye, head, simple body movement). Using a head mounted display with haptic feedback is a higher level of physical interaction. Physical interaction also has a positive relationship with SP and NSP (Jelfs & Whitelock, 2000; Kiousis, 2002; Lombard & Ditton, 1997; Nash et al, 2000; Nasoz et al, 2003; Reiner, 2004; Riva, 1999, 2000, 2002; Riva et al, 2002; Rourke, Anderson, Garrison & Archer, 1999; Schubert et al, 2001). Mental interaction is defined as interaction with others (Ahmed, 2004; Bailenson et al, 2002; Cyr et al, 2007; Goffman, 1983; Heeter, 1992, 2003; Krauss et al, 2001; Nasoz et al, 2004; Pertaub et al, 2002; Riva, 1999, 2000, 2002); interaction with the environment (Bystrom et al, 1999; Freeman et al, 2000; Heeter, 1992, 2003; Kiousis, 2002; Murray et al, 2000; Slater et al, 1998; Vincelli, 1999; Witmer & Singer, 1998); and the effect or sway of others (Bente et al, 2008; Kimmerle & Cress, 2008; Kreijns et al, 2004; Riegelsberger et al, 2005; Short et al, 1976; Wallace, 2003; Tu, 2000). Mental interaction also has a positive relationship to SP. Mental and physical interactions are enhanced by one another.

SP produces a relational togetherness, or "esprit de corps" (Bailenson et al, 2001; Bailenson et al, 2005; Biocca, et al, 2003; Durlach & Slater, 2000; Garau et al, 2005; Isgro et al, 2004; Moreno & Mayer, 2004; Wellman et al, 1996; Wrench et al, 2007; Zhao, 2003). It also produces a connectedness into a community of practice (Rourke et al, 1999; Tu & McIsaac, 2002; Shin, 2002; Thurmond & Wambach, 2004; Picciano, 2002; Garisson et al, 2000, 2004). NSP produces experiences of flow (Csiksentmihalyi, 1975, 1990; Csiksentmihalyi & Rathunde,

1993) and contemporaneity (Gadamer, 2000). Hypothesized (but unproven) relationships may exist between flow and communities of practice; flow and relational togetherness; contemporaneity and communities of practice; contemporaneity and relational togetherness; and communities of practice and relational togetherness.

Other attempts at ontology cited above (Sheridan, 1999, 2001; Mantovani & Riva, 1999, 2001; Floridi, 2005) were based on various theoretical frameworks. They examined philosophical ideas from Heidigger, Gibson, and Descartes, and attempted to apply engineering estimation theory and information ethics. None appeared to review scholarly literature and attempted to develop an ontology from a systematic literature review process. As a result, it is difficult to compare and contrast such widely divergent approaches to ontology. Upon further review, it appears that the pieces by Sheridan (1999, 2001), Mantovani and Riva (1999, 2001) and Floridi approach ontology development with the primary purpose of making domain assumptions specific. This is especially evident in their attempts to impose differing theoretical perspectives onto domain specific knowledge. On the other hand, our attempt at developing an ontology was to share common understanding of the structure of information about presence among presence researchers. Both purposes are appropriate and result in divergent outcomes. Figure 1 and the above explanation provide a good beginning at sharing and annotating information on presence to researchers from various academic disciplines.
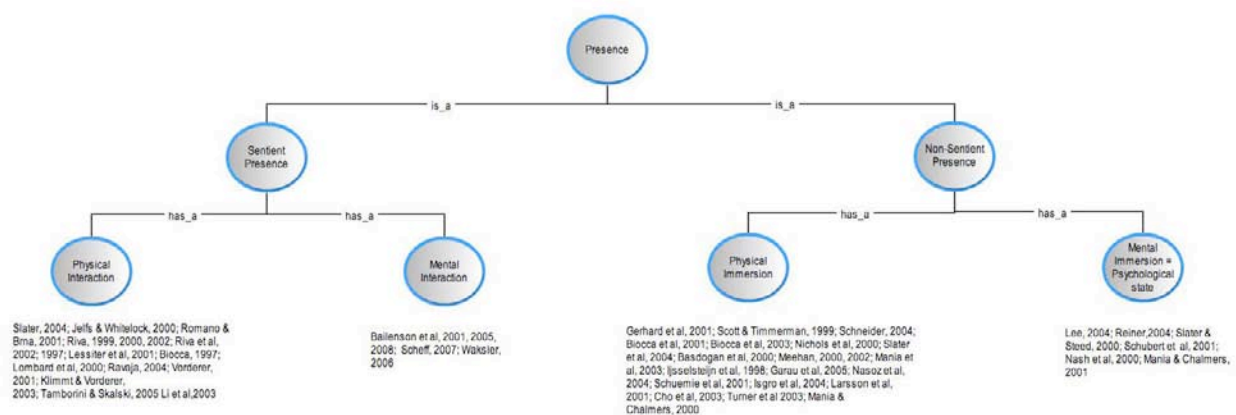
Figure 1: **A Simple Ontology of Presence**
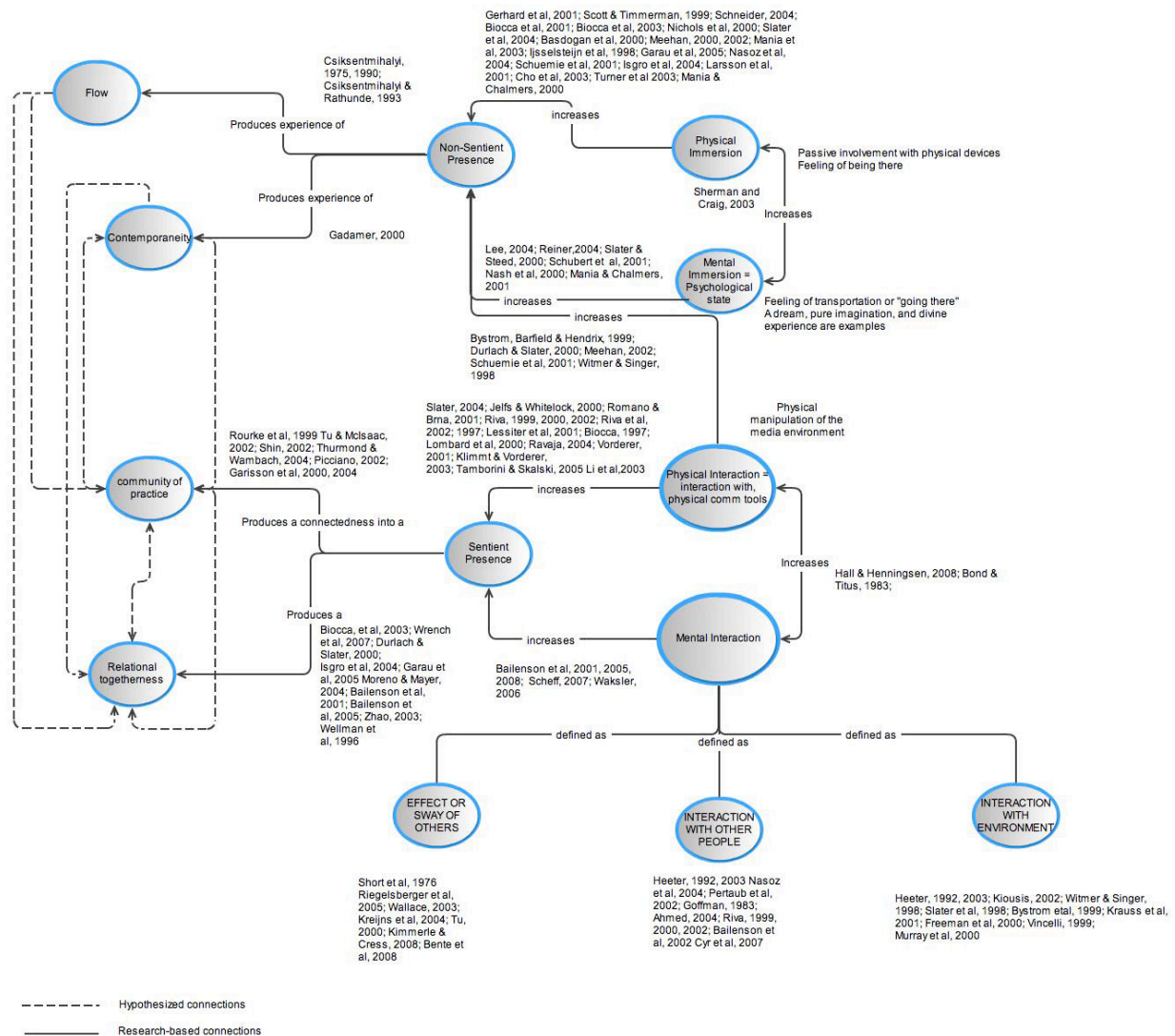
Figure 2: **A Descriptive Ontology of Presence**

Implications and Conclusion

Due to the lack of multidisciplinary literature reviews on the concept of presence, there remained a need to examine how presence was viewed from this perspective. This article has sought to synthesize the understandings of presence from the academic disciplines of Mass Communications, HCI, Education, and Psychology. It utilized Rogers' propositional inventory to meld definitions of presence into multidisciplinary understandings of sentient and non-sentient presence. One of the points of this paper is that a connecting definition of SP and NSP will drive

research in all academic fields, because it will help everyone understand what has been done, and where gaps exist in the research. Enough overlap exists between fields to speak to the diversity of presence research and what is and is not being researched in different fields.

Taken together with the above-synthesized definitions, the described ontology should help produce a single interrelated concept from the multiple academic perspectives. The first area in which this unifying of perspective has occurred is in the definitions of SP and NSP. This ontology is a beginning that we hope will:

1. Create greater awareness of presence among scholars and encourage its use in research studies;

2. Stimulate more discussion on the definition of presence and result in a greater multidisciplinary understanding of the concept;

3. Promote the use of these synthesized definitions in future presence-related research, resulting in common operational definitions and higher quality studies with the potential for meaningful outcomes regardless of discipline;

4. Encourage further discussion of the various dependent and independent variables, and outcomes that span these different academic disciplines;

5. Encourage more multidisciplinary research grounded in presence theory.

6. Increase discussion around the development of an ontology of presence.

We encourage the use of the synthesized definitions of NSP and SP on p. 13 and 14 going forward, as it serves all fields in the measurement and operationalization of presence. We also encourage the editing and modification to this ontology, as it will help all academic fields in their understanding of relevant variables and methods.

Finally, researchers from various academic disciplines could potentially utilize this ontology as a starting point to create an online presence codebook from which one could draw results from a number of different perspectives. For example, if a researcher from mass communications was interested in researching the effect of increased SP on VR TV viewing habits, he/she could access all of the work done on SP from this regularly updated codebook. If, however, a researcher from literature was interested in discovering the effect of narrative

interactions between characters in a virtual novel on user immersion, he/she could access the results in those specific cells. Using common definitions, this ontology would enable us to systematically approach and research nearly every aspect of SP and NSP. We would then have an invaluable tool that would list the variables and their values in a way that is helpful to researchers from different fields.

References

Aarts, E. and de Ruyter, B. (2009). New research perspectives on Ambient Intelligence. *Journal of Ambient Intelligence and Smart Environments, 1*, 5–14

Ahmed, S. (2004). Collective feelings: Or, the impressions left by others. *Theory, Culture and Society, 21 (2),* 25-41.

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

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

Bailenson, J.N., Beall. A.C., & Blascovich, J. (2002). Mutual gaze and task performance in shared virtual environments. *Journal of Visualization and Computer Animation*, *13*, 1-8.

Barfield, W., & Weghorst, S. (1993). The sense of presence within virtual environments: A conceptual framework. In G. Salvendy & M. Smith (Eds.)., *Human computer interaction: Software and hardware interfaces* (pp. 699-704). Amsterdam: Elsevier Science Publishers.

Barfield, W. Sheridan, T., Zeltzer, D. and Slater, M. (1995). Presence and performance within virtual environments. In W. Barfield and T. Furness (Eds.), *Virtual environments and advanced Interface design*, Oxford University Press.

Basdogan, C., Ho, C.-H., Srinivasan, M. A. & Slater, M. (2000). An experimental study on the role of touch in shared virtual environments. *ACM Transactions on Computer-Human Interactions, 7,* 443–460.

Bente, G., Rüggenberg, S., Krämer, N. C. & Eschenburg, F. (2008). Avatar-mediated networking: Increasing social presence and interpersonal trust in net-based collaborations. *Human Communication Research, 34,* 287-318.

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

Biocca, F., Kim, J., & Choi, Y. (2001). Visual touch in virtual environments: An exploratory study of presence, multimodal interfaces, and cross-modal sensory illusions. *Presence: Teleoperators & Virtual Environments, 10*(3)*,* 247-265

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

Bond, C. F., & Titus, L. J. (1983). Social facilitation: A meta-analysis of 241 studies. *Psychological Bulletin, 94,* 265–292.

Bregman, A. & Haythornthwaite, C. (2003). Radicals of presentation: Visibility, relation & co-presence in persistent conversation. *New Media and Society, 5*(1)*,* 117–140.

Bystrom, K-E., Barfield, W. & Hendrix, C. (1999). A conceptual model of the sense of presence in virtual environments. *Presence: Teleoperators & Virtual Environments, 8(2),* 241-244.

Casanueva, J. S. and Blake, E. H. (2001). The effects of avatars on co-presence in a collaborative virtual environment. Technical Report CS01-02-00, Department of Computer Science, University of Cape Town, South Africa.

Csikszentmihalyi, M. & Rathunde, K. (1993). The measurement of flow in everyday life: Towards a theory of emergent motivation. In J. E. Jacobs (Ed.), *Nebraska symposium on motivation, Vol. 40: Developmental perspectives on motivation* (p. 60). Lincoln: University of Nebraska Press.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience.* New York: Harper Collins.

Csíkszentmihályi, M. (1975). *Beyond boredom and anxiety*. San Francisco, CA: Jossey-Bass.

Cyr, D., Hassanein, K., Head, M & Ivanov, A. (2007). The role of social presence in establishing loyalty in e-service environments. *Interacting with Computers, 19,* 43-56.

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

Dinh, H. Q., Walker, N., Song, C. , Kobayashi, A. & Hodges, L. F. (1999). Evaluating the importance of multi-sensory input on memory and the sense of presence in virtual environments. *Proceedings of the IEEE Virtual Reality,* p.222, March 13-17, 1999.

Dorval, M., & Pepin, M. (1986). Effects of playing a video game on a measure of spatial visualization, *Perceptual and Motor Skills, 62,* 159-162.

Dunlap, J. C. & Lowenthal, P. R. (2009). Tweeting the night away: Using Twitter to enhance social presence. *Journal of Information Systems Education, 20*(2), 129-135.

Draper, J.V., Kaper, D.B., & Usher, J.M. (1998). Telepresence. *Human Factors, 40*(3), 354–375.

Durlach, N. & Slater, M. (2000). Presence in shared virtual environments and virtual togetherness. *Presence: Teleoperators & Virtual Environments, 9*(2), 214-217.

Edirisingha, P., Nie, M., Pluciennik, M. and Young, R. (2009). Socialisation for learning at a distance in a 3-D multi-user virtual environment. *British Journal of Educational Technology, 40*(3), 458-479.

Esprit de corps (2009). In Merriam-Websters Online Dictionary. Retrieved February 20, 2009, from http://www.merriam-webster.com/dictionary/esprit+de+corps.

Feenberg, A. (1989).   The written world: On the theory and practice of computer conferencing. In R. Mason, & A. Kaye (Eds.), *Mindweave: Communication, computers, and distance education* (pp. 22-39), New York: Pergamon Press.

Floridi, L. (2005).   The philosophy of presence: From epistemic failure to successful observation. *Presence, 14*(6), 656-667.

Fox, J. and Bailenson J. N. (2009). Virtual self-modeling: The effects of vicarious reinforcement and identification on exercise behaviors. *Media Psychology, 12*, 1–25.

Gadamer, H. G. (2000). *Truth and method.* Trans. J. Weinsheimer and D. Marshall. New York: Continuum.

Garau, M., Slater, M., Pertaub, D-P. & Razzaque, S. (2005). The responses of people to virtual humans in an immersive virtual environment. *Presence: Teleoperators & Virtual Environments, 14*(1), 104-116.

Garrison, D.R., Anderson, T., Archer, W. (2004). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education, 15*(1), 3-21.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *Internet and Higher Education*, *2*(2/3), 87-105.

Gaver, W. (1996). Situating action II: Affordances for interaction: The social is material for design. *Ecological Psychology 8*(2), 111–129.

Gerhard, M., Moore, D. J., & Hobbs, D. J. (2001). Continuous presence in CVEs: Towards the evaluation of a hybrid avatar-agent model for user representation. *Lecture Notes in Computer Science, 2190,* 137-155.

Gerrig, R. J. (1993). *Experiencing narrative worlds*. New Haven, CT: Yale University Press.

Goffman, E. (1983). The interaction order. *American Sociological Review, 48,* 1–17.

Gray, P. O. (2010). Foundations for the study of psychology. *Psychology* (6th ed.). New York, New York: Worth Publishers.

Greenfield, P. M., Brannon, C., & Lohr, D. (1994). Two-dimensional representation of movement through three-dimensional space: The role of video-game expertise. *Journal of Applied Developmental Psychology, 15*, 87-103.

Guerin, B. (1993). *Social Facilitation*. Cambridge: Cambridge University Press.

Hackman, M. Z. & Walker, K. B. (1990). Instructional communication in the televised classroom: The effects of system design and teacher immediacy on student learning and satisfaction. *Communication Education, 39*(3), 196-206.

Hall, B. & Henningsen, D. D. (2008). Social facilitation and human–computer interaction. *Computers in Human Behavior, 24,* 2965-2971.

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

Heeter, C. (2003). Reflections on real presence by a virtual person. *Presence: Teleoperators & Virtual Environments, 12*(4)*,* 335-345.

Hess, T., Fuller, M, and Campbell, D. (2009). Designing Interfaces with Social Presence: Using Vividness and Extraversion to Create Social Recommendation Agents   *Journal of the Association for Information Systems, 10*(12), 889-919

Hevern, V. W. (2004, March). Narrative Psychology: Basics. Narrative psychology: Internet and resource guide. Retrieved January 6, 2011 from the Le Moyne College Web site: http://web.lemoyne.edu/~hevern/nr-basic.html.

Ijsselsteijn, W., de Riddera, H., Hamberga, R., Bouwhuisa, D. & Freeman, J. (1998). Perceived depth and the feeling of presence in 3DTV. *Displays, 18*(4), 207-214.

Isgro, F., Trucco, E., Kauff, P. & Schreer, O. (2004). Three-dimensional image processing in the future of immersive media. *IEEE Transactions on Circuits and Systems for Video Technology, 14*(3), 288-303.

Jelfs, A. & Whitelock, D. (2000). The notion of presence in virtual learning environments: What makes the environment "real." *British Journal of Educational Technology, 31*(2), 145-152.

Kalman, R. E. (1960). A new approach to linear filtering and prediction problems. *Journal of Basic Engineering, Transactions of the ASME, 82D,* 33-45.

Kim T. & Biocca, F. (1997). Telepresence via television: Two dimensions of telepresence may have different connections to memory and persuasion. *Journal of Computer-Mediated Communication [Online], 3(*2), Available: http://jcmc.indiana.edu/vol3/issue2/kim.html

Kimmerle, J. & Cress, U. (2008). Group awareness and self-presentation in computer-supported information exchange. *Computer-Supported Collaborative Learning, 3,* 85–97.

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

Klimmt, C. & Vorderer, P. (2003). Media psychology "is not yet there:" Introducing theories on media entertainment to the presence debate. *Presence: Teleoperators & Virtual Environments, 12*(4), 346-359.

Kreijns, K., Kirschner, P., Jochems, W., & Buuren, H. V. (2004). Determining sociability, social space, and social presence in (a)synchronous collaborative groups. *Cyberpsychology & Behavior, 7(*2), 155-172.

Lea,. M. (1992). *Contexts of computer-mediated communication.* New York: Harvester Wheatsheaf.

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

Lessiter, J., Freeman, J., Keogh, E. & Davidoff, J. (2001).   A cross-media presence questionnaire: The ITC-sense of presence inventory.   *Presence: Teleoperators and Virtual Environments, 10*(3), 282-297.

Lombard, M. & Ditton, T. B. (1997). At the heart of it all: The concept of presence. *Journal of Computer-Mediated Communication [Online], 3*(2), Available: http://www.ascusc.org/jcmc/vol3/issue2/lombard.html

Lombard, M., Reich, R. D., Grabe, M. E., Bracken, C. C. & Ditton, T. B. (2000). Presence and television: The role of screen size. *Human Communication Research, 26*(1), 75-98.

Loomis, J. M., Blascovich, J. J. & Beall, A. C. (1999).   Immersive virtual environment technology as a basic research tool in psychology. *Behavior Research Methods, Instruments, & Computers, 31*(4), 557-564.

Lowenthal, P. R. (2009). The evolution and influence of social presence theory on online learning. In T. T. Kidd (Ed.), *Online education and adult learning: New frontiers for teaching practices*. Hershey, PA: IGI Global.

Mania, K. & Chalmers, A. (2001). The effects of levels of immersion on memory and presence in virtual environments: A reality centered approach. *CyberPsychology & Behavior, 4*(2)*,* 247-264.

Mania, K., Troscianko, T., Hawkes, R. & Chalmers, A. (2003). Fidelity metrics for virtual environment simulations based on spatial memory awareness states. *Presence: Teleoperators & Virtual Environments, 12*(3), 296-310.

Mantovani, G. & Riva, G. (1999). `Real' presence: How different ontologies generate different criteria for presence, telepresence. *Presence: Teleoperators & Virtual Environments, 8*(5), 540-550.

Mantovani, G. & Riva, G. (2001). Building a bridge between different scientific communities: On Sheridan's eclectic ontology of presence. *Presence, 10*(5), 537-543.

Meehan, M. (2002). Physiological measures of presence in stressful virtual environments. *ACM Transactions on Graphics, 21*(3)*,* 645-652.

Meehan, M. (2000). An objective surrogate for presence: Physiological response. *3rd International Workshop on Presence.*

Moore, M. G. (1993). Theory of transactional distance. In D. Keegan (Ed.), *Theoretical principles of distance education.* New York: Routledge.

Moreno, R. & Mayer, R. E. (2004). Personalized messages that promote science learning in virtual environments. *Journal of Educational Psychology, 96*(1), 165-173.

Murray, C. D., Arnold, P. & Thornton, B. (2000). Presence accompanying induced hearing loss: Implications for immersive virtual environments. *Presence, 9*(2), 137-148.

Nash, E. B., Edwards, G. W., Thompson, J. A. & Barfield, W. (2000). A review of presence and performance in virtual environments. *International Journal of Human-Computer Interaction, 12*(1), 1-41.

Nasoz, F., Alvarez, K., Lisetti, C. L. & Finkelstein, N. (2004). Emotion recognition from physiological signals using wireless sensors for presence technologies. *Cognition, Technology & Work, 6*(1), 4–14.

Nichols, F. (2000). Communities of Practice: Definition, Indicators & Identifying Characteristics. Retrieved February 24, 2009, from http://home.att.net/~discon/KM/CoPCharacteristics.htm

Nichols, S., Haldane, C., & Wilson, J. (2000). Measurement of presence and its consequences in virtual environments. *International Journal of Human-Computer Studies, 52*(3), 471-491.

O'Brien, M. G. & Levy, R. M. (2008). Exploration through virtual reality: Encounters with the target culture. *The Canadian Modern Language Review, 64*(4), 663-691.

Orman, E. K. (2003). Effect of virtual reality graded exposure on heart rate and self-reported anxiety levels of performing saxophonists. *Journal of Research in Music Education, 51*(4), 302–315.

Orman, E. K. (2004). Effect of virtual reality graded exposure on anxiety levels of performing musicians: A case study. *Journal of Music Therapy, 41*(1), 70–78.

Pertaub, D. P., Slater, M. & Barker, C (2002). An experiment on public speaking anxiety in response to three different types of virtual audience. *Presence: Teleoperators & Virtual Environments, 11*(1), 68-78.

Picciano, A. (2002). Beyond student perceptions: Issues of interaction, presence, and performance in an online course. *Journal of Asynchronous Learning Networks, 6*(1), 21-40.

Ravaja, N. (2004).   Contributions of psychophysiology to media research: Review and recommendations. *Media Psychology, 6*(2)*,* 193-235.

Reiner, (2004).   The Role of Haptics in Immersive Telecommunication Environments. *IEEE Transactions on Circuits and Systems for Video Technology, 14*(3), 392-401.

Richardson, J. C. & Swan, K. (2003). Examining social presence in online courses in relation to students' perceived learning and satisfaction.   *Journal of Asynchronous Learning Networks, 7*(1)*,* 68-88.

Riegelsberger, J., Sasse, M. A. & McCarthy, J. D. (2005). The mechanics of trust: A framework for research and design. *International Journal of Human-Computer Studies, 62*(3), 381-422.

Riva, G. (2002). From technology to communication: Psycho-social issues in developing virtual environments. *Journal of Visual Languages & Computing, 10*(1), 87-97.

Riva, G. (1999). Virtual reality as communication tool: A sociocognitive analysis. *Presence: Teleoperators & Virtual Environments; 8*(4), 462-468.

Riva, G. (2000).   Design of clinically oriented virtual environments: A communicational approach. *CyberPsychology & Behavior, 3*(3), 351-357.

Riva, G., Molinari, E. & Vincelli, F. (2002). Interaction and presence in the clinical relationship: virtual reality (VR) as communicative medium between patient and therapist. *IEEE Transactions on Information Technology in Biomedicine, 6(3),* 198-205.

Rogers, E. M. (1985). Methodology for meta-research. In H. H. Greenbaum, S. A. Hellweg, & J. W. Walter (Eds.), *Organizational communication: Abstract, analysis, and overview* (pp. 13-33). Beverly Hills, CA: Sage.

Romano, D. M. & Brna, P. (2001). Presence and reflection in training: Support for learning to improve quality decision-making skills under time limitations. *CyberPsychology & Behavior, 4*(2), 265-277.

Rothbaum B. O. & Hodges L. F. (1999). The use of virtual reality exposure in the treatment of anxiety disorders. Behavior Modifications, 23, 507–525.

Rothbaum, B. O., Hodges, L., Alarcon, R., Ready, D., Shahar, F., Graap, K., Pair, J., Hebert, P., Gotz, D., Wills, B. and Baltzell, D. (1999). Virtual reality exposure therapy for PTSD Vietnam veterans: A case study. *Journal of Traumatic Stress, 12*(2), 263-271.

Rothbaum, B. O., Hodges, L. Watson, B. A., Kesslerb, G. D. and Opdyke, D. (1996). Virtual reality exposure therapy in the treatment of fear of flying: a case report. *Behaviour Research and Therapy, 34*(5/6), 477-481.

Rourke, L., Anderson, T. Garrison, D. R., & Archer, W. (1999). Assessing social presence in asynchronous, text-based computer conferencing. *Journal of Distance Education*, *14*(3), 51-70.

Roussos, M., Johnson, A., Moher, T., Leigh, J., Vasilikas, C., & Barnes, C. (1999). Learning and building together in an immersive virtual world. *Presence, 6*(3)*,* 247-263.

Salzman, M.C., Dede, C., Loftin, R.B., & Chen, J. (1999). A model for understanding how virtual reality aids complex conceptual learning. *Presence: Teleoperators and Virtual Environments, 8*(3), 293–316.

Sanders, J. A. & Wiseman, R. L. (1990). The effects of verbal and nonverbal teacher immediacy on perceived cognitive, affective, and behavioral learning in the multicultural classroom. *Communication Education, 39*(4), 341-352.

Scheff, T. J. (2007). A concept of social integration. *Philosophical Psychology, 20*(5), 579-593.

Schneider, E. F. (2004). Death with a story: How story impacts emotional, motivational, and physiological responses to first-person shooter video games. *Human Communication Research, 30*(3), 361-375.

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

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

Scott, C. R. & Timmerman, C. E. (1999). Communication technology use and multiple workplace identifications among organizational teleworkers with varied degrees of virtuality. *IEEE Transactions on Professional Communication, 42*(4)*,* 240-260.

Sears, A. and Jacko, J. A. (Eds.). (2007). Handbook for Human Computer Interaction (2nd Edition). CRC Press

Sentient (2009). In Merriam-Websters Online Dictionary. Retrieved February 20, 2009, from http://www.merriam-webster.com/dictionary/sentient

Shea, P. and Bidjerano, T. (2009). Community of inquiry as a theoretical framework to foster ''epistemic engagement'' and "cognitive presence" in online education. *Computers & Education, 52*, 543–553

Sheridan, T. B. (1999). Descartes, Heidigger, Gibson, and God: Toward an eclectic ontology of presence. *Presence, 8*(5), 551-559

Sheridan, T. B. (2001). Response to "Building a bridge between different scientific communities: On Sheridan's eclectic ontology of presence". *Presence, 10*(5), 544-545

Sherman, W. R. & Craig, A. B. (2003). *Understanding virtual reality: Interface, application, and design* (The Morgan Kaufmann Series in Computer Graphics). Elsevier Science: USA.

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

Shin, N. (2002). Beyond interaction: the relational construct of 'transactional presence'. *Open Learning, 17*(2), 121-137.

Slater, M., Khanna, P., Mortensen, J., and Yu, I. (2009). Visual realism enhances realistic response in an immersive virtual environment. *IEEE Computer Graphics and Applications, 29*(3), 76-84

Slater, M. (2004). How colorful was your day? Why questionnaires cannot assess presence in virtual environments. *Presence: Teleoperators & Virtual Environments, 13*(4), 484-493.

Slater, M. & Steed, A. (2000). A virtual presence counter. *Presence: Teleoperators and Virtual Environments, 9*(5), 413-434.

Slater, M., Steed, A., McCarthy, J. & Maringelli, F. (1998). The influence of body movement on subjective presence in virtual environments. *Human Factors, 40,* 469–477.

Slater, M.,& Wilbur, S. (1995). Through the looking glass world of presence: A framework for immersive virtual environments. In M. Slater (Ed.), *FIVE '95 framework for immersive virtual environments.* London: QMW University.

Smith, G. W. H. (2006). Enacted others: Specifying Goffman's phenomenological omissions and sociological accomplishments. *Human Studies, 28*, 397–415.

Steinhardt, A. (2003). Making new stuff work. *IEEE Signal Processing Magazine, 20*(3), 14-18.

Steptoe. W., Steed, A., Rovira, A., and Rae, J. (2010). Lie Tracking: social presence, truth and deception in avatar-mediated telecommunication. In *Proceedings of the 28th International Conference on Human Factors in Computing Systems*, ACM, 2010.

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

Thurmond, V. & Wambach, K. (2004). Understanding interactions in distance education: A review of the literature. *International Journal of Instructional Technology and Distance Learning, 1*(1)*,* 9-26.

Tu, C-H. (2000). On-line learning migration: from social learning theory to social presence theory in a CMC environment. *Journal of Network and Computer Applications, 23,* 27-37.

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

Vincelli, F. (1999). From imagination to virtual reality: The future of clinical psychology. *CyberPsychology & Behavior, 2*(3)*,* 241-248.

Vorderer, P. (2001).   It's all entertainment—sure. But what exactly is entertainment? Communication research, media psychology, and the explanation of entertainment experiences. *Poetics, 29*(4/5), 247-261.

Vorderer, P., Klimmt, C. & Ritterfeld, U. (2004).   Enjoyment: At the heart of media entertainment. *Communication Theory, 14*(4), 388-408

Vygotsky, L. (1978). Mind in Society: The Development of Higher Psychological Processes. Harvard University Press, Cambridge, Massachusetts.

Waksler, F. C. (2006). Analogues of ourselves: Who counts as an other? *Human Studies, 28*(4)*,* 417-429.

Wallace, R. M. (2003). Online learning in higher education: A review of research on interactions among teachers and students. *Education, Communication & Information, 3*(2)*,* 241-280.

Walther, J. B. (1992). Interpersonal effects in computer-mediated interaction: A relational perspective. *Communication Research, 19*(1), 52-90.

Walther, J. B. (1996). Computer-mediated communication: Impersonal, interpersonal, and hyperpersonal interaction. *Communication Research, 19*(1)*,* 52-90.

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

Waterworth, E. L. & Waterworth, J. A. (2001). Focus, locus, and sensus: The three dimensions of virtual experience. *Cyberpsychology & Behavior, 4*(2), 203-213.

Wellman, B., Salaff, J., Dimitrova, D., Garton, L., Gulia, M. & Haythornthwaite, C. (1996). Computer networks as social networks: Collaborative work, telework, and virtual community. *Annual Review of Sociology, 22,* 213-238.

Whitelock, D., Romano, D. A., Jelfs, A. & Brna, P. (2000). Perfect presence: What does this mean for the design of virtual learning environments? *Education and Information Technologies, 5*(4), 277-289.

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

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

Zahoric, P. & Jenison, R. L. (1998). Presence as being in the world. Presence: *Teleoperators and Virtual Environments, 7,* 78-89

Zajonc, R. B. (1965). Social facilitation. *Scienc*e, 149, 269-274.

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

Zitzen, M., & Stein, D. (2004). Chat and conversation: a case of transmedial stability? *Linguistics, 42*(5)*,* 983-102