



Research article

Embodiment and presence in virtual worlds: a review

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Abstract

The multimodal, 3D-graphical communication platforms known as virtual worlds have their historical roots in multi-user domains/dungeons (MUDs) and virtual reality (VR). Given the extensive research on these technologies and the novelty of virtual worlds as a topic of study in information systems (IS), it behooves us to learn from the concepts, theories and insights generated primarily by other disciplines that have focused on these technologies. Because neither MUDs nor VR have significant organizational application, thus locating them outside of the IS discipline's purview, very little of this literature has found its way into IS research thus far. This article reviews the extant literature on virtual environments and seeks to make its insights accessible to IS research on virtual worlds. In particular, this will focus on concepts, theories and insights regarding embodiment and presence, which are afforded by the avatar, a distinguishing technological artifact of virtual worlds.

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Before paper, wires and silicon, the primordial communication medium is the body.
(Biocca, 1997)

Objectives and motivation

Virtual worlds, or graphical immersive environments that support a host of activities ranging from social interaction (e.g., Second Life, ProtoSphere, Teleplace, OLIVE, VastPark and Multiverse) to action-oriented gaming (e.g., World of Warcraft, EverQuest and Dark Age of Camelot), are multi-modal platforms that feature rich graphics, 3D rendering, high-fidelity audio and video, motion and interactivity (Schultze and Rennecker, 2007). They essentially rely on man-made technology to create and experience spaces, objects and people with which a user can interact (Lee, 2004). As such virtual worlds differ from actual worlds, which can be perceived, manipulated and interacted with by the human body's sensory systems alone.

Despite being dismissed as environments of play initially, virtual worlds have gained legitimacy in business, educational and government settings for their application to serious endeavors, such as distributed collaboration, virtual teamwork, multi-media meetings and training, as well as real-time simulation. For example, IBM is utilizing private instances of Second Life for global team collaboration, conferences (run at 20% of the cost of a 'real'-world event),

and training through simulation and rehearsal (Schultze *et al.*, 2008; LeGoes, 2010). Ernst & Young used a simulation of a cookie manufacturer's warehouse to enhance the inventory-count training of entry-level auditors (Rosenthal, 2009).

In summer 2010, cosmetics giant, L'Oreal, launched an online game called Reveal, which was built on a virtual world platform, to support its recruitment efforts (Tims, 2010). Another way in which virtual worlds can support the Human Resources function in organizations is through diversity training.¹ By having participants complete tasks while being represented by an avatar of a different race, gender, physical ability and/or age than their own, individuals have an opportunity to literally walk in another's shoes, thus gaining a deeper understanding of and appreciation for others' 'reality.'

NASA CoLab developed an island in Second Life to connect communities inside and outside NASA to collaborate on issues surrounding the space program. Its goal is to make NASA-at-large more open and innovative. Although NASA CoLab also exists as a physical community, the objectives of building a virtual presence included prototyping the physical CoLab in Second Life as a test bed before investing resources in building the actual CoLab, enabling technology entrepreneurs outside the San Francisco Bay Area to participate in CoLab, communicating the value of CoLab to other NASA

facilities and external institutions and creating expertise around 'social software' within NASA.

Another example of community involvement is the Obama administration's healthcare team, which used Second Life to solicit the input on healthcare reform from people with medical problems and disabilities (Despres, 2009). Participants remarked on the ease with which participants talked candidly about rather private information, such as their health issues and health care needs in this virtual setting.

Even though Gartner maintains that public virtual worlds, such as Second Life, were initially overhyped and are now in the Trough of Disillusionment on its Hype Cycle, it expects virtual worlds to be as significant as the web in 10 years time (Jennings, 2008). It also notes the potential of 'intraverses,' that is, private virtual worlds that are implemented on company-owned infrastructure, for communication and collaboration among globally distributed teams. For instance, British Petroleum implemented ProtoSphere behind its firewall for strategy planning, global collaboration and anonymous counseling for staff (Riley, 2007).

As more and more organizations are identifying valuable applications of virtual worlds, thereby making these technologies increasingly relevant to information systems (IS) research, it behooves us to learn from the theories and insights that have previously been developed about virtual environments by other disciplines. Schroeder (2002) highlights that virtual worlds have their historical roots in multi-user domains/dungeons (MUDs) and virtual reality (VR). MUDs, and their object-oriented version, namely MUD object oriented (MOOs), are persistent text-based worlds developed and inhabited by players who devise characters and create virtual rooms using only textual descriptions. VR facilitates mostly single-user interaction with a virtual space and requires such complex interface technologies (e.g., head-mounted displays) that it is typically limited to lab settings.² Furthermore, users' experience of VR is typically limited to a single 30-min session (Nilsson *et al.*, 2002). In contrast, virtual worlds are shared environments that are rendered on personal computers and both the environments and users' identities are more persistent (Jakobsson, 2002), as online gamers spend on average 23 h a week in-world (Yee, 2006).

A key difference between today's graphical virtual environments and the text- and VR-based ones is the customizable avatar, the virtual body with which communicators make themselves present to themselves and others in virtual space.³ Avatars differ from embodied agents or bots in that they are driven by humans in real time (Bailenson *et al.*, 2006). A defining feature of virtual worlds, avatars re-embody the communicator who has been disembodied through computer mediation. Their key affordances are embodiment and presence (Taylor, 2002). Embodiment implies that the communicator can engage in practices of the body (e.g., sit, smile, and dress appropriately), and presence refers to the user's sense that she exists in a given setting, be it virtual or actual.⁴ Hoffman *et al.* (1998) point out that presence is the essence of immersive technology.

Some of the avatar-related questions that arise when organizations plan to use virtual worlds include the following: in order to maximize the efficacy of role play in a war

game scenario wherein a product manager tries to play her counterpart in a competing firm, what appearance should the product manager's avatar take and what affordances should it have? Should the avatar resemble the role-playing manager, the manager being played, or something (e.g., dragon or robot) with features that are representative of the competitor's strategic positioning? Similarly, what virtual embodiment and affordances are most appropriate for a task-focused meeting when a globally distributed team prepares a bid, for instance? How should the avatars and the virtual environment be adapted to prepare a brainstorming meeting, in which people are encouraged to think outside the box, most effective? Furthermore, how important is the user's sense of presence in each of these applications? Which form of presence needs to be activated? How is presence activation best achieved? Also, what new communicative practices emerge as a result of user's re-embodiment? And what are the implications of these practices? These are just a few of the questions that are worth exploring by the IS discipline.

The purpose of this article is to review some of the prior research on embodiment and presence in virtual environments to provide IS researchers with a map, with which to orient themselves and find pathways into the various research questions and theories pertaining to virtual worlds. The focus of this review article is more on diversity than completeness. In other words, no claims are made that every publication on embodiment and presence in virtual environments has been reviewed; however, the paper highlights the most prominent forms of and theoretical lenses on presence developed in this literature.

This article will proceed as follows: Given this paper's focus on avatar-enabled embodiment and presence, it starts by considering the role of the (physical) body in communication. This provides the conceptual foundation for a discussion about embodiment and presence. Different forms of presence and different theoretical framings of the concept are introduced, and empirical examples of their use are highlighted. The article concludes by highlighting the essentialist bias in the extant conceptualization of virtual worlds. In light of this, suggestions for questions future IS research on virtual worlds might tackle and theoretical perspectives it might take will be made.

On the role of the physical body in communication

There is a paradoxical relationship between technology and our physical bodies. On the one hand, our bodies have inherent limitations in that they are situated, making us present in a given place, time and social context. They are also the primary site of identity with markers such as sex, race, age and social class. In other words, we are our bodies; they make who we are manifest to the world (Anderson, 2000). Not surprisingly, we seek to eliminate the constraints of corporeality through technology by masking the body's identity markers and engaging in simultaneous global conversations so as to be ubiquitously present. And yet, there are many valuable communicative capabilities of the body that are difficult to recreate technologically. Consequently, we continuously strive to emulate the face-to-face encounter in our development of new technologies.

Even though there are different theories related to the implications of computer mediation on communication, i.e., social presence theory (Short *et al.*, 1976), cues-filtered out and media richness theory (Daft and Lengel, 1984) and social information processing theory (Walther, 1992), they all subscribe to 'the same metatheory that the social effects of communication technology are caused by the disembodiment of interpersonal communication' (Tanis and Postmes, 2007). Loomis (1992) reminds us that our bodies are the primary medium through which we interact with the physical world, suggesting that non-mediated communication does not exist. It is through our bodily senses that we perceive the physical world and construct our phenomenal world.

Our bodies thus serve as information acquisition, processing and display systems (Biocca, 1997). As an *information acquisition system*, the senses act as communication channels to the actual world absorbing its energy fields as they impinge on the body. As an *information processing system*, the body serves as a frame of reference for the neural processes of the mind. Damasio (1994: xvi) states this quite eloquently: 'our most refined thoughts and best actions, our greatest joys and deepest sorrows, use the body as a yardstick.' This implies that thinking and feeling do not reside in the mind only; our bodies sense, store and process knowledge as well. Thus, what we know about the world is embodied and all meaning derives from the experience of our bodies in the world (Lakoff and Johnson, 1980). As a *communication or display system*, the body emits information (intentionally and involuntarily; consciously and unconsciously; and verbally and non-verbally) that is perceived by other bodies. Thus emotions and mood are communicated through the body, and a body's outward appearance (e.g., clothing, posture and physical disabilities/enhancements), says a lot about a person's identity. Indeed, our bodies are a rhetorical device (Kolko, 1999).

Even more fundamental than the body's information processing and communicative functions is its role in making the communicator present. Presence is defined as the existence of an object (e.g., a body) in a given space and time (Schloerb, 1995). It is thus synonymous with the conscious feeling of one's body existing in and being distinct from a prefigured, external world,⁵ which can be both 'real' and virtual (Waterworth and Waterworth, 2003, 2006). Absence, the opposite of presence, occurs when an individual retreats from the shared world of the here and now into a private, internal and imagined world of the mind, i.e., being absent-minded (Waterworth and Waterworth, 2001). Absence tends to be a highly self-reflexive state, in which the individual focuses on her idea of what is happening in the external world and her own place in it at the expense of experiencing herself in the world.

As communication devices, our bodies generally work in the background and are thus taken for granted. In computer-mediated communication our bodies seem to become irrelevant and only the presence of our minds matters. However, by emphasizing and problematizing the digital body, virtual worlds offer us an opportunity to become aware of and explore the role of the physical body in communication, as well as the implications of disembodied interactions (Ihde, 2002; Dreyfus, 2009).

Embodiment

As virtual bodies, avatars promise users the affordances of 'real' bodies and are thus touted as more expressive interfaces that increasingly approach face-to-face communication, even though facial expressions and gestures are contrived and under the user's control (Donath *et al.*, 1999). Vasalou *et al.* (2008) highlight that this controlled expressivity creates opportunities for misrepresentation, as does the delay between constructing and actually displaying the avatar because this allows users to be exceptionally strategic in tailoring their avatar to convey a precise message. Galanxhi and Nah's (2007) research provides support for misrepresentation in avatar-mediated communication. They found that the users of avatar-enabled chat were less anxious when they engaged in deceptive behavior than their counterparts in text-only chat.

Nevertheless, Vasalou *et al.* (2008) found that in creating static, 2D Yahoo! avatars users tended to balance their desire to (i) represent themselves accurately by mirroring their actual, idealized or ought self in the avatar; (ii) take advantage of the fantasy element virtuality offers to ambiguate their representation, and thus challenge social conventions and their own self-image; and (iii) use their avatar's appearance to embody a message. Their research, like Kafai *et al.*'s (2010), noted how rooted most users' avatars were in their actual selves. Jin's (2009) research on Miis, the avatars in the Wii games, provides insights into the effect of (and a potential reason for) these choices. She found that users who created avatars that represented their actual selves were more likely to become psychologically immersed in the virtual world than those users who had created their avatars to look like their ideal selves. In other words, the user's sense of presence is enhanced with an avatar that represents his actual self.

Like physical bodies, avatars are not mere objects manipulated by their human owner; instead, they are also subjects in a socio-cultural world of meaning (Wolfendale, 2007). As an object-body, avatars might be seen as cursors that serve mainly navigational purposes (Schultze and Leahy, 2009). As a subject-body, however, the avatar is the site of social practices, such as impression management. Bente *et al.* (2008) found that when users were interacting with others via avatars (rather than chat- or voice-only), they exposed their face to the communication window more even when they were not using it as an information source. The researchers regard this as an indicator of more active impression management.

How the user constructs her avatar with regard to appearance, personality and behavior is embedded in a system of meaning informed by the social norms and conventions shaped by both the actual and the virtual world (Becker and Mark, 2002). Nowak and Rauh (2005) highlight some of the social norms of avatar appearance. In a study of people's perceptions of avatars, they found that the more anthropomorphic and gendered (i.e., clearly male or female) avatars looked, the more attractive, credible and homophilous (i.e., similar to the perceiver) they were judged to be. In other words, a humanoid, gendered avatar, which is what most participants listed as their first choice of self-representation, was deemed more likeable and persuasive, both of which are qualities necessary to be effective in social settings.

Similarly, Eastwick and Gardner (2008) noted that the laws of social influence established in the actual world could not be escaped in the virtual world. They found that the success rates of dark-skinned avatars that requested help was lower than that of their light-skinned counterparts. This suggests that virtual worlds are not immune to 'real'-world biases and stereotypes. Indeed, Pena *et al.* (2009) were able to activate such stereotypes through priming. Black-cloaked avatars led users to express more aggressive intentions and attitudes, as well as less group cohesion, than white-cloaked ones.

Thus, avatar appearance has behavioral implications. Yee and Bailenson's (2007) study on the effects of avatar appearance on self-perception and behavior showed that attractive avatars disclosed more about themselves than unattractive ones, and that participants who were assigned a taller avatar were more confident in their negotiations as compared to their shorter counterparts. Their research thus provides support for the Proteus Effect, i.e., inferring one's expected behavior and attitudes from observing one's avatar. It is interesting to note that a follow-on study (Yee *et al.*, 2009) showed that the Proteus Effect persisted in subsequent face-to-face interactions.

One of the avatar's key affordances is embodiment, i.e., giving participants a virtual body that enables them to engage in 'practices of the body' (Taylor, 2002). These practices are physical (sitting, gesturing, smiling and touching objects and people) and social (wearing appropriately fashionable clothing, behaving in a way that recognizes a community's logic of power and status). Through these bodily practices, avatars expand the modes of expression available to communicators beyond explicit, textual interaction, thus recapturing some of the physical body's non-discursive capabilities.

Soukup (2004), in an ethnographic study of The Palace, a 2D graphical virtual world, found that the practices of the avatar bodies were inextricably tied to the physical bodies of participants. Not only were avatars seen as physical representations of the communicator in virtual space, but they were also treated like real bodies when making sense of the virtual world. For instance, proximity to other avatars was interpreted in a way similar to physical proximity: although we are comfortable standing close to people who are familiar and dear to us, we seek some distance from strangers (also Taylor, 2002). Thus avatars move when others crowd them and when one avatar (accidentally) stands on another's head, it will invariably elicit remarks with a sexual connotation (Soukup, 2004).

Fundamental to the avatar-enabled bodily practices is presence. Avatars make communicators present to both themselves and to others (Taylor, 2002). By comparison, in text-based chat environments, people have to actively message to signal their presence, a logic that can be summed up in terms of 'I post, therefore I am' (Riva, 2002).

Presence

As prior reviews of the literature on presence in computer-mediated environments have shown (Lombard and Ditton, 1997; Nash *et al.*, 2000; Lee, 2004), there are many definitions, theoretical positions and forms of presence. These

will be discussed in the ensuing sections. Nevertheless, in computer-mediated environments presence essentially refers to the sense of existing or of 'being there' in a virtual space. The International Society of Presence Research defines presence in computer-mediated environments as a 'psychological state in which even though part or all of the individual's current experience is generated by and/or filtered through human-made technology, part or all of the individual's perception fails to accurately acknowledge the role of the technology in the experience' (Riva, 2009: 159). In other words, presence is a 'psychological state in which the virtuality of the experience is unnoticed' (Lee, 2004).

Forms of presence

Presence is a multi-faceted phenomenon (Kim and Biocca, 1997) whose conceptualization has evolved in part because of technological advancement. As virtual environments became more social and were used for different applications, the conceptual infrastructure of presence grew more elaborate. The objective of introducing various forms of presence is to develop an appreciation for the multi-faceted nature of presence and to highlight their relevance to different technological features. Table 1 provides a summary. It should be noted that some forms of presence will have been omitted here, e.g., environmental (Heeter, 1992) and object presence (Reiner and Hecht, 2009), because of their apparent lack of relevance to IS research.

Telepresence

Telepresence is the origin of the concept of presence as adopted by most of the research on virtual environments. The prefix 'tele' was initially used to signal the conceptualization of presence in a computer-mediated rather than a physical environment (Lee, 2004). The term telepresence was coined by NASA and the robotics community to refer to the illusion of being transported via telecommunication systems to a real, physical location, which could then be experienced synchronously from afar (Minsky, 1980).

Over time, the meaning of telepresence was relaxed to include virtual settings also, especially single-user VR. Soon the prefix was dropped or adapted. For instance, what was previously labeled telepresence, namely the perceptual illusion of 'being there' in the virtual setting (Biocca, 1997), became merely 'presence' or virtual, physical, spatial, mediated and subjective personal presence (Heeter, 1992; Ijsselstein *et al.*, 2001), to name a few. Some of these descriptors were technology specific. For instance, virtual presence was used to define presence in virtual environments specifically. Others were related to the diverse disciplinary backgrounds of the researchers from computer science, business, IS, engineering, education and psychology, who were attracted to the interdisciplinary research into computer-mediated environments (Lee, 2004). For instance, applying a cognitive lens to their study of presence, Regenbrecht and Schubert (2002) coined the term spatial presence to separate the user's mental representation of his body being part of the virtual space from the attentional component of presence, namely involvement.

Table 1 Forms of presence

<i>Form of presence</i>	<i>Definition</i>	<i>Example</i>
Telepresence (also known as presence)	Illusion of being in a distant place, that is, being there	User's sense of actually flying a plane by interacting with the instruments, even though he is sitting at a computer in an office.
Social presence	Illusion of access to a remote or distant other, that is, being with	User's sense of knowing another person (i.e., his actual personality and intentions), even though this person is encountered only in virtual space.
Co-presence	Illusion of having access to a remote or distant other that shares the same distant place, that is, being there with others	User's sense of actually shaking a customer's hand at the start of a meeting, even though both the user and the customer are in avatar form and the meeting space is virtual.
Self-presence	Illusion that one's virtual representation (e.g., avatar) is indeed oneself, that is, inhabiting the virtual body	User's sense that her avatar's appearance and (scripted) gestures, as well as the attitude and impression they give off, are her own.
Hyper presence	Illusion of more 'real' and 'true' access to self, others and places in virtual than in actual settings	User's sense that her 'truer' self emerges in virtual settings and that connections made with others in virtual spaces are more authentic because they are stripped of 'real world' social expectations and conventions.
Eternal presence	Illusion of being with others by being connected to distant others all the time, that is, alone together	User's sense that he is not alone even though he spends most of his time working on his own without social interactions.

Social presence

If telepresence is the illusion of being in a distant place (being there), then social presence is the illusion of access to a remote or distant other (being with). Even though social presence was originally conceptualized as a property of the communication medium (Lombard and Ditton, 1997), specifically the medium's ability to increase others' salience in an interaction (Short *et al.*, 1976), in the research on virtual environments, social presence became a psychological construct that reflected the subjective experience of closeness to and connectedness with others in mediated communication (Biocca, 1997). This definition seems appropriate given the more social nature of persistent virtual environments such as MUDs. Compared to media like bulletin boards, web pages and blogs, virtual worlds required synchronous presence (Kolko, 1999). As such, the focus of social presence increasingly moved to the user's experience of virtual others, leading Blascovich (2002, p. 130) to defines it as 'a psychological state in which the individual perceives himself or herself as existing within an interpersonal environment'.

Avatars, with their ability to convey social cues, are deemed to enhance social presence, in that they convey agency (i.e., control by human means) and behavioral realism (Blascovich, 2002). As such, they make an expanded definition of social presence possible, namely one that relies on the user's access to the other's intelligence so as to read the other's mind and infer his intentional states (Biocca *et al.*, 2003). Bente *et al.* (2008) thus conceptualize

social presence as a multi-dimensional continuum, wherein low social presence pole denotes the communicator's sense of spatial co-presence and high social presence is associated with gaining access to others' intentional, cognitive and affective states. Bente *et al.* (2008) found that high levels of social presence correlated significantly with interpersonal trust.

Social presence can apply to both human and non-human forms of intelligence, either real or imagined (Biocca, 1997). To the extent that these real or imagined others (e.g., people, animals, fantastical creatures or robots) populate the virtual world and react to the communicator, she is assured that she and the world exist (Heeter, 1992). If the individual is ignored, doubts about her and the world's existence are likely to arise. Social presence thus supports an individual's sense of 'being there.'

Co-presence

If telepresence focuses on being there (in a space), and social presence focuses on being in the presence of real or imagined others, then co-presence is the sense of being in a shared virtual setting with remote others (Ijsselstein *et al.*, 2001). As such, co-presence is conceptualized at the intersection between tele- and social presence. It is the virtual equivalent to Goffman's (1959) definition of co-presence as collocation of embodied – not merely imagined – others that become available and accessible to each other. This

form of presence is made possible by shared virtual environments.

Durlach and Slater (2000), who refer to co-presence as virtual togetherness, view it as the socially shared counterpart to an individual's experience of (tele)presence. One key determinant of co-presence is the ability to touch virtual others and to jointly manipulate shared space and shared objects (e.g., documents). Unlike audition and vision, touch requires proximity. To the extent that one person's actions affected by touching people, things and spaces in the environment are clearly perceived by the other participants, co-presence is enhanced (Durlach and Slater, 2000).

Self presence

Self presence derives from our experience of ourselves in everyday life (Goffman, 1959). In persistent virtual environments in particular, this experience of the self can become virtual when the user is represented through an avatar or, as in first person shooter games, a hand or gun. Lee (2004) maintains that self presence occurs when users do not notice the virtuality of the representation of their own selves. In other words, self presence is high when users inhabit their avatar and feel no distinction between themselves and their digital representation (also Eastwick and Gardner, 2008; Gee, 2008).

In his conceptualization of self presence, Biocca (1997) highlights that the whole concept of presence in virtual worlds is only possible because of the distinction users make between their actual/physical, their virtual/avatar and their phenomenal bodies. The phenomenal body is the user's mental model or schema of her body. It consists of perceived shape, size and capabilities, among other bodily attributes. Self presence is the users' mental model of themselves inside the virtual world; it is their awareness of self-identity. As such, it plays an important role in users' self-discovery, which in turn shapes their mental model.

Hyperpresence

Biocca (1997) developed the concept of hyperpresence to acknowledge the possibility that computer-mediated environments might make forms of interaction possible that are even more direct and more intimate than is currently possible with our physical bodies. For instance, technology might create situations in which access to others' intelligence, intentions and sensory impressions is greater than is achievable in face-to-face contexts. In other words, technology may be able to augment the intentional and unintentional cues that our bodies give off during communicative acts, and thus provide greater access to both our own and others' emotional states and intentions.

Hyperpresence appears to draw on Walther's (1996) hyperpersonal communication model, which predicts that, under certain circumstances, interpersonal relationships can develop to a greater extent in computer-mediated environments than in face-to-face interactions. Observing that many players of online role-playing games reported that their in-world friends were comparable or better than their 'real'-world friends, Yee (2006) explains that virtual worlds have the ingredients for creating interactions that are more intense and intimate than are feasible in the 'real'

world. First, senders can optimize their representation of self. Second, the receiver inflates the pieces of information that the sender has optimized to form an impression of the correspondent. Third, the participants can devote their cognitive resources, which in face-to-face settings would be used to maintain socially acceptable non-verbal behavior, to optimizing the structure and content of the online interaction, thereby making the exchanges more personal and articulate. Finally, through reciprocity the idealized impressions and personal interactions are intensified. Thus, hyperpresence is likely to be prevalent in virtual worlds.

Eternal presence

Eternal (Loy, 2007) or connected (Schroeder, 2006) presence refers to the notion of always being connected to distant others through computer-mediated means. This type of presence is increasingly common in social networking and virtual world technologies that enable users to make themselves present by continuously letting virtual others know about their whereabouts, thoughts and activities, and staying up-to-date with those of others.

Loy (2007) points to the paradox of this form of presence, highlighting that being everywhere is the same being nowhere. Being connected to everything implies being connected to nothing. In other words, connected presence is equivalent to being alone and lonely. Furthermore, being always on suggests that there is no presence because there is no absence. Without arrivals and departures there can be no sense of being there.

Ducheneaut *et al.*'s (2006) concept of 'alone together' seems to provide support for Loy's argument. The researchers found that play in massively multi-player online games (MMOGs) was less social than is typically assumed. Instead of players seeking out shared experiences and collaborative activities, most played alone. Nevertheless, they seemed to value the persistent social ambiance the virtual environment provided. In other words, the gamers found the idea and possibility of direct social interaction more appealing than actual togetherness and social engagement.

In summary, this discussion on the forms of presence highlights how presence evolved from the single concept of telepresence to a multi-faceted constellation of psychological states that include spatial, social, individual and temporal aspects. Thus, the apparently simple notion of 'being there' in a virtual space entails space (i.e., tele- and co-presence), identity (i.e., social-, self- and hyper-presence) and time (i.e., eternal presence). With this appreciation for the complexity of presence, the next section will discuss the different theoretical lenses that have been applied to this concept.

Theories of presence

There are many different theories of how presence is generated, the most prominent of which are reviewed below. Although these theories are categorized and presented as distinct for analytical and didactic reasons, it is important to note that there is some overlap among them. In practice, researchers pragmatically borrow and combine concepts and frameworks from various theoretical lenses. Despite the fact that these theories of presence are frequently circular (Biocca *et al.*, 2003), difficult to discern in empirical studies

and typically restricted to the antecedents of presence, the discussion below will summarize each theoretical perspective in terms of an oversimplified causal model and, where possible, provide examples of empirical research that illustrate it. Table 2 summarizes the ensuing discussion.

Presence as a human reaction to sensory immersion

Slater (Slater and Wilbur, 1997; Slater, 2003) is one of the most vocal proponents of a theoretical perspective of

presence as a human response to *sensory immersion*. Sensory immersion is a technology's ability to create a convincing, immersive environment with which the user can interact. As a technical capability, sensory immersion is thus defined as an objective and quantifiable property of the technology (Sanchez-Vives and Slater, 2005). Although Slater acknowledges that presence and the user's sensory immersion are probably strongly related empirically, he argues that they are theoretically distinct (Slater, 2003).

Table 2 Theories of presence

<i>Theory</i>	<i>Main argument</i>	<i>Antecedents</i>	<i>Consequences</i>
Human response to sensory immersion	Technical Focus The more immersive the virtual environment, that is, the more convincing the sensory data generated by the technology, the greater the user's sense of presence.	Technological characteristics that generate sensory immersion: • Inclusiveness • Extensiveness • Surroundingness • Vividness • Proprioceptive matching → Sensory or representational fidelity (i.e., realism) → Presence	Presence → Psychological immersion, that is, involvement and emotional engagement → (More immediate) transfer of knowledge between 'real' and virtual worlds → task performance in virtual setting
Attention allocated to the virtual world	Cognitive Focus The more attention the user allocates to the virtual world (i.e., away from both his/her internal and the 'real' world), and the more conscious the user is of the events in the virtual world, the greater his/her sense of presence.	Stimuli from actual and virtual worlds → Attention allocation: • Focus of attention • Locus of attention • Sensus of attention • Cognitive feelings that link unconscious cognitive processes to conscious feeling of presence → Involvement → Presence	Presence → Persuasion and memory → Transfer of knowledge and intentions from virtual to 'real' world (e.g., purchase intentions)
Capacity for action	Situated Focus The greater the technology's affordances for the user's intended actions and interactions in a given social and physical setting in the virtual world, the greater the user's sense of presence. The sense of 'being there' is grounded in the ability to 'do there.'	Affordances for action + user's agency in taking intended action → Behavioral fidelity → Spatial presence → Involvement → Judgment of the virtual environment's realness → Presence	Given situated nature of this theoretical model, the dependent variables are dependent on the specific context of the study. Nevertheless, task performance is likely to be a dependent variable in studies that adopt this model.
Defining feature of the self	Neuropsychological Focus. The more a virtual environment makes present the three levels of the self (i.e., proto-, core- and extended presence), and the more aligned these layers are around a common focus, the more present the user.	Concreteness of sensory stimuli + content's significance to user → Level of presence activated (i.e., proto-, core- and/or extended presence) → Alignment of levels across common focus → Optimal presence	Optimal presence + positive feeling → Flow

Presence is the sense of 'being there' that is created when the technology's simulated sensory data and the user's perceptual processing combine to produce a coherent place, in which the user can locate herself and interact with spaces, people and things. As such, presence is a matter of form. In contrast, *psychological immersion*, i.e., involvement and emotional engagement, is a matter of content. For instance, users might have a sense of actually being in a virtual concert hall (i.e., presence), but simultaneously experience boredom because the music fails to engage them (i.e., no involvement).

From this theoretical vantage point, presence is defined in terms of the three aspects (Slater, 1999):

- the sense of being there in the virtual environment;
- the extent to which the virtual environment becomes the dominant one, i.e., that participants respond to events in the virtual rather than the actual environment; and
- the extent to which participants remember having visited the place depicted in the virtual environment rather than having seen computer-generated images of it.

According to this definition, one indicator of presence is that people behave in virtual environments the same way they would in similar real-world situations. It is interesting to note that some researchers rely on in-world behavior that is consistent with 'real'-world behavior as a proxy for presence (Blascovich, 2002), rather than use subjective measures elicited through instruments like the Presence and Immersive Tendencies Questionnaire (Witmer and Singer, 1998) or the ITC-Sense of Presence Inventory (Lessiter *et al.*, 2001).

Slater and Wilbur (1997) define sensory immersion as the extent to which a display technology exhibits the following five characteristics:

- *inclusiveness*: the degree to which stimuli from the 'real' world are shut out from the virtual world;
- *extensiveness*: the number of sensory modalities used to represent the virtual world, e.g., spatialized sound;
- *surroundingness*: how panoramic the displays are;
- *vividness*: the fidelity and variety of a particular modality, i.e., the richness of the display or its pictorial realism; and
- *proprioceptive matching*: the degree to which the user perceives the virtual environment by relying on the same perceptual mechanisms they use in the 'real' world. An alternative way of describing this attribute is in terms of user interface transparency (Nash *et al.*, 2000). For instance, enabling the user to see the virtual world through the eyes in the head of her virtual body and eliminating any lag between her head movement and the rendering of the virtual world, enhance immersion. Similarly, affording avatars context-appropriate gestures, such as hand-raising in virtual classrooms, increases immersion.

Not surprisingly, proponents of this human-response framing of presence, advocate technical solutions to enhance the users' sense of presence. For instance, Bystrom *et al.* (1999) propose a spatial fidelity model of presence, which argues that technologies with update rates that are sufficiently fast to create an illusion of continuous motion

enhance realism, and thus increase the user's sense of presence. Conversely, high lag and interruptions caused by breaks in display disturb the realism and are likely to reduce presence.

In causal terms, the basic model of presence's antecedents looks something like this: technological features → immersion → realism/sensory fidelity → presence. The technological factors identified in the literature are largely captured in Slater and Wilbur's (1997) definition of immersion; however, Nowak and Biocca (2001) add that having an image to represent oneself in the virtual space produces a greater sense of presence than when one is invisible. Realism or sensory fidelity is the degree to which displays of spatial, auditory and haptic (touch-related) information in the virtual worlds is similar to that in the actual world (Bystrom *et al.*, 1999).

With regard to the consequences of presence, a coherent set of dependent variables is difficult to discern. For instance, Slater (1999) suggests psychological immersion, i.e., involvement and emotional engagement, as a consequence of presence. Also, many have noted that performance is not impacted by presence. Indeed, in their review of the presence literature, Nash *et al.* (2000) found that 90% of the variance in performance was explained by factors other than presence. This lack of a relationship is explained in terms of the user's attention that is divided between experiencing the virtual place and performing the task (Slater and Wilbur, 1997). However, Bystrom *et al.* (1999) wonder to what extent presence is a necessary condition for performance in virtual settings.

Held and Durlach (1992) maintain that a high degree of presence is desirable as it places the human operator's remarkably adaptive problem solving and manipulation skills in the virtual setting. In other words, the human operator inhabits the remote body or machine. Furthermore, Harris *et al.* (2009) suggest that a strong sense of presence increases the likelihood that 'real'-world behavior is transferred to the virtual world, and vice versa.

It is worth noting that the technological effects on presence become less salient with repeated use as the technology is adapted and becomes increasingly transparent. For example, in an experiment that involved social interactions between low-realism avatars, Slater and Steed (2002) found that participants' sense of presence and co-presence rose with each session. Thus, although technical glitches can cause breaks in presence (Garau *et al.*, 2008), technological characteristics may be less important as antecedents of presence in our contemporary virtual worlds.

Presence as attention allocated to the virtual world

Waterworth and Waterworth (2001) maintain that virtual world participants are simultaneously present in both the 'real' and the virtual world. When the user's sense of presence shifts from the virtual to the actual environment, this implies a 'break in presence' (Garau *et al.*, 2008). However, to create a break in presence, the user's attention need not necessarily move to the 'real,' external world; it can also move to his internal world of thoughts, dreams and fantasies. In other words, the user can become absent (Waterworth and Waterworth, 2003). Presence is thus a matter of how attention is allocated.

Conceptualizing presence in terms of attention, Waterworth and Waterworth (2001) develop a model of presence with the following three dimensions:

- *focus of attention*: given limited cognitive capacity, the user needs to balance his attention between the external world (present), which could be actual or virtual, and his internal world (absent);
- *locus of attention*: in a computer-mediated context, the user can attend to either the actual or the virtual environment as the external world; and
- *sensus of attention*: this dimension captures the level of conscious arousal that the user experiences, i.e., his attention to and awareness of events around him. This dimension ranges from relatively unconscious to highly conscious.

Bystrom *et al.* (1999) propose that the nature of the task completed in a virtual environment indirectly contributes to the user's sense of presence. During an engaging task, the user is likely to allocate more attentional resources to the virtual setting, thus creating the conditions for a greater sense of presence. Furthermore, an expert requires less *sensus* (conscious attention) than a novice when learning a new task (Waterworth and Waterworth, 2001). This is because the expert relies on her subconscious information processing facilities to acquire new knowledge.

One of the challenges in process models of presence is that the cognitive processes underlying presence are unconscious, whereas the experience of presence is conscious. To address this challenge, Schubert (2009) has developed a theory of presence based on a cognitive model of how the experience of presence emerges. It highlights the role of cognitive feelings, which are unconscious but provide feedback to the conscious cognitive processes. As such, they bridge the gap between the conscious and the unconscious. An example is the feeling of knowing that is triggered when we believe we recognize something or someone (relatively unconscious) and attempt to retrieve information about the object or the person from memory (highly conscious).

The antecedents of presence implied in this theoretical perspective appear to be: stimuli from actual and virtual worlds → attention → involvement → presence (Kim and Biocca, 1997; Sallnas, 2002). In other words, the number of stimuli from both the actual and the virtual environment that bombard the user determine her ability to attend to the virtual world. To the extent that the user then makes the events in the virtual world meaningful by attaching significance to them, she becomes increasingly involved in the virtual world, which in turn leads to presence (Hoffman *et al.*, 1998; Sallnas, 2002).

With regard to the consequences of presence, the two dependent variables affected by presence are memory and persuasion, which ultimately enhance the transfer of virtual experience in the 'real' world. In an assessment of telepresence experienced by television viewers, Kim and Biocca (1997) hypothesized that the more direct and unmediated the experience of a product or place, the greater the cognitive elaboration of the experience, making the place, product or event more memorable. However, they found that it was the absence from the physical environment rather than presence in the virtual

one that enhanced the viewers' product recall, i.e., memory.

Another aspect of Kim and Biocca's (1997) study was the relationship between telepresence and persuasion. They hypothesized that trying a product first-hand even in a mediated environment allows users to form an attitude of confidence (persuasion), which in turn influenced their buying intention (transferring learning from the virtual to the 'real' world). Their research found that telepresence had a strong positive effect on both of these dependent variables.

Presence as capacity for action

Relying on Gibson's (1979) ecological approach to visual perception, Flach and Holden (1998) maintain that presence in virtual environments is determined by the technology's affordances for action, e.g., the bodily practices of which the avatar is capable. Affordances are not merely characteristics of the technology. Instead they are resources that are revealed to users in their desire to take a certain action (Riva and Mantovani, 2000). As such, they are dependent on the individual's intention for action and the cultural context in which it occurs. For instance, users are more present in a perceptually poor environment like text-based virtual worlds, in which they can act and interact in a way that their goals are realized, than in a 3D graphical virtual world in which they cannot (Riva, 2009). Also, for in-worlds collaborative tasks, realistic appearance of avatars is secondary to support for body positioning, pointing and object manipulation (Sallnas, 2002). This suggests that behavioral fidelity, such as an avatar's ability to smile, is prioritized over sensory or representational fidelity (Lok *et al.*, 2003; Garau, 2006).

Carassa *et al.* (2005, p. 387) highlight that a situated view of presence depends on neither representational fidelity and technological perfections nor the place in which users find themselves, but on the connection that is made between meaningful situations in both the past and the future. They further note that presence relies on the 'integration of aspects relevant to the agent's movement and perception, to her actions, and to her conception of the overall situation in which she finds herself, as well as on how these aspects mesh with the possibilities for action afforded in the interaction with the virtual environment'. This perspective therefore stresses the reciprocal contribution of both the environment and its inhabitants in configuring each other, and the role that local action plays in shaping presence (Spagnoli *et al.*, 2003).

Applying the notion of embodied cognition (Lakoff and Johnson, 1980), which argues that environments are conceptualized in terms of bodily experience, Schubert *et al.* (2001) developed an embodied presence model. They maintained that presence is a subjective experience that depends on a multi-dimensional process through which users understand and construct virtual worlds. This model highlights the following steps:

- *spatial presence*, which represents the mental image of one's own body being in and interacting with the virtual space;
- *involvement*, which is the attentional component that signifies the user's interest and engagement with the content of the virtual environment; and

- *judgment of the virtual environment's realness* as it relates to the user's actions and interactions within the virtual world.

This model of embodied presence, which was also validated empirically (Regenbrecht and Schubert, 2002), highlights that the virtual environment's affordances for interaction activate spatial presence first, because they shape the user's mental representation of what bodily actions are possible in the virtual space. The cognitive nature of spatial presence suggests that the perception of the environment's affordance for action alone enhances the user's sense of presence. In other words, no objective interaction between the user's body and the virtual environment is required to create a sense of spatial presence. To the extent that the user's mental representation draws the user's attention to the virtual world, involvement is activated. The more attention the user pays to the virtual rather than the actual world, and the more absorbed and emotionally engaged he becomes in the virtual space, the greater his sense of presence. The user's judgment regarding the environment's realness, however, remains independent of the other two components. This suggests that giving users the technical capabilities of camming, moving and interacting freely in a virtual environment not only increases its realness, but also enhances the users' sense of presence.

In summary, this perspective on presence argues that 'being there' is grounded in the ability 'to do there' (Sanchez-Vives and Slater, 2005). An individual is present in a space if he can act and interact in it (Riva, 2009), and fails to notice the virtual or simulated nature of the objects he interacts with (Lee, 2004). To achieve this, users' freedom (both social and physical) needs to be assured (Riva and Mantovani, 2000). If the user relies on a tool (e.g., an avatar) to enact his intentions in a virtual world, then the tool extends the user's senses (McLuhan, 1964) and the user becomes physically present in the tool (Riva, 2009). Thus, presence is an accomplishment of both the individual and the technology. Furthermore, the user and his avatar become inextricably linked, thereby blurring the boundaries between the virtual and the actual, and the social and the material. Thus, the avatar becomes a sociomaterial configuration (Suchman, 2007).

Given the dynamic and entwined nature of this theoretical perspective, the antecedent of presence might cautiously be summarized as follows: technological affordances for action + user agency in taking intended action → behavioral realism → spatial presence → involvement → judgment of virtual environment's realness → presence. There are a number of studies whose conclusions for technology design are that users be given as much control as possible to customize their avatar's appearance and movement, as well as their virtual environment (Cheng *et al.*, 2002), in order to support their sense of agency. When avatars can be shaped and used by their human owner in an individualistic manner, behavioral realism is enhanced because the virtual world exhibits characteristics reminiscent of the 'real' world, such as unique avatar identities and a dynamic, somewhat unpredictable social environment. And, to the extent that the user experiences a social environment in which people interact with him in

anticipated ways, he feels present both in the physical and social environment (Heeter, 1992).

Even though Bailenson *et al.* (2002) did not apply this situated theory of presence outlined here, their findings nevertheless provide empirical support for this model. They found that users of a virtual world environment, in which they were represented by humanoid avatars with head movements rendered in real time such that users could direct their gaze onto their interaction partner as they would in an actual encounter, reported higher levels of co-presence than participants in the other two conditions (i.e., human avatars without head movements and voice-only). Furthermore, they liked each other more.

Given the situated nature of this action-oriented perspective, one would expect the dependent variables to be specific to the study's specific context. For example, Bailenson *et al.* (2002) found that the participants in their high behavioral realism condition spoke for a lower percentage of the time, even though the overall information communicated and the time to complete the task were the same. In other words, non-verbal cues were effectively communicated in the condition with avatars whose gaze direction was discernable, but this did not improve performance time. Instead it led to more silences among group members. Bailenson *et al.* (2002, p. 319) concluded that 'adding an extra channel of non-verbal communication may have actually diluted the amount of time dedicated to solving the problem', which echoes earlier research on the effect of presence on performance (Nash *et al.*, 2000).

Presence as a defining feature of the self

If the essence of presence is the feeling of existing as a distinct being in an external world, then to be present implies experiencing the self (Heeter, 1992). This feeling of presence is further enhanced when the environment (i.e., people, things and spaces) acknowledges one's existence. As such, presence (both in actual and virtual settings) is a defining feature of the self. Taking an evolutionary psychology lens,⁶ Riva *et al.* (2004b) argue that the ability to feel present in a virtual world is no different from feeling present in the 'real' world. This is because they regard presence as a neuropsychological phenomenon that evolved from the interplay of our biological and cultural development. They maintain that it is the feeling of presence that allows the central nervous system to differentiate between a purely imagined, internal world and our perceptions of the external world in order to discern actual environmental threats, prioritize them and respond appropriately to them (Waterworth and Waterworth, 2003). In other words, presence serves the basic biological purpose of survival.

Riva and Waterworth (2003, p. 4) define presence as 'the feeling of what happens when your being is modified by acts of apprehending something'. Presence thus occurs when a user perceives a stimulus and recognizes it as her own, thus giving her the choice to act on it. Even though this may be a unitary sensation, Riva *et al.* (2004b) adopt Damasio's (1999) three layers of the evolving self to develop a theory of presence as an experience consisting of the following three layers:

- *Proto presence*: an unconscious, embodied presence that is rooted in the biological, neural patterns that map an

individual's physical state in the here and now. Proto presence enables people to distinguish between the self and the non-self (i.e., the external situation). It relies on continuous, albeit unconscious, sensory input to assess its sense of being in the world on a moment-to-moment basis. Given the proprioceptive nature of this form of presence, most mediated experiences fail to evoke it. However, when participants in a virtual reality experiment duck to avoid being hit by a virtual object or experience simulation/motion sickness, their sense of proto presence has been activated. Some users of virtual worlds, such as *The Palace* (Jakobsson, 2002) and *Second Life* (Schultze and Leahy, 2009), report feeling dance motions in their bodies and wind on their skin, suggesting that the avatar feels like an extension of the physical body (Ratan and Hasler, 2010).

- **Core presence:** a situated and conscious sense of being in the present, in the here and now. Core presence relies on both the sensory input from the external world and the knowledge and experiences stored in the individual's mind. In other words, core presence is the result of events in the external world being filtered through the user's selective perception or internal model of the external world, implying conscious and selective attention. Ratan and Hasler (2010) operationalize core presence in terms of the emotional response an avatar's actions and interactions evoke in the person driving it. As its name implies, core presence is central to a user's experience of presence; unless it is evoked, a user's overall sense of presence will remain low (Waterworth and Waterworth, 2006).
- **Extended presence:** the sense of being in the external world as an autobiographical/historical and an envisioned/future self that has a relatively persistent identity with fairly immutable properties. When experiences of the external world are deemed significant and valuable for the ongoing construction of the individual's identity, extended presence is evoked. Thus, the more the user becomes a part of an interactive drama, a game narrative, or an evolving, self-authored story (Gee, 2008), the greater his sense of extended presence (Riva *et al.*, 2009).

Text-based media such as books, emails or web pages, which are typically not intimately related to the reader's present situation in the actual world, will activate extended presence provided the content is intellectually or emotionally stimulating. The abstract, textual information relies on mental models in the reader's mind to uncode it. With more pictorial media such as television and virtual worlds that present information in more concrete ways, the immediate, emotional response system underlying core presence is activated. Virtual reality applications have the capacity to affect proto presence, as they are capable of generating proprioceptive information that gives the user a sense of being in a virtual place.

Optimal presence is achieved when all three layers of consciousness are focused on a particular activity or situation in the external environment, such that the cognitive processes shaped by biological and cultural forces work in harmony. Only then are the three layers of presence integrated and the user's perceptual system convinced that something is happening to the self in the here and now.

This is when the user might enter a state of 'flow' (Csikszentmihalyi, 1990), the optimal experience of presence, even in a virtual setting.

We might crudely depict the antecedents of presence in this theoretical perspective as follows: concreteness of sensory stimuli + content's significance to user → level of presence activated → alignment of levels around common focus → optimal presence. With regard to the dependent variables related to presence, the causal model might be construed in these terms: optimal presence + positive feeling = flow → change in self. Riva *et al.* (2004a) suggest that flow requires both optimal presence and an experience that is perceived as positive. When this occurs, improvements in, for example, self-confidence, self-efficacy and self-image are likely, thus increasing the user's sense of empowerment.

To date, very few researchers have adopted this theoretical lens in their empirical work, except for Ratan and Hasler (2010), who maintain that it is particularly useful for the study of self presence, or what Schultze and Leahy (2009) call the avatar-self relationship. It is evident from the literature – starting with Turkle's (1995) work on the play with multiple selves in MUDs and MOOs, through Shiano's (1999) and Kendall's (2002) research on sociality and pseudonymity in text-based virtual worlds, to Kafai *et al.*'s (2010) description of virtual worlds as 'identity playgrounds' (also Morrison, 2010) – that issues of selfhood and identity are central to understanding virtual worlds.

Even though this layers-of-the-self perspective has not yet been widely applied, prior research on the relationship between one's self and one's virtual representation does shed light on parts of the theory. For instance, one of the assumptions about the disinhibition effect that occurs in virtual worlds is that the 'true' self emerges when users escape the social norms and constraints of their 'real' lives. Challenging this, Suler (2004) suggested that the self is not layered like an onion, with the true self at the center. Instead, the self is like a crystal with multiple facets that are revealed as constellations of emotion, memory and cognition, each of which is enacted in situated environments. Thus, both the online and offline selves are 'true' in their respective contexts. Pena *et al.*'s (2009) research using black- and white-cloaked avatars to prime a user's attitudes and behavior, provides support for this 'crystallized' (Tracy and Trethewey, 2005) view of the self; depending on the avatar's priming effect, a certain self emerges. One way of visualizing the process of a particular self being enacted in-world is to see core presence being activated and drawing on the stereotypes and narratives that inform extended presence to shape the facet of the self that emerges.

Opportunities for IS research

The purpose of this article is to review the prior literature on virtual environments, especially MUDs and VR, so as to provide IS researchers with a map by which to orient themselves and find pathways into the various research questions and theories pertaining to avatars, embodiment and presence in virtual worlds. The focus on embodiment and presence was chosen because the customizable avatar is the key IT artifact that distinguishes the graphical virtual worlds of today from earlier virtual environments. Given

the central role of the avatar and its affordances in virtual world technology, the research findings, concepts and theories presented in this paper are expected to be relevant to many areas of application, including education and business.

Before summarizing the key insights generated by this review, it is worth pointing out an essentialist bias in most of the prior literature. Most of the definitions and theories of presence, for instance, draw *a priori* boundaries around the 'real' and the virtual world, between the user and his/her virtual representation, and between presence and absence. For instance, the distinction between the actual, virtual, ideal and true self implies that these categories exist and that an individual can recognize and point to them. The sociomaterial lens that seems to be gaining some traction in IS research (Orlikowski and Scott, 2008), provides an alternative ontology that is much more appropriate to the study of virtual worlds (Orlikowski, 2010). By focusing on situated practice, sociomateriality sees the virtual-'real,' work-play, avatar-self and presence-absence boundaries as enacted, performed and always in the making (see Schultze, 2010 for an example). By adopting such a performative perspective (Barad, 2003), IS research has the opportunity to develop a much more contextualized and nuanced understanding of what it means to be embodied and present in a virtual environment.

This review has also highlighted a number of insights that IS research might pursue. These include the following:

Avatars enhance users' sense of presence

Avatars are not just associated with virtual worlds. Instead they are appearing in many communication media, including Internet Relay Chat (Kang and Yang, 2006), online chat (Galanxhi and Nah, 2007; Vasalou *et al.*, 2008), as well as email, most of which are commonly used in business contexts. One opportunity for IS research is to explore what implications avatars have on the communicative practices in these media, what forms of presence they invoke (for both sender and receiver), and what their presence implications are for communication efficacy.

People tend to create avatars that resemble their actual selves and this enhances their psychological immersion in virtual worlds

As virtual worlds have numerous applications in business and educational environments, gaining an understanding of how an avatar's appearance and behavioral affordances impacts a communicative objective and why, is likely to form a key theme in IS research. For instance, what should the user's embodiment be in order to activate the best form of presence, so that the more assertive attitude that the user brings to bear as an avatar in the virtual setting is likely to be added to the user's behavioral repertoire such that it becomes available in non-virtual settings also?

Furthermore, given that virtual world applications in organizational and educational settings typically identify users by their actual names, IS researchers have an opportunity to investigate what features of the avatar make the communicator perceive her virtual representation as reflective of her actual self, and what features allow others to recognize the avatar as a representation of the actual user. To the extent that these are in conflict, implying a

trade-off between the avatar-owner's and others' sense of realism and presence, guidelines for making these trade-offs and avatar customization will be needed.

Avatar appearance affects behavior in the virtual and the 'real' world

To the extent that virtual environments are used for diversity training or for playing out war game scenarios, both of which require the user to role-play another person, questions about the most effective virtual embodiment arise. How different from the actual user should the avatar be to maximize the user's sense of presence such that this perspective-taking exercise generates the desired learning and its lessons are transferred to settings other than the virtual world? Furthermore, in situations where the user's avatar is supposed to represent him/herself, how photo-realistic does the avatar need to be in order to enhance the user's sense of tele- and self-presence? If representational realism can be low, what are the minimal requirements for a user to still feel made present by the avatar?

In light of the uncontrolled nature of open grids such as Second Life, organizations have developed policies for the user's online presentation (e.g., a virtual world dress code) and/or have limited the customizability of avatars, thus making different users indistinguishable from each other. As people are unique, such policies and practices raise questions about the efficacy of the medium, especially with regard to tele-, social- and co-presence. This is an area ripe for future IS research.

Social norms and stereotypes from the 'real' world are replicated in the virtual world

Determining the circumstances (e.g., task objectives and group composition) under which extant social norms and stereotypes are useful *vs* harmful in virtual world settings presents another research opportunity. For instance, in the context of global, multi-cultural teams, whose social norms should be accepted versus adapted? How might the virtual environment be used to critically examine a group's taken-for-granted social conventions, and what affordances of avatars, objects and places would be helpful in developing and embedding a new set of social norms?

For instance, in their study of The Sims Online, Martey and Stromer-Galley (2007) noted a strong cultural norm of politeness, which they argued was largely shaped and maintained by the house metaphor underlying the design of this virtual world. Players transferred real-world expectations of being a guest in someone's home, as well as hosting behavior (i.e., welcoming guests and offering refreshments), into The Sims Online. Given the flexibility of virtual worlds, IS research might address questions around the design metaphors that could be employed to instill norms of reciprocity in teamwork or conventions of constructive debate in training and educational applications.

For realism and presence, behavioral fidelity is more important than visual fidelity

As most commercial virtual worlds are currently used for entertainment rather than business purposes, there appears to be little support for behaviors and bodily practices specifically designed for business. Identifying what objects

and bodily modes of interacting are needed for various business-related applications would give IS researchers an opportunity to critically assess communicative and work practices in 'real' organizations and the role of bodies and spaces in them.

No causal relationship between presence and in-world task performance has been identified

One question that prior research on presence fails to answer pertains to the value of presence with respect to certain outcomes like task performance and learning. Identifying pertinent dependent variables associated with virtual embodiment and presence, and empirically assessing their causal relationships, ought to be a priority in organization-focused research on virtual worlds.

Presence is a multi-faceted phenomenon

The multi-faceted nature of presence raises a number of research questions. The first set of questions pertains to the relationship among the different forms of presence. For instance, is telepresence a necessary condition for co-presence to occur? What shapes do the different forms of presence take: are they experienced as binary, graded or quick switching among the different forms? Another set of questions relates to the completeness of the list of presence types. Is there redundancy in the forms of presence reviewed here, or are there additional forms of presence that are enacted by virtual world users? Although some develop application-specific forms of presence, e.g., teaching and cognitive presence for educational settings (Garrison *et al.*, 2000; Anderson *et al.*, 2001), others argue for fewer presence types to enhance the construct's generalizability and applicability to future technologies (Lee, 2004).

The extant literature also fails to align the different theories of presence with the various forms of presence. In other words, it is not clear whether the technology-focused model of presence explains how tele-, social- and self-presence are activated. This presents an opportunity for IS researchers to identify (either theoretically or empirically) the theories of presence that best explain how different forms of presence are generated.

Conclusion

Highlighting that virtual worlds are increasingly relevant to organizational applications including virtual meetings, skills development through simulation and rehearsal, and idea and insight generation through role play, this article suggests that these technologies are increasingly in the IS discipline's purview. Given that our contemporary 3D, graphical virtual worlds have their roots in MUDs and VR, this paper has reviewed the extant literature on these virtual environments, with a focus on the concepts of embodiment and presence. This focus was chosen as the key affordances of the customizable avatar, a distinguishing feature of virtual worlds. The review has provided insight into the empirical research on embodiment and presence, most of which has been done outside of IS. Furthermore, it has summarized numerous concepts, definitions and theories related to embodiment and presence in virtual environments, and has identified numerous questions and themes

of inquiry that IS researchers interested in virtual worlds might pursue.

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Notes

- 1 The FutureWork Institute (www.FutureworkInstitute.com) has developed this application in Second Life.
- 2 The recent development of 3D technology for the home might make VR much more accessible though. In 2010, Sony launched a 3D controller called the PlayStation Move. It resembles the Wii but is able to depict the player's movement in 3D space.
- 3 A subset of VR technology, known as 'second person' VR, relies on avatars to represent the user (Heeter, 1992), but these representations have traditionally been of the generic, one-size-fits-all variety (Lok *et al.*, 2003).
- 4 As virtual experiences are perceived as 'real' and involve 'real' people, the term 'real' is problematic as an antonym for 'virtual.' Following Lee (2004), the term 'actual' will therefore be used instead of 'real' for the most part.
- 5 The term 'external world' highlights the information processing (Mokros and Deetz, 1996) or representational (Barad, 2003) perspective that underlies the extant literature's conceptualization of presence. This perspective assumes that the external world and objects within it exist, that we perceive them with our bodily senses, then rely on language to represent them and, in this abstracted form, make them amenable to mental information processing.
- 6 Evolutionary psychology explores how certain features of human behavior have been designed by natural selection to ensure the specie's survival (Riva *et al.*, 2004).

References

- Anderson, T., Rourke, L., Garrison, D.R. and Archer, W. (2001). Assessing Teaching Presence in a Computer-Conferencing Context, *Journal of Asynchronous Learning Networks* 5(1): 1–17.
- Anderson, T.C (2000). The Body and Communities in Cyberspace: A Marcellian analysis, *Ethics and Information Technology* 2(3): 153–158.
- Bailenson, J., Beall, A.C. and Blascovich, J. (2002). Gaze and Task Performance in Shared Virtual Environments, *The Journal of Visualization and Computer Animation* (13): 313–320.
- Bailenson, J., Yee, N., Merget, D. and Schroeder, R. (2006). The Effect of Behavioral Realism and Form Realism of Real-Time Avatar Faces on Verbal Disclosure, Nonverbal Disclosure, Emotion Recognition, and Copresence in Dyadic Interaction, *Presence* 15(5): 359–372.
- Barad, K. (2003). Posthumanist Performativity: Toward an understanding of how matter comes to matter, *Signs: Journal of Women in Culture* 28(3): 801–831.
- Becker, B. and Mark, G. (2002). Social Conventions in Computer-Mediated Communication: A comparison of three online shared virtual environments, in R. Schroeder (ed.) *The Social Life of Avatars*, London: Springer, pp. 19–39.
- Bente, G., Ruegggenberg, S., Kraemer, N.C. and Eschenburg, F. (2008). Avatar-Mediated Networking: Increasing social presence and interpersonal trust in net-based collaborations, *Human Communication Research* 34(2): 287–318.

- Biocca, F. (1997). The Cyborg's Dilemma: Progressive embodiment in virtual environments, *Journal of Computer Mediated Communication* 3(2): 1–18.
- Biocca, F., Harms, C. and Burgoon, J.K. (2003). Toward a More Robust Theory and Measure of Social Presence: Review and suggested criteria, *Presence* 12(5): 456–480.
- Blascovich, J. (2002). Social Influence within Immersive Virtual Environments, in R. Schroeder (ed.) *The Social Life of Avatars*, London: Springer, pp. 127–145.
- Bystrom, K.-E., Barfield, W. and Hendrix, C. (1999). A Conceptual Model of the Sense of Presence in Virtual Environments, *Presence* 8(2): 241–244.
- Carassa, A., Morganti, F. and Tirassa, M. (2005). A Situated Cognition Perspective on Presence, in B. Bara, L.W. Barsalou and M. Bucciarelli (eds.) *XXVII Annual Conference of the Cognitive Science Society*, Sheridan Printing, pp. 384–389.
- Cheng, L., Farnham, S. and Stone, L. (2002). Lessons Learned: Building and deploying shared virtual environments, in R. Schroeder (ed.) *The Social Life of Avatars*, London: Springer, pp. 90–111.
- Csikszentmihalyi, M. (1990). *Flow: The Psychology of Optimal Experience*, New York: Harper Collins.
- Daft, R.L. and Lengel, R.H. (1984). Information Richness: A new approach to managerial behavior and organizational design, in L.L. Cummings and B.M. Staw (eds.) *Research in Organizational Behavior*, Homewood, IL: JAI Press, pp. 191–233.
- Damasio, A.R. (1994). *Descartes' Error: Emotion, reason, and the human brain*, New York: Putnam.
- Damasio, A.R. (1999). *The Feeling of What Happens: Body, emotion and the making of consciousness*, San Diego: Hartcourt Press.
- Despres, D. (2009). Obama Healthcare Team and Second Life, in *Science Roll: A Doctor's Journey in Genetics, PhD and Medicine Through Web 2.0*. [www document] <http://scienceroll.com/2009/01/10/obama-healthcare-team-and-second-life/>.
- Donath, J., Karahalios, K. and Vidas, F. (1999). Visualizing Conversation, *Journal of Computer Mediated Communication* 4(4): 1–17.
- Dreyfus, H.L. (2009). *On the Internet*, 2nd edn. New York: Routledge.
- Ducheneaut, N., Yee, N., Nickell, E. and Moore, R. (2006). Alone Together? Exploring the social dynamics of massively multiplayer games, in conference proceedings on human factors in computing systems (CHI 2006). April 22–27, Montreal, Canada. 407–416.
- Durlach, N. and Slater, M. (2000). Presence in Shared Virtual Environments and Virtual Togetherness, *Presence* 9(2): 214–217.
- Eastwick, P.W. and Gardner, W.L. (2008). Is It a Game? Evidence for social influence in the virtual world, *Social Influence* 4(1): 18–32.
- Flach, J.M. and Holden, J.G. (1998). The Reality of Experience: Gibson's way, *Presence* 7(1): 90–95.
- Galanzhi, H. and Nah, F.F.-H. (2007). Deception in Cyberspace: A comparison of text-only vs Avatar-Supported Medium, *International Journal of Human-Computer Studies* 65(9): 770–783.
- Garau, M. (2006). Selective Fidelity: Investigating priorities for the creation of expressive avatars, in R. Schroeder and A.-S. Axelsson (eds.) *Avatars at Work and Play*, Dordrecht: Springer, pp. 17–37.
- Garau, M., Friedman, D., Ritter Widenfeld, H., Antley, A., Brogni, A. and Slater, M. (2008). Temporal and Spatial Variations in Presence: Qualitative analysis in interviews from an experiment on breaks in presence, *Presence* 17(3): 293–309.
- Garrison, D.R., Anderson, T. and Archer, W. (2000). Critical Inquiry in a Text-Based Environment: Computer conferencing in higher education, *The Internet and Higher Education* 2(2–3): 87–105.
- Gee, J.P. (2008). Video Games and Embodiment, *Games and Culture* 3(3–4): 253–263.
- Gibson, J.J. (1979). *The Ecological Approach to Visual Perception*, Boston, MA: Houghton Mifflin.
- Goffman, E. (1959). *The Presentation of Self in Everyday Life*, Garden City, NY: Doubleday.
- Harris, H., Bailenson, J., Nielsen, A. and Yee, N. (2009). The Evolution of Social Behavior over Time in Second Life, *Presence* 18(6): 434–448.
- Heeter, C. (1992). Being There: The subjective experience of presence, *Presence* 1(2): 262–271.
- Held, R.M. and Durlach, N.I. (1992). Telepresence, *Presence* 1(1): 109–112.
- Hoffman, H.G., Prothero, J., Wells, M.J. and Groen, J. (1998). Virtual Chess: Meaning enhances users' sense of presence in virtual environments, *International Journal of Human-Computer Interaction* 10(3): 251–263.
- Ihde, D. (2002). *Bodies in Technology*, Minneapolis, MN: University of Minnesota Press.
- Ijsselstein, W., Freeman, J. and De Ridder, H. (2001). Presence: Where are we? *CyberPsychology & Behavior* 4(2): 179–182.
- Jakobsson, M. (2002). Rest in Peace, Bill the Bot: Death and life in virtual worlds, in R. Schroeder (ed.) *The Social Life of Avatars*, London: Springer, pp. 63–76.
- Jennings, C. (2008). A Second Life for Virtual Worlds? *Computer Weekly*: [www document] <http://www.computerweekly.com/Articles/2008/12/03/233528/A-second-life-for-virtual-worlds.htm>.
- Jin, S.-A.A. (2009). Avatars Mirroring the Actual Self Versus Projecting the Ideal Self: The effects of self-priming on interactivity and immersion in an exergame, *Wii Fit*, *CyberPsychology & Behavior* 12(6): 761–765.
- Kafai, Y.B., Fields, D.A. and Cook, M.S. (2010). Your Second Selves: Player-designed avatars, *Games and Culture* 5(1): 23–42.
- Kang, H.-S. and Yang, H.-D. (2006). The Visual Characteristics of Avatars in Computer-Mediated Communication: Comparison of internet relay chat and instant messenger as of 2003, *International Journal of Human-Computer Studies* 64(4): 1173–1183.
- Kendall, L. (2002). *Hanging out at the Virtual Pub: Masculinities and relationships online*, Berkley, CA: University of California Press.
- Kim, T. and Biocca, F. (1997). Telepresence Via Television: Two dimensions of telepresence may have different connections to memory and persuasion, *Journal of Computer Mediated Communication* 3(2): 1–26.
- Kolko, B.E. (1999). Representing Bodies in Virtual Space: The rhetoric of Avatar design, *The Information Society* 15(2): 177–186.
- Lakoff, G. and Johnson, M. (1980). *Metaphors We Live By*, Chicago, IL: University of Chicago Press.
- Lee, K.M. (2004). Presence, Explicated, *Communication Theory* 14(1): 27–50.
- LeGoes, F. (2010). Digital Nation, PBS, *Frontline*, (February), [www document] <http://www.pbs.org/wgbh/pages/frontline/digitalnation/interviews/legoues.html>.
- Lessiter, J., Freeman, J., Keogh, E. and Davidoff, J. (2001). A Cross-Media Presence Questionnaire: The ICT-Sense of presence inventory, *Presence* 10(3): 282–297.
- Lok, B., Naik, S., Whitton, M. and Brooks Jr., F.P. (2003). Effects of Handling Real Objects and Self-Avatar Fidelity on Cognitive Task Performance and Sense of Presence in Virtual Environments, *Presence* 12(6): 615–628.
- Lombard, M. and Ditton, T. (1997). At the Heart if it All: The concept of presence, *Journal of Computer Mediated Communication* 3(2), [www document] <http://jcmc.indiana.edu/vol3/issue2/lombard.html>.
- Loomis, J.M. (1992). Distal Attribution and Presence, *Presence* 1(1): 113–119.
- Loy, D. (2007). Cyberbabe? *Ethics and Information Technology* (9): 251–258.
- Martey, R.M. and Stromer-Galley, J. (2007). The Digital Doll-House: Context and social norms in the sims online, *Games and Culture* 2(4): 314–334.
- McLuhan, M. (1964). *Understanding Media: The Extensions of Man*, New York: McGraw Hill.
- Minsky, M. (1980). Telepresence, *Omni* (2): 45–51.
- Mokros, H.B. and Deetz, S.A. (1996). What Counts as Real?: A Constitutive view of communication and the disenfranchised in the context of health, in E.B. Ray (ed.) *Communication & Disenfranchisement: Social health issues and implications*, Mahwah, NJ: Lawrence Erlbaum and Assoc., 29–44.
- Morrison, C. (2010). *Who Do They Think They Are? Teenage Girls and Their Avatars in Spaces of Social Online Communication*, New York: Peter Lang Publishing.
- Nash, E.B., Edwards, G.W., Thompson, J.A. and Barfield, W. (2000). A Review of Presence and Performance in Virtual Environments, *International Journal of Human-Computer Interaction* 12(1): 1–41.
- Nilsson, A., Heldal, I., Axelsson, A.-S. and Schroeder, R. (2002). The Long-Term Uses of Shared Virtual Environments: An exploratory study, in R. Schroeder (ed.) *The Social Life of Avatars*, London: Springer, pp. 112–126.
- Nowak, K.L. and Biocca, F. (2001). The Effect of the Agency and Anthropomorphism on Users' Sense of Telepresence, Copresence, and Social Presence in Virtual Environments, *Presence* 12(5): 481–494.
- Nowak, K.L. and Rauh, C. (2005). The Influence of the Avatar on Online Perceptions of Anthropomorphism, Androgyny, Credibility, Homophily, and Attraction, *Journal of Computer Mediated Communication* 11(1).
- Orlikowski, W.J. (2010). The Sociomateriality of Organizational Life: Considering Technology in Management Research, *Cambridge Journal of Economics* (34): 125–141.
- Orlikowski, W.J. and Scott, S.V. (2008). Sociomateriality: Challenging the separation of technology, work and organization, *Annals of the Academy of Management* 2(1): 433–474.
- Pena, J., Hancock, J.T. and Merola, N.A. (2009). The Priming Effects of Avatars in Virtual Settings, *Communication Research* 36(6): 838–856.

- Ratan, R. and Hasler, B.S. (2010). Exploring Self-Presence in Collaborative Virtual Teams, *PsychNology* 8(1): 11–31.
- Regenbrecht, H. and Schubert, T.W. (2002). Real and Illusory Interactions Enhance Presence in Virtual Environments, *Presence* 11(4): 425–434.
- Reiner, M. and Hecht, D. (2009). Behavioral Indications of Object-Presence in Haptic Virtual Environments, *CyberPsychology & Behavior* 12(2): 183–186.
- Riley, J. (2007). Virtual Worlds Are 2008's 'Breakthrough Technology', *Computer Weekly*, 2nd November, [www document] <http://www.computerweekly.com/Articles/2007/11/02/227900/virtual-worlds-are-2008s-breakthrough-technology.htm>.
- Riva, G. (2002). The Sociocognitive Psychology of Computer-Mediated Communication: The present and future of technology-based interactions, *CyberPsychology & Behavior* 5(6): 581–598.
- Riva, G. (2009). Is Presence a Technology Issue? Some insights from cognitive science, *Virtual Reality* 13(1): 159–167.
- Riva, G., Mantovani, F. and Gaggioli, A. (2004a). Presence and Rehabilitation: Toward second-generation virtual reality applications in neuropsychology, *Journal of NeuroEngineering and Rehabilitation* 1(9): 1–11.
- Riva, G. and Mantovani, G. (2000). The Need for a Socio-Cultural Perspective in the Implementation of Virtual Environments, *Virtual Reality* 5(1): 32–38.
- Riva, G. and Waterworth, J.A. (2003). Presence and the Self: A cognitive neuroscience approach, *Presence-Connect*, Vol 3, April issue, [www document] <http://presence.cs.ucl.ac.uk/presenceconnect/>.
- Riva, G., Mantovani, F. and Gaggioli, A. (2004a). Presence and Rehabilitation: Toward second-generation virtual reality applications in neuropsychology, *Journal of NeuroEngineering and Rehabilitation* 1(9): 1–11.
- Riva, G., Waterworth, J.A. and Waterworth, E.L. (2004b). The Layers of Presence: A bio-cultural approach to understanding presence in natural and mediated environments, *CyberPsychology & Behavior* 7(4): 402–416.
- Riva, G., Waterworth, J.A., Waterworth, E.L. and Mantovani, F. (2009). From Intention to Action: The role of presence, *New Ideas in Psychology* 11(2): 1–14.
- Rosenthal, B.E. (2009). Ernst & Young Uses Avatars to Test the Use of Virtual Worlds as a Way to Enhance Training for New Auditors, *Outsourcing Journal*, (March), [www document] <http://www.outsourcing-journal.com/mar2009-ac.html>.
- Sallnas, E.-L. (2002). Collaboration in Multi-Modal Virtual Worlds: Comparing touch, text, voice and video, in R. Schroeder (ed.) *The Social Life of Avatars*, London: Springer, pp. 172–187.
- Sanchez-Vives, M.V. and Slater, M. (2005). From Presence to Consciousness through Virtual Reality, *Nature Reviews: Neuroscience* 6: 332–339.
- Schloerb, D.W. (1995). A Quantitative Measure of Telepresence, *Presence* 4(1): 64–80.
- Schroeder, R. (2002). Social Interaction in Virtual Environments: Key issues, common themes, and a framework for research, in R. Schroeder (ed.) *The Social Life of Avatars: Presence and interaction in shared virtual environments*, London: Springer, pp. 1–18.
- Schroeder, R. (2006). Being There Together and the Future of Connected Presence, *Presence* 15(4): 438–454.
- Schubert, T.W. (2009). A New Conception of Spatial Presence: Once again, with feeling, *Communication Theory* 19(1): 161–187.
- Schubert, T.W., Friedmann, F. and Regenbrecht, H. (2001). The Experience of Presence: Factor analytic insights, *Presence* 10(3): 266–281.
- Schultze, U. (2010). A Performative Perspective on Virtual Worlds: The dialectics of the avatar-self relationship, paper presented at *Academy of Management*. Montreal.
- Schultze, U., Hiltz, R., Nardi, B., Rennecker, J. and Stucky, S. (2008). Synthetic Worlds in Work and Learning, *Communications of the AIS* 22(19): 351–370.
- Schultze, U. and Leahy, M.M. (2009). The Avatar-Self Relationship: Enacting presence in second life, *International Conference on Information Systems*, Phoenix, AZ: Association of Information Systems.
- Schultze, U. and Rennecker, J. (2007). Reframing Online Games: Synthetic worlds as media for organizational communication, in K. Crowston, S. Sieber and E. Wynn (eds.) *Virtuality and Virtualization*, Boston, MA: Springer, pp. 335–351.
- Shiano, D.J. (1999). Lessons from LambdaMoo: A social, text-based virtual environment, *Presence* 8(2): 127–139.
- Short, J., Williams, E. and Christie, B. (1976). *The Social Psychology of Telecommunications*, London: John Wiley & Sons.
- Slater, M. (1999). Measuring Presence: A response to the Witmer and Singer presence questionnaire, *Presence* 8(8): 560–565.
- Slater, M. (2003). A Note on Presence Terminology, *Presence-Connect* 3 (January) [www document] <http://presence.cs.ucl.ac.uk/presenceconnect/>.
- Slater, M. and Steed, A. (2002). Meeting People Virtually: Experiments in Shared Virtual Environments, in R. Schroeder (ed.) *The Social Life of Avatars*, London: Springer, pp. 146–171.
- Slater, M. and Wilbur, S. (1997). A Framework for Immersive Virtual Environments (Five): Speculations on the role of presence in virtual environments, *Presence* 6(6): 603–617.
- Soukup, C. (2004). Multimedia Performance in a Computer-Mediated Community: Communication as a virtual drama, *Journal of Computer Mediated Communication* 9(4): 1–30.
- Spagnoli, A., Varotto, D. and Mantovani, G. (2003). An Ethnographic, Action-Based Approach to Human Experience in Virtual Environments, *International Journal of Human-Computer Studies* 59(7): 797–822.
- Suchman, L.A. (2007). *Human-Machine Reconfigurations: Plans and situated action*, 2nd edn, New York: Cambridge University Press.
- Suler, J. (2004). *The Online Disinhibition Effect*. *CyberPsychology & Behavior* 7(3): 321–326.
- Tanis, M. and Postmes, T. (2007). Two Faces of Anonymity: Paradoxical effects of cues to identity in CMC, *Computers in Human Behavior* 23(9): 955–970.
- Taylor, T.L. (2002). Living Digitally: Embodiment in virtual worlds, in R. Schroeder (ed.) *The Social Life of Avatars: Presence and interaction in shared virtual environments*, London: Springer Verlag.
- Tims, A. (2010). L'oréal Hopes Recruitment Game Will Attract Top Graduates, *The Guardian*, 12th June, [www document] <http://www.guardian.co.uk/money/2010/jun/12/loreal-recruitment-game-top-graduates>.
- Tracy, S.J. and Trethewey, A. (2005). Fracturing the Real-Self <-> Fake-Self Dichotomy: Moving toward 'crystallized' organizational discourses and identities, *Communication Theory* 15(2): 168–195.
- Turkle, S. (1995). *Life on the Screen: Identity in the life of the internet*, New York: NY: Simon & Shuster.
- Vasalou, A., Joinson, A., Banziger, T., Goldie, P. and Pitt, J. (2008). Avatars in Social Media: Balancing accuracy, playfulness and embodied messages, *Human-Computer Studies* 66(6): 801–811.
- 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* 23(1): 3–43.
- Waterworth, E.L. and Waterworth, J.A. (2001). Focus, Locus, and Sensus: The three dimensions of virtual experience, *CyberPsychology & Behavior* 4(2): 203–213.
- Waterworth, J.A. and Waterworth, E.L. (2003). The Meaning of Presence, *Presence-Connect* 3 (February) [www document] <http://presence.cs.ucl.ac.uk/presenceconnect/>.
- Waterworth, J.A. and Waterworth, E.L. (2006). Presence as a dimension of communication: Context of use and the person, in G. Riva, M.T. Anguera, B.K. Wiederhold and F. Mantovani (eds.) *From Communication to Presence: Cognition, emotions and culture toward the ultimate communicative Experience*, Amsterdam: IOS Press, pp. 81–96.
- Witmer, B.G. and Singer, M.J. (2002 [1998]). Measuring Presence in Virtual Environments: A presence questionnaire, *Presence* 7(3): 225–240.
- Wolfendale, J. (2007). My Avatar, My Self: Virtual harm and attachment, *Ethics and Information Technology* 9(2): 111–119.
- Yee, N. (2006). The Psychology of Massively Multi-User Online Role-Playing Games: Motivations, emotional investment. Relationships and problematic usage, in R. Schroeder and A.-S. Axelsson (eds.) *Avatars at Work and Play*, Dordrecht: Springer, pp. 187–207.
- Yee, N. and Bailenson, J. (2007). The Proteus Effect: The effect of transformed self-representation on behavior, *Human Communication Research* 33(3): 271–290.
- Yee, N., Bailenson, J. and Ducheneaut, N. (2009). The Proteus Effect: Implications of transformed digital self-representation on online and offline behavior, *Communication Research* 36(2): 285–312.

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