1 Being There: The experience of presence in mediated environments

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Abstract. Presence, the experience of 'being there' in a mediated environment, has become closely associated with VR and other advanced media. Different types of presence are discussed, including physical presence, social presence, and co-presence. Fidelity-based approaches to presence research emphasize the fact that as media become increasingly interactive, perceptually realistic, and immersive, the experience of presence becomes more convincing. In addition, the ecological-cultural approach is described, pointing out the importance of the possibility of action in mediated environments, as well as the role that a common cultural framework plays in engendering a sense of presence. In particular for multi-user or collaborative virtual environments (CVEs), processes of negotiation and community creation need to be supported by the CVE design to enable communication and the creation of a social context within the CVE.

Contents

1.1   Where am I?

In 1978, the philosopher Daniel Dennett presented us with an interesting and entertaining thought experiment entitled 'Where am I?' as the last chapter of his *Brainstorms* book [1].

   Dennett recounts the story of a 'curious episode' in his life where his brain got surgically separated from his body, with each connection between them restored by placing two 'microminiaturized radio transceivers' between each input and output pathway. After the operation he, or rather his body, goes to visit his brain which was placed, in keeping with the best philosophical traditions, in a life-support vat. While looking with his own eyes at his own brain he starts to wonder:

> "*Being a philosopher of firm physicalist conviction, I believed unswervingly that the tokening of my thoughts was occurring somewhere in my brain: yet when I thought "Here I am," where the thought occurred to me was here, outside the vat, where I, Dennett, was standing staring at my brain.*" (p. 312)

Dennett reasons that the location of the 'I' he was referring to in the question 'Where am I?' may be related, though not identical, to his *point of view*. He states [1]:

> "*Point of view clearly had something to do with personal location, but it was itself an unclear notion. It was obvious that the content of one's point of view was not the same as or determined by the content of one's beliefs or thoughts. For example, what should we say about the point of view of the Cinerama viewer who shrieks and twists in his seat as the roller-coaster footage overcomes his psychic distancing? Has he forgotten that he is safely seated in the theater? Here I was inclined to say that the person is experiencing an illusory shift in point of view. In other cases, my inclination to call such shifts illusory was less strong. The workers in the laboratories and plants who handle dangerous materials by operating feedback-controlled mechanical arms and hands undergo a shift in point of view that is crisper and more pronounced than anything Cinerama can provoke.*" (p. 314-315)

What Dennett calls 'an illusory shift in point of view' nicely conceptualizes the central idea of presence and his examples are particularly well-chosen. Morton Heilig, arguably one of the virtual reality pioneers, described his experience with Cinerama as such:

> "*When the curtain swept up to reveal the now-legendary wide-screen roller coaster ride, I realized that the film's creators were no longer content to have me look at the roller coaster but were trying to put me physically on the ride. The audience no longer surrounded the work of art; the work of art surrounded the audience – just as reality surrounds us. The spectator was invited to plunge into another world. We no longer needed the device of identifying with a character on the other side of the 'window.' We could step through it and be a part of the action!*"

The Cinerama experience was often likened to being transported to other lands. Escape from reality - to be able do anything one may desire to do, and go anywhere one wishes - seems to be one of the basic motivations behind the appeal of media in general, and the fascination with virtual environments (VEs) in particular. With telerobotics, the illusory shift in point of view entails a sense of 'distal attribution', the externalization of the self to include remote tools that phenomenologically become part of one's own body, even if they are not physically part of it [2]. These experiences, both with interactive and non-

interactive media, share a number of characteristics, most notably a displacement of the participant's self-perception, and a sense of transparency of the medium, of direct perceptual stimulation without an awareness of the remoteness in time or space of the simulated or reproduced realities.

As a user experience, the feeling of 'being there', or presence, is not intrinsically bound to any specific type of technology – it is a product of the mind. In normal, daily life we are seldomly aware of our sense of presence in the world. It is not an experience we are used to reflecting upon. As conscious and awake perceivers we have little doubt of the visible three-dimensional world which extends in front of us, and that we are part of this space. It may take something like an altered psychological state (e.g. a dream or hallucination), a leap of the imagination (like Dennett's thought experiment), or a mediated perception (through e.g. cinema) to make us become aware of this 'default' experience.

With the advent and improvement of immersive displays, computing and network technologies, and interactive computer graphics, we can create more accurate reproductions and/or simulations of reality than were previously possible. This makes us increasingly aware of the relevance of the presence experience for the design and evaluation of media experiences. It seems fair to say that the concept of presence has today become common currency in areas such as virtual environments, advanced broadcast and cinematic displays, teleoperation systems, and advanced telecommunication applications.

Since the early 1990's, a growing community of multidisciplinary researchers has turned its attention to presence, looking at what causes it, how the experience may be measured, and what effects it has on the media user.

1.2   The structure of presence

There is consensus that the experience of presence is a complex, multidimensional perception, formed through an interplay of raw (multi-)sensory data and various cognitive processes – an experience in which attentional factors play a crucial role as well [3]. Two general categories of variables can determine a user's presence: (i) media characteristics, and (ii) user characteristics. This differentiation is in line with the distinction made by Slater and colleagues' [4-7] (between "external" (objective) and "internal" (subjective) determinants of presence. Characteristics of the medium can be subdivided into media *form* and media *content* variables. Both of these are known to have a significant impact on the individual's sense of presence such that, depending on the levels of appropriate, rich, consistent, and captivating sensory stimulation, varying levels of presence can be produced.

Sheridan [8] proposed three categories of determinants of presence: (i) the extent of sensory information presented to the participant, (ii) the level of control the participant has over the various sensor mechanisms and (iii) the participant's ability to modify the environment. These three factors all refer to the media form, that is, to the physical, objective properties of a display medium. Additionally, the media content is of vital importance – that is, the objects, actors, and environments represented by the medium, often tied together in a logical flow of events known as the narrative or story, are essential in keeping the user interested and involved. Social elements, such as the reactions of other actors, virtual or real, to the user's presence in a mediated environment provide an acknowledgement to the user that signals the reality of his or her existence in virtual space.

As a product of the individual's mind, it is highly likely that the presence experience will vary significantly across individuals, based on differences in perceptual-motor abilities, mental states, traits, needs, preferences, experience, etc. For a more detailed overview of presence determinants, we refer to IJsselsteijn, de Ridder, Freeman, and Avons [9] or Sadowski and Stanney [10].
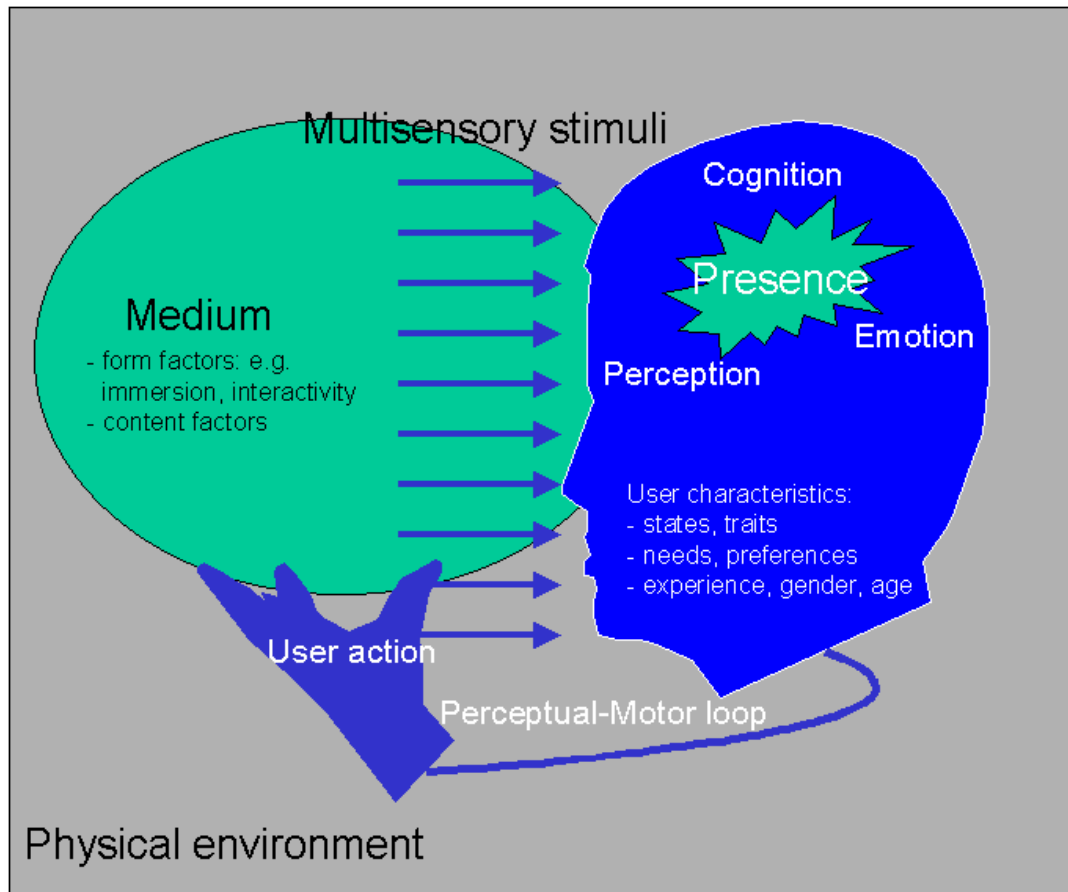
Figure 1.1 A general framework of presence.

In Figure 1.1, we have summarized the main factors that are likely to play a role in determining the presence experience. In this diagram, the continuous perceptual-motor loop reflects the ongoing process of real-time action-based perception, i.e. perception that changes dynamically as we move through and interact with the world in real-time.

Importantly, multisensory stimulation arises from both the physical environment as well as the mediated environment. There is no intrinsic difference in stimuli arising from the medium or from the real world – the fact that we can feel present in either one or the other depends on what becomes the dominant perception at any one time. Both bottom-up and top-down processes will play a significant role in determining this – presence in a mediated environment will be enhanced when the environment is immersive and perceptually salient, as well as when attentional selection processes are directed towards the mediated environment, thus allowing the formation of a consistent environmental representation [6, 7]. Draper et al. [3] describe how both the computer-mediated world and the local environment may compete for limited attentional resources. Telepresence occurs when more attentional resources are allocated to the computer-mediated environment: "The more attentional resources that a user devotes to stimuli presented by the displays, the greater the identification with the computer-mediated environment and the stronger the sense of telepresence" (p. 366). This is in line with Slater and Steed's [7] notion of presence as a perceptual mechanism for organizing the incoming stream of sensory data into a coherent environmental gestalt, thus essentially selecting between alternative hypotheses of self-location: 'I am in this place' versus 'I am in that place'. Again, the question 'Where am I?' appears to be of fundamental importance.

Factor analytic studies are starting to shed light on the multidimensional structure of presence. In particular, studies by Schubert, Friedman, and Regenbrecht [11] and Lessiter, Freeman, Keogh, and Davidoff [12] reveal very similar factor structures. Schubert et al. [11] arrived at a 3-factor solution for the presence construct, which they termed 'spatial presence', 'involvement', and 'realness'. Similarly, Lessiter et al. [12] reported a 4-factor solution for presence, with three factors almost identical to the ones identified by Schubert and colleagues: 'physical space', 'engagement', and 'naturalness', and a fourth attenuating factor they termed 'negative effects'. Importantly, both Schubert's 'involvement' factor and Lessiter's 'engagement' factor point at a central role for attentional mechanisms in engendering a sense of presence.

A measure of presence that is reliable, valid and robust is an essential tool in designing and evaluating media from a user-centred perspective. It will allow engineers and media developers to identify the factors (and trade-offs between them) needed to optimise the level of presence for the media user. Moreover, a good presence measure will allow the research community to further develop its understanding and systematic investigation of the construct, which will in turn enable further refinement of measurement methodologies, and so on. To date, a variety of presence measures have either been proposed or used which can generally be classified into subjective and objective corroborative approaches.

The former is by far the most common approach taken and is usually questionnaire-based. The latter approach may involve the measurement of various behavioural and psychophysiological responses, which are thought to be sensibly related to the medium manipulation under study. Importantly, both approaches present complementary ways of measuring presence, and should ideally be used together to overcome limitations of either approach alone (for review and discussion see IJsselsteijn et al., [9, 13]; Insko, this volume). Despite considerable progress in investigating several candidate measurement methodologies, measuring presence in a reliable, valid and robust way still remains one of the main research challenges of the field [13-15].

1.3   Types of presence

Lombard and Ditton [16] reviewed a broad body of literature related to presence and identified six different conceptualizations of presence: realism, immersion, transportation, social richness, social actor within medium, and medium as social actor. Based on the commonalities between these different conceptualizations, they provide a unifying definition of presence as the 'perceptual illusion of non-mediation', i.e. the extent to which a person fails to perceive or acknowledge the existence of a medium during a technologically mediated experience. The conceptualizations Lombard and Ditton identified can roughly be divided into two broad categories – physical and social. *Physical presence* refers to the sense of being physically located in mediated space, whereas *social presence* refers to the feeling of being together, of social interaction with a virtual or remotely located communication partner. At the intersection of these two categories, we can then identify *co-presence* or a sense of being together in a shared space, combining significant characteristics of both physical and social presence. Figure 2 illustrates their relationship with a number of media examples that support the different types of presence to a varying extent. For example, while a painting may not necessarily support physical presence to any great extent (although trompe l'oeil and panorama paintings may be examples to the contrary), interactive virtual reality (VR) technology has the potential to engender a high sense of physical presence.
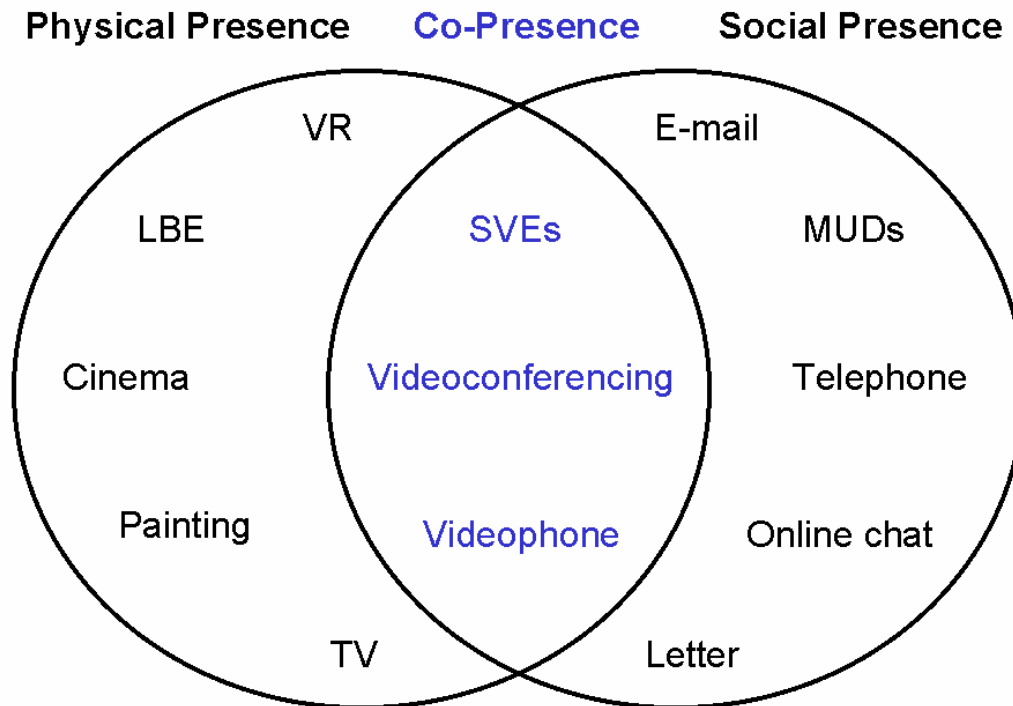
Physical Presence   **Co-Presence**   **Social Presence**

VR   E-mail

LBE   SVEs   MUDs

Cinema   Videoconferencing   Telephone

Painting   Videophone   Online chat

TV   Letter

Figure 1.2 A graphical illustration of the relationship between physical presence, social presence and co-presence, with various media examples. Abbreviations: VR = Virtual Reality; LBE =Location-Based Entertainment; SVEs = Shared Virtual Environments; MUDs = Multi-User Dungeons (from [13]).

It is clear that social and physical presences are distinct categories that can (and should) be meaningfully distinguished. Whereas a unifying definition, such as the one provided by Lombard and Ditton [16] accentuates the common elements of these different categories, it is of considerable practical importance to keep the differences between these categories in sight as well.

The obvious difference is that of *communication* which is central to social presence but unnecessary to establish a sense of physical presence. Indeed, a medium can provide a high degree of physical presence without having the capacity for transmitting reciprocal communicative signals at all. Conversely, one can experience a certain amount of social presence, or the 'nearness' of communication partners, using applications that supply only a minimal physical representation, as is the case, for example, with telephone or internet chatrooms. This is not to say, however, that the two categories are unrelated. There are likely to be a number of common determinants, such as the immediacy of the interaction, that are relevant to both social and physical presence. As illustrated in Figure 1.2, applications such as videoconferencing or shared virtual environments are in fact based on providing a mix of both the physical and social components. The extent to which shared space adds to the social component is an empirical question, but it seems likely that as technology increasingly conveys non-verbal communicative cues, such as gaze direction or posture, social presence will increase.

1.4   Why study presence?

"The overriding goal in designing a ride-film attraction is to make the guests feel as if they are in the experience, not just watching it. I want them to go places they've never been, see things they've never seen, and feel things they've never felt before. I want to completely inundate their senses with explosive sights, sounds, and feelings. And I want them to come back to do it again. Most importantly, every simulator experience I design and direct is another chance to get closer to creating that ultimate believable reality."

From *Seafari: An expedition into motion base ride filmmaking* by Mario Kamberg, 1998.

"What do people do at work? They go to meetings. How do we deal with meetings? What is it about sitting face to face that we need to capture? We need software that makes it possible to hold a meeting with distributed participants -- a meeting with interactivity and feeling, such that, in the future, people will prefer being telepresent."

Bill Gates, MIT, 1999

Historically, research interest in presence has mainly been motivated by work in three related domains: teleoperation, simulation and telecommunication. Teleoperation has been driven to a large extent by the ideal of telepresence, i.e. sensing sufficient information about the teleoperator device and remote task environment, and communicating this to the human operator in a sufficiently natural way, that the operator feels physically present at the remote site (referred to earlier as distal attribution).

Advanced simulation systems, such as those used for flight and combat training, have long been known to engender a sense of presence in their participants, and although the relation of presence to task performance within the simulated setting has been a matter of some debate (see e.g. Ellis, [17]; Welch, [18]), there is little doubt that training transfer to real-world settings benefits from a realistic simulation. More recently, computing power and rendering possibilities have dramatically increased and have made it possible to create virtual environments of ever increasing realism, at a fraction of the cost of professional simulation systems. Virtual environments can be made so convincing that they can lead to a feeling of presence in the created environment (see e.g. Slater & Wilbur, [19]).

From a telecommunication perspective, social presence, or the feeling of being together, has received considerable attention for several decades already (see e.g. Short, Williams & Christie, [20]). The emergence and proliferation of email, mobile communication devices, internet chatrooms, shared virtual environments, advanced tele-conferencing platforms and other telecommunication systems underlines the importance of investigating the basic human need of communication from a multidisciplinary perspective that integrates media design and engineering, multisensory perception, and social psychology. Add to this the increasingly social nature of interfaces and the increase in mediated communications with non-human entities (avatars, embodied agents), it becomes abundantly clear that we need to develop a deeper understanding, both in theory and in practice, of how people interact with each other and virtual others through communication media. The experience of social presence within different contexts and through different applications thus becomes a concept of central importance.

A common theme linking the above examples is that presence research offers the possibility to engineer a better user experience, to optimize the effectivity, efficiency and pleasurability of the different applications. From an application viewpoint, presence

research will spur the development of numerous tele-applications in home and professional environments. Such tele-applications have the potential to support a great number of activities, including communication, work, education, shopping, banking, health monitoring, and entertainment.

Inasmuch as these tele-applications will partially make redundant the necessity for traveling physically, they will contribute to a more sustainable use of limited resources and will put less strain on the environment in terms of pollution. In addition, they will enable individuals that are physically unable to travel to actively participate in activities previously beyond their reach.

Another recent area of application with the potential of being extremely beneficial to a large number of people is the use of VE technology in the service of psychotherapy [21], in particular for the treatment of phobias (e.g. fear of heights, fear of spiders, fear of flying, etc.) [22, 23] and body image disturbances [24, 25]. Results in this area have been promising, and presence research has the potential to contribute significantly by addressing questions such as: What is the necessary level of presence needed in order for VE psychotherapy to be effective? What elements in a representation of a feared situation are fundamental in order to achieve this sense of presence? How much like a real spider does the virtual spider have to look and behave?

A more fundamental reason for studying presence is that it will further our theoretical understanding of the basic function of mediation: How do media convey a sense of places, beings and things that are not here? More importantly even, presence research provides the necessary bridge between media research on the one hand and the massive interdisciplinary program on properties of perception and consciousness on the other [26].

1.5   Cultural issues

In 1.2 we have seen that there are two general categories of variables that determine a user's presence: (i) media characteristics, and (ii) user characteristics. What is the link between these two variables? As noted by Lombard and Ditton [16] presence can be described as "perceptual illusion of nonmediation", a level of experience where the VR system and the external physical environment disappear from the user's phenomenal awareness: the term *perceptual* shows that the illusion "involves continuous (real time) responses of the human sensory, cognitive, and affective processing systems to objects and entities in a person's environment." And, what's more, a subject experiences an *illusion of nonmediation* when he or she "fails to perceive or acknowledge the existence of a medium in his/her communication environment and responds as he/she would if the medium were not there".

For Slater and colleagues [5, 19] the notion of presence includes three aspects:

> "*the sense of being there in the environment depicted by the VE;*" · "*the extent to which the VE becomes the dominant one, i.e., that participants will tend to respond to events in the VE rather than in the real world;*"   "*the extent to which participants, after the VE experience, remember it as having visited a place rather than just having seen images generated by a computer.*" (pp. 560-561).

In fact, these authors [6, 7] differentiate between *immersion* and *presence* [6]: "Immersion is simply a description of overall fidelity in relation to physical reality provided by the display and interaction systems. In this view presence research is essentially that of carrying out experiments that manipulate the variables that make up immersion, in order to build an equation with presence on the left hand side, and the factors of immersion on the

right hand side. Individual differences between people can be also included as variables on the right hand side" (p.14). According to this vision, the perceptual illusion of non-mediation is provided by the fidelity, in relation to physical reality, provided by the medium.

A different position is offered by the ecological/cultural approach [27-30] whose focus concentrates on action within a social context (how actors exploit affordances in a given situation) rather than how things look and sound. The roots of this position are in Heidegger's philosophy [31], in the theory of perception of J. Gibson [32], and in the cultural psychology of M. Cole [33]. For these authors, the environment does not provide undifferentiated information or ready-made objects equal for everyone. It offers different opportunities according to the actors, their social context, and their goals and needs. *Affordances* are not "things which are outside" simply waiting for someone to come and take a photograph of them. They are resources, which are only revealed to those who seek them [34]. Following this approach, Zahoric & Jenison [27] underline that *"presence is tantamount to successfully supported action in the environment"* (italics in the original). In their vision the reality of experience is defined "relative to functionality, rather than to appearances". What is important in this approach are the affordances offered in the medium and the actions needed to exploit them. A key role is also played by the social distribution of knowledge and action, the cultural grid providing the common reference ground for joint activity, and the rules governing it. As noted by Cole & Engestrom [35]:

> ''*Within each local setting, such 'cognitive actions' as remembering and decision making are distributed not only among the artifacts (the menu, the arrangement of chairs and tables, the sign pointing to the restrooms) but among the rules (one pays before leaving the premises; sitting up at a table with strangers requires one to ask permission) and among people according to the division of labor*'' (pp. 17–18).

Tracing a surprising parallel between the task of VR designers and that of phone sex workers - two figures who have the task of making the human body visible by means of extremely narrow channels of communication and who succeed in their task to the extent in which they use powerful, shared, cultural codes - Stone [36] describes the context, as composed mainly of symbolic references which allow actors to orient and coordinate themselves.

Following these considerations Mantovani & Riva proposed a *cultural* concept of presence as a social construction [29, 34]. Lying at the base of this view are three elements, which promise an elevated sense of presence: a *cultural framework*, the possibility of *negotiation*, both of actions and of their meaning, and the possibility of *action*. Within this view, experiencing presence and telepresence does not depend so much on the faithfulness of the reproduction of 'physical' aspects of 'external reality' as on the capacity of simulation to produce a context in which social actors may communicate and cooperate [37]. This may also explain how it is possible to speak of a sense of presence in text-based virtual environments, commonly called MUDs (Multi-User Dungeons). Although these environments are poor from the sensory viewpoint, recent research on 207 MUD users showed that 69% of the subjects did feel a sense of presence [38].

A study analyzed a large sample of visitors to Walt Disney World's Epcot Center to identify the aspects that lead to a more realistic experience of a VR ride [39]. The results showed that aspects of immersive interfaces, including displays, graphics and control device quality were not as important to the users as the "physics fidelity" (e.g. motion) of the rides, their background stories and goals.

As noted by Draper and colleagues [3] the ability of a VE to create a rich computer-mediated world does not annul the responsibility of designers to tailor interfaces to meet the task-dependant needs of the user. It is true that rich and immersive interfaces can

display much more information and in a more compelling way than was possible with non-immersive technology. However, it is also true [3] that "in some cases, simple map reading has been more effective in imparting knowledge about an environment than experience in a virtual representation of that environment" (p. 361). First, VEs are designed to serve a purpose, so must be designed with intended users' tasks and goals explicitly considered [34] Moreover, during the VR experience the knowledge relevant to the goal should be distributed, and actions should be coordinated.

1.6   Social issues

In paragraph 1.3 we defined *co-presence* as the intersection between physical presence and social presence: the sense of being together in a shared space. Co-presence plays a critical important in *collaborative virtual environments* (CVEs), multi-user virtual environments that are designed to support collaborative activities. On one side, being in a synthetic environment, the extent to which the participants feel present in it will depend on the same factors that determine presence in single-user virtual environments. On the other side, being it shared, additional factors will be relevant.

Particularly, to support collaborative activities VEs should provide task appropriate information representation and communication tools embedded in the environment in which activities happen [40]. According to Durlach and Slater [41], the sense of presence in a shared virtual environment will be increased by fostering interactions with the environment in which alterations of the environment caused by actions of one participant are clearly perceived by the other participants. As noted by Mantovani and Riva [29]:

> "*Action in everyday situations is not just made up of movements, which single individuals execute, but is part of a strategic game in which certain goals, both individual and collective, are aimed at, through the joint efforts of several actors. In order to be achieved, many human activities – work, play, dancing, courting – require that knowledge relevant to the goal be distributed and that actions be coordinated among the various actors by means of cultural modes which pre-exist those interactions (between actors, and between them and the environment) and make them possible*" (p. 545).

However, subjects vary tremendously in their negotiation strategies, both of actions and of their meaning, as well as in their task accomplishment process [40]. The difficulty of managing negotiation has two consequences for the design of CVEs [42]:

– the only way to understand negotiation is by analyzing the subjects involved in the environment in which they operate. This means that the social context in which the VR experience occurs plays a crucial role;
– new processes and activities will develop during interactions which challenge and change the initial relationship between subject and context. So clinical oriented VEs have to be flexible enough to handle these changes without imposing constraints to the interaction.

Churchill & Snowdon [40] recently identified a series of key issues a VE developer has to face for supporting the negotiation process (pp. 5-7):

1. *the transition between shared and individual activities*: Actors should know what is currently being done and what has been done in the context of the task goals.
2. *flexible and multiple viewpoints and representations*. Tasks often need use of

multiple representations each tailored to a different point of view and different subtasks.

3. *a shared context*: The shared context is composed of symbolic references which allow actors to orient and coordinate themselves. It includes the shared knowledge of each others' current activities, shared knowledge of each others' past activities, shared artifacts and shared environment.

4. *the awareness of others*: This awareness includes both the knowledge of shared task related activities and the sense of co-presence.

5. *the support to communication activities*: Negotiation through face-to-face talks is important for collaboration. In fact, conversation analytic studies of negotiation at work have detailed how subtle verbal and non verbal contribute to such negotiation.

However, this is more difficult in VR than in other computer-based activities. In face-to-face communication facial expression and body posture play an important role. To reproduce these features in the shared virtual world is a complex task. In particular, it requires a trade-off between the use of direct, pass-through video of the participants or the use of special sensing systems to extract the relevant visual information about the participants and the use of special algorithms to generate the appropriate expressions and postures for the avatars [41]. As noted by Oravec [43], VR forces individuals "to deal with such issues of image manipulation and distortion on an immediate and personal basis, as participant immersed in fast-moving interaction" (p. 51). This adds layers of complexity to an already-overwhelming set of social constructs.

Many developers of multi-user VR systems are aware of this and are conscious of the need to "create community" in the context of their efforts [43]. Even if many traditional means for creating community are not available, a great effort is given to the creation of virtual town squares or meeting rooms. According to Coate [44] the work of maintaining virtual communities is similar to the one of an innkeeper: facilitating interaction and keeping order among patrons. In fact, if multi-user VR has to serve as community for its users, it has to embody, or replace with adequate substitutes, some functions of community life that parallel those commonly provided by "traditional" communities.
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1.7   Conclusion

It will likely be some time before simulations and/or reproductions of reality will provide the level of realism and interactivity required to make us pose Dennett's 'Where am I ?' question from a slightly different perspective, trying to distinguish between reality and virtuality. However advanced such systems eventually may become from a technological point of view, the social acceptance and uptake (and consequent commercial success) will depend to a large extent on users' experiences and responses towards them. It is here that research into presence and other user-centered concepts (e.g. usability, flow, affective responses) is of particular importance, since it has the potential to help us move beyond a technology-push approach, and ask questions concerning *purpose* and *context of use*. These questions are essential to the success of any human-centered technology.

Clearly, research into presence will have to extend beyond a search for realism or fidelity only. Although the experience of presence becomes more convincing as media become more interactive, immersive, and perceptually realistic, it is interesting to note that we already can feel present in environments which will not be mistaken for reality if we were to be asked. Even the impoverished world that VR provides appears to be sufficient for a perception of 'being in' the computer-generated environment. When considering the minimal cues provided by VR to our perceptual apparatus, it becomes clear that the experience is not governed solely by bottom-up sensory input, but that appropriate top-

down knowledge interacts with these input signals to construct an *apparently* coherent and complete mental representation of space. As with the so-called 'real world', the experience of a complete and vivid virtual world, continuous in space and time, is an illusion based on the opportunistic, economical, and top-down nature of our perceptual system.

On the social and cultural side, two core characteristics of the presence experience are the perceptual illusion of nonmediation and the possibility of building and sharing a common ground. The first characteristic of a satisfying virtual environment is the *disappearance of mediation*, a level of experience where both the VR system and the physical environment disappear from the user's phenomenal awareness. When this happens, the user is not simply an external observer of pictures or one who passively experiences the reality created by the computer, but on the contrary may actively change the three-dimensional world in which he is acting, in a condition of complete sensorial immersion.

The second characteristic is the possibility of *building and sharing a common ground* through the interaction process. Through interaction, individuals share empathy and, in multi-user VR, form groups that share interests. So, information exchange becomes the carrier for expressing self-concept and eliciting emotional support.

At the end we can include in presence research a socio-cultural focus [29] that (a) recognizes the mediated character of every possible experience of presence; (b) always conceives experience as immersed in a social context; (c) stresses the component of ambiguity inherent in everyday situations; (d) highlights the function of confirmation which culture (artifacts and principles) plays.

Breaking down this idea into formulas, we may say that [29, p. 545]:

– presence is always mediated by both physical (our body, technological devices, etc.) and conceptual tools which belong to a given culture: "physical" presence in an environment is no more "real" or more true than telepresence or immersion in a simulated virtual environment;
– the criterion of the validity of presence does not consist of simply reproducing the conditions of physical presence (immersion) but in constructing environments in which actors may function in an ecologically valid way:, in line with the emphasis that the ecological approach places on the primacy of action in perception;
– action is not undertaken by isolated individuals but by members of a community who face ambiguous situations in a relatively coordinated way.

In this sense, experiencing presence requires the reproduction of the physical features of external reality; the possibility of interaction and free action, and the creation and sharing of the cultural web that makes meaningful - and therefore visible - both people and objects populating the environment.

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