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Presence in the Future

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Abstract

*We view the **sense of presence** as being the result of an evolved neuropsychological process, created through the evolution of the central nervous system, and which solves a key problem for an organism's survival: how to differentiate between the internal (the self) and the external (the other). When we experience strong **mediated presence**, our experience is that the technology has become part of the self, and the mediated reality part of the other. There is no attentional **effort of access** to information. We can perceive and often act directly, as if unmediated. The rapidly developing phenomena of mediated presence point beyond the replacement of the world with virtual other worlds, and towards dynamically changing relationships between self (and selves) and others. We discuss the implications these developments for the future of the sense of presence and of presence research.*

1. The past and future evolution of presence

We see the natural, unmediated sense of presence as the feeling of being somewhere in the world, in the present. It is the means by which an organism knows when something is happening in the world at the present, and is the manifestation of an encoded ability to know when consciousness is occupied with situations in the immediate, outside world. To survive, an organism must feel directly when they are attending to the external world; this is the feeling we call *presence*. The strength of the feeling of presence reflects the extent to which *conscious attention* is focused on the non-self, *the other*.

In previous papers, we suggested that through evolution this developed into the ability to distinguish external, physical events and situations from events and situations realized mentally, in thought and imagination [1, 2, 3]. This cannot be done through emotional appraisal or reality judgments, since imagined situations trigger the same emotional responses as physical situations [4], and may also seem real or unreal (as may physical events).

Both perception and imagination are uncertain processes, but we must somehow judge the significance of events. We can and often do misperceive aspects of the environment [5] and we may imagine or remember scenarios, which never did, or could, take place. Yet to survive we must try to answer, fast and unconsciously, at least three questions about situations of which we are conscious (though not necessarily in this order):

(i) Is this happening in the world around me, or only in my head?
(ii) Is this likely to be true or is it fiction? and
(iii) Is this good or bad for me (and how good or bad)?

We suggest that the answer to (i) is the degree of presence felt, the answer to (ii) is arrived at through a reality judgment, and the answer to (iii) is the strength of a positive or (more commonly) negative emotional response.

Presence mediated by information and communication technologies (ICTs) is the feeling of being in an external world, in the realization of which technology plays an active and direct role. To arise and persist, it requires adequate form to be directly perceived, conscious attention to that form, and content that will sustain such attention. Although presence can be distinguished from emotion, an important aspect of designing for specific degrees of presence is the evocation of explicit types of emotional state [e.g. 6]. The three-layer model of presence [7] provides one way of thinking about presence, and its relationship to emotional experience, in terms of the fundamental psychological distinction between self and other.

The rapidly developing phenomena of mediated presence point to a dynamically changing relationship between self and other. When we experience strong mediated presence, our experience is that the technology has become part of the self, and the mediated reality part of the other. When this happens, there is no conscious *effort of access* to information, nor *effort of action* to overt responses. We can perceive and act directly, as if unmediated.

In the remainder of this paper, we discuss the implications of this view, and of the likely course of technological innovations in this area, for the future of presence and of presence research.

2. Action and altered body experiences

Sanchez-Vives and Slater [8] argue that "[mediated] presence is a phenomenon worthy of study by neuroscientists and may help towards the study of consciousness, since it may be regarded as consciousness within a restricted domain". Since

in a virtual reality all technical aspects affecting the experience can be controlled and replicated precisely, it would seem obvious that virtual reality provides a powerful paradigm for experimenting with the impact of various external cues on perception, with presence measures serving as dependent variables. And this could be done at different levels of detail, for both top-down and bottom-up processes. Sanchez-Vives and Slater [8] also suggest that "[mediated] Presence occurs when what is said about consciousness occurs within the domain of a virtual reality". But this seems to imply that if one is conscious one will feel presence in a virtual reality, which is clearly not the case. This partly motivates our emphasis on what is not presence but is still conscious, which we have termed *absence* [1]

Earlier [9] support for the role of presence experiments in understanding the concept of minimal cues is based on the idea that there are determinable minima of, say, the number of modalities or level of scenic detail which underlie presence and, hence, perception. We think this should be viewed with some caution. While it is generally agreed that we do not need all details of an unmediated situation to be reproduced (and of course they never are or could be), and that remarkable low fidelity simulations can sometimes induce high levels of presence, it doesn't follow that this is because there are generalisable minimal cues that are the key to the generation of a convincing sense of presence. Overt action is a strong indicator of high presence, as when immersants in a virtual reality really try to run away from a portrayed dangerous situation. One might think that the richness of cues could be systematically reduced to find the minimal cues needed for this to happen. But it seems likely that this will depend on a host of other factors including who the immersant is, who they are with, how the situation is understood by them before they get into it, and whether they have experienced this situation before, etc.. We should remember that when the Lumière brothers first showed grainy, jumpy, black and white, but moving images of a train coming into a station, people 'screamed, ducked or even ran out of the theatre' (p. 24) [10]. And we should also keep in mind that presence is not an all or none thing. We rarely, if ever, feel totally present, whether this is in a virtual reality or in physical reality.

While we can question the future of searching for minimal cues to *presence*, virtual realities will be valuable in searching for minimal cues for perception-based *action*, both in animals and in humans. Research on such minimal cues is beginning to use virtual reality to access the precise sensory information needed, for example, for a fly to adjust its flight adaptively [11]. But a fly, presumably, does not share its attention between internal and external world models. If we assume that these relatively simple animals are conscious, and that they are conscious of all they perceive, then for them perception *is* presence. (If they are not conscious, then they do not feel present at all.) This is not the case with humans.

Action is not always an indicator of conscious attention, and our view implies that it is on such attention that presence depends. Overt actions are often indicators of presence, but action can be automatised, reflex, or otherwise unconscious – or at least not bearers of conscious intention. It is possible to feel high levels of presence without actually acting. At the extreme, a victim of paralysis may feel extremely present – the fact of being paralysed might be expected to maximize presence in horrific or otherwise threatening situations, just because action to leave or modify the situation is not possible. Presence is maximized when there is no attentional 'effort of access' to information (nor attentional 'effort of action', if action is possible).

New interface methods directly question our understanding of what presence is and how mediated presence will evolve. So called brain/computer interfaces (BCIs) allow a person to make direct inputs to the computer by thought. Typically, electrodes attached to the scalp or implanted on the surface of the brain allow electrical activity of the brain to control external devices (see [12] for a summary). With practice, a user can play a simple game (such as on-screen 'pong'), move a cursor around and select from options (to compose a test message, for example) or, more, interestingly, navigate through a virtual world (or, indeed, a real one if seated in a computer-controlled wheelchair or other vehicle). Since there is significant attentional 'effort of action', we would predict that the user will not feel much presence, reflecting that the technology will not be felt to be a part of the self, psychologically speaking. But with much practice, and in light of the potential for plasticity in the brain, will this continue to be the case? Will navigation by thought then become as attentionally effortless as walking or driving a car? If it does, then the technology can be said to have modified the other - the world - while itself disappearing, and high levels of presence in the world become possible whilst also navigating.

The body image can be remarkably flexible, and may be 'stretched' well beyond the confines of the biological body. It has been known for some time that it is possible for virtual reality to achieve a kind of "sensory rearrangement" resulting in modified experiences of ones own body [13, 14, 15, 16]. More recently, methods for inducing out of body experiences have been reported [17, 18], and these could readily be reproduced and extended with virtual reality technology. Standard effects such as 'the rubber hand illusion' [19] have also been successfully reproduced in virtual reality and, though with reduced vividness, mixed reality [20].

3. First, second and third person presences

First person presence is the norm in 'classical' virtual reality, in which we view the virtual world as if embodied there ourselves (to some degree) and with a first person perspective on things. We move our physical head and the virtual view changes accordingly; we move our physical arms and hands and we see a representation of these body parts depicted as if they are collocated with our internal image of our physical body. But just how important is this collocation? Some studies of "dextrous" work in virtual reality suggest that collocation is not a very strong factor in accurate task performance (although

of course hand eye coordination is) whether one is working in two *or* three dimensional space [21, 22]. One reason is that we seem to be very adept at dealing with mappings of bodily actions onto the behaviour of tools, as long as the behaviour of the tool is closely coordinated with movements of the body. This is how we can do such a wide variety of things as use a computer mouse, drive a car, or fly a remote control model aeroplane without much difficulty. Future research will be needed to understand how body-virtual image collocation, or lack of it, affects our sense of presence. Is it perhaps the distinction between being present *as* ourselves versus being present *with* ourselves?

Increasingly we see ourselves represented in the third person in social virtual spaces, but generally not in a realistic way, and with minimal body-virtual image coordination – as when mouse actions or arrow buttons control gross movements and pre-programmed gestures of our avatar. In these social spaces we can usually choose the appearance of our virtual persona from a selection of avatars or avatar parts. And these social spaces do give us a degree of co-presence with others, even though we are looking at ourselves from the outside, as a third person self amongst the third person selves of one or more other people. This limited embodiment has opened up many opportunities to experiment with notions of self and personal identity over the last 20 years or so [23]. But what happens if our physical body is closely coordinated with that of the avatar? Increasingly in animation movies and special effects movies the onscreen character's bodily actions are modeled from those of an actor (though not in real time due to the heavy computational demands of computer graphics rendering). What will happen when a person's virtual third person avatar (or a robot in the physical world) closely mimics the bodily and facial changes of the physical person in real time? Will there be a sudden shift in the quality of presence? How does the realism of the depiction affect the sense of self and of presence? In other words, do I feel more present if my avatar looks and behaves like me, and how does this compare or perhaps interact with degree of body-avatar coordination? These are as yet open research questions, although there is at least one preliminary study in the literature [24].

Other questions revolve around second person presences of others, which are also coming along - though usually not corresponding to other real people. Examples include virtual characters that help us do things or entertain us, and more or less personable robots. Would these characters be improved by their having their own sense of presence (do they perhaps have one already)? Does that require or follow from having a sense of self? And what would implementing a sense of presence in virtual personalities tell us about presence in general? Note that, as we have emphasized, having a sense of presence is not the same as having an emotional response system.

There are few second-person, interactive and virtual representations of self as yet (arguably the mediated mirror-image camera view provided by the Sony Eye-Toy™ game environment is a potentially large-scale step in that direction). This is the case where one can interact with a virtual characterization of oneself, and which – as with third person self representational avatars – would be more or less like ones physical self. If the virtual image (or even robot) is coordinated with my body, it would be somewhat like looking in a more or less distorting mirror. How would this affect my sense of self?

4. ICT and the future evolution of consciousness

Since more and more of our experiences are now mediated by information and communication technology (ICT) it is reasonable to see the future development of human consciousness as mostly a reflection of the rapid evolution of ever more pervasive ICT. This has been interpreted by some authors (e.g. [25]) in terms of three inter-related arguments. The first is that ICT in general is increasingly part of our bodies: not only embedded devices such as pacemakers or electrodes on the brain, but also carried devices such as mobile phones or even laptops. The second is that tangible or 'embodied' interaction characterizes our future. And the third is that the individual is in some ways an abstraction. The mind is extended by ICT beyond the body, through extended perception and distributed cognition.

These views are challenged when we consider the sense of mediated presence, which stresses the continuing significance of distinguishing self from other. Our view suggests that some kinds of ICT become part of the self; but other kinds become part of the other, the non-self. This divergence is vital in attempting to understand the future evolution of human consciousness thorough technological innovation.

Without the technologies we have become used to and depend on, we feel at a loss, at least temporarily. The loss may feel as if some aspect of the world no longer exists. But it may also feel as if a part of memory has been erased, as when the address book on ones mobile phone suddenly disappears due to a technical fault. These are quite different psychological effects that reflect the presence faculty in operation. Certainly, we may feel strong presence in some kinds of technologically-realized external environments. But we do not feel present within an electronic address book; nor would we want to, because of the inherent limits of tangible interaction. Language, after all, is intangible.

It seems unlikely that full-blown virtual reality, where the 'immersant' is isolated from the physical world and exposed to a simulated world through maximized sensory replacement, will ever become the dominant technology for generating mediated presence. On current technological trends, it seems more likely that generally when we feel mediated presence we will not either be in a virtual world or in the physical world, but in a blended reality that includes aspects of both. This has obvious advantages. Virtual reality excludes the physical world, as it must since the two are usually in complete conflict. But in many situations, such exclusion is undesirable, unsafe, or unsociable.

The big expansions in use of information and communications technologies are likely to be seen in situations where the user is also active in the physical world. The mobile

phone, now with multiple functions including internet access, television and other media access, is the most obvious example, but there are many others, including those in the home, the car, and the office. When using most existing products of this type there is competition for the user's conscious attention, on a smaller scale than with virtual reality, but still representing a potentially serious conflict. This is why, for example, using a mobile phone while driving is illegal in some countries. This is a conflict between self and other, the internal and the external, which may never totally be resolved as long as we communicate in intangible ways.

Mixed realities, combinations of the physical and the virtual, based on technologies such as tangible interaction objects, wearable augmented reality displays, and sensor and camera-based capture of body movements and state information, are beginning to emerge as perhaps the most promising technological direction for presence research. Interreality systems [26, 27] go further than this. In these blended real-virtual realities, not only are the virtual and the physical combined into a perceptual whole, as with augmented reality, but the physical affects the virtual and - which is more challenging - the virtual affects the physical. Blended realities are combinations of the real and the virtual that affect each and that can come to be understood as new real/virtual things in themselves. Ambient intelligent spaces are one example, though currently these are extremely limited in scope and number.

We foresee the main programme for future presence research as being systematically to implement and experiment with singular and multiple first, second and third person virtual representations of self, varying factors such as degree of body-virtual image coordination, sensory-motor coupling and visual similarity (amongst other factors) and assess the impact on mediated sense of presence (by means of triangulations of introspective, behavioural and neuro-psychological data). A particular focus for the interpretation of results would be quantum shifts in the quality of presence in response to the manipulation of such independent variables. Theory building would be achieved through progressive model development and hypothesis testing.

Conclusions

Is there anything new about this view of presence? Sometimes it seems that Lombard and Ditton said it all over 10 years ago [28]. To begin with, viewing presence as an evolved faculty with a specific purpose is a new insight (or was, when we first proposed it [1, 2, 3]). Until 2003, no-one, as far as we are aware, had specifically suggested that having a conscious sense of presence confers an advantage in terms of an organism's survival. Related to that, there was no clear indication of the purpose of presence as distinguishing self from other via the different experiential characters of internal experiences (of imagined worlds) and external experiences (of physical or virtual worlds). So we would claim to have laid the foundations for a new way of looking at presence, although our view has been frequently misunderstood, even recently [29]. In the present paper, we are focusing this evolutionary perspective on the future, and also expanding on the notion of presence as the ability to distinguish self versus other (internal from external), bringing in a consideration of cyborgs and a discussion of this in terms of how the (widely predicted) confluence of person and information technologies may come to be understood (see also [30]). There have been many earlier discussions of cyborgs, including a seminal paper on presence as progressive embodiment by Frank Biocca [31]. But our view puts specific limits on what contributes to psychological cyborgism, and does this in terms of presence through new media.

When we experience strong mediated presence, our experience is that the technology has become part of the self, and the mediated reality part of the other. When this happens, there is no conscious *effort of access* to information, nor *effort of action* to overt responses. We can perceive and act directly, as if unmediated.

We are currently developing our view in relation to the perception of other people (or avatars, robots, etc.) which has implications for our understanding of social presence. A starting point is the insight that the experience of self only develops through embodied perception and interaction with other agents [32]. A very young infant experiences no differentiation from the other. If the sense of self arises through social interaction with others, this may suggest that social presence precedes and is a pre-requisite for the experience of varying degrees of individual presence.

Mediated presence, then, is the feeling of being in an external world, in the realization of which technology plays a role. To persist, it requires adequate form to be directly perceived, conscious attention to that form, and content that will sustain such attention. When information is realized internally, as with abstract forms of representation, any ICT involved is experienced as part of the other. But when information is realized externally, in or as a surrounding environment to which one can consciously attend, the ICT becomes part of the self. To be part of the self, ICT must create or modify an external other of which it is not perceived to be a part. This will be another in which, or with which, we can be consciously present.

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