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## *On Feeling (the) Present*

*An evolutionary account of the sense of presence  
in physical and electronically-mediated  
environments*

### **1. Introduction**

The *sense of presence* is the ability to experience the fact that one is physically present in the place in which the body is currently located. In other words, it refers to the part of the contents of consciousness that relate to the current time and place in which the body is located. One may have a relatively strong or weak *feeling of presence* at any given moment, since one may be more or less aware of one's location within the current surroundings - this experiential aspect of one's physical presence may be more or less psychologically salient. In what follows, we are not concerned with physical presence *per se* but only the extent to which we have the experience of being present in our surroundings.

We present an account of the sense of presence understood as 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

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internal and the external. We suggest that in its simplest form this originated as the feeling of something happening to an organism from outside rather than within. In this sense, presence distinguishes self from other. In its highly evolved form in humans, the degree of presence we feel tells us the extent to which we are focusing conscious attention on the outside world as opposed to attending to the internal world of thoughts and imaginings.

Our suggestion is that we need this calibration of the current focus of attention in order to act effectively and indeed to know that we are acting. We cannot do this through emotional appraisal of situations, nor through reality judgments, because imagined situations trigger the same emotional responses as physical situations (Russell, 2003), and may also be judged realistic or unrealistic (as may physical events). In short, the sense of presence — distinguishing the physically present from the imagined — is necessary to survive, and this is why it has evolved. Our view is that calibrating the focus of attention in this way is necessary, and that when we do so we experience presence to varying degrees.<sup>1</sup>

Since more and more of our experiences are now mediated by digital information and communication technology — from mobile phones to home entertainment centres to video conferences to game environments, it is reasonable to see the future of the human sense of presence as reflecting the rapid development of ever more pervasive digital technologies — technologies which will increasingly mediate our experiences of the world around us. We therefore also consider how the feeling of presence can be invoked in computer-mediated environments, to produce what is currently termed *mediated presence*, and how this relates to the sense of presence experienced in and of the physical world. The sense of presence has not been much discussed in the psychological literature relating to consciousness, although research on mediated presence<sup>2</sup> has received considerable attention in relation to technological developments and applications in virtual reality (VR), and digital media generally.

Interest in the sense of presence has been most actively stimulated, in the last decade or so, by a widely reported sensation experienced

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- [1] Our position is that conscious experience (‘the feeling of what happens’; Damasio, 1999) is necessary for survival. But whether or not we do actually need to *feel* the sense of presence — whether the *conscious experience* of degrees of presence has functional value beyond the ability of the organism to discriminate between them — is beyond the scope of this article.
- [2] In fact, most recent authors on the topic (generally coming from the fields of human-computer interaction or media studies) use the term *presence* to mean only *mediated presence*.

during the use of interactive virtual reality (VR) environments, that of ‘being there’ — of (to some degree) feeling that one is actually physically present in the portrayed but virtual reality — a technology-induced illusion of being present in one (simulated) place when one is actually present in another (physical) place. But, as pointed out by Biocca (1997), ‘while the design of virtual reality technology has brought the theoretical issue of presence to the fore, few theorists argue that the experience of presence suddenly emerged with the arrival of virtual reality’. On the contrary, we see presence as a basic state of consciousness: the attribution of sensation to some distal stimulus, or more broadly to some external environment.

Sanchez-Vives and Slater (2005) 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 fully-immersive VR all technical aspects affecting the experience can be controlled and replicated precisely, VR can indeed provide a powerful paradigm for experimenting with the impact of various external cues on perception, with presence measures serving as dependent variables, and this can be done at different levels of detail, for both top-down and bottom-up processes. Sanchez-Vives and Slater (2005) also suggest that ‘[mediated] presence occurs when what is said about consciousness occurs within the domain of a VR’. This seems to imply that if one is conscious one will feel presence, which is clearly not the case.

We define presence as *the feeling of being located in a perceived external world around the self*. This applies to both unmediated and mediated presence. Variations in the strength of this feeling provide vital information to the organism for its survival, as we describe in section 2. A useful definition of presence must have implications for what is not presence (Floridi, 2004) and we have previously termed this ‘absence’, a state of absorption in an internal world (Waterworth & Waterworth, 2001; 2003a, b) detached from the current perceptual flow. The feelings of total presence and absence are opposite poles of experience in our relation to the self and the other. Total absence is complete experiential absorption with the internal world of thought and imagination (the self), whereas total presence is complete absorption in the external world (the other). The sense of presence allows us to place ourselves at a point along this continuum. Feeling presence is not the same thing as being conscious; we may be highly conscious, but quite unaware of the current external world.

## 2. Presence and the Self

The basic evolutionary function of presence is to allow the organism to differentiate between the internal (the self) and the external (the other). In this section, we relate presence to the evolution of the conscious sense of self (borrowing heavily from Damasio, 1999) and suggest that three levels of self he identified, emerging over the course of human evolution, correspond directly to three distinct *layers of presence* (Riva *et al.*, 2004).

### 2.1 *The evolutionary levels of selfhood*

Damasio distinguishes between a preconscious antecedent of self and two distinct notions of selfhood :

- the *proto self*: a coherent collection of neural patterns that map, moment by moment, the physical state of the organism;
- the *core self*: a transient entity which is continuously generated through encounters with objects;
- the *extended self*:<sup>3</sup> a systematic record of the more invariant properties that the organism has discovered about itself.

The basis for a conscious self is a feeling state that arises when organisms represent a largely non-conscious proto-self in the process of being modified by objects. In essence, the core sense of self is thought to depend on the creation of a second-order mapping, in certain brain regions (brainstem nuclei, hypothalamus, medial forebrain and insular and somatosensory cortices), of how the proto-self has been altered . This gives the feeling, not just that something is happening, but that something is happening *to me*. However, it is only the extended self that generates the subjective experience of possessing a trans-temporal identity .

When we imagine, think, plan and generally deal with information that does not only constitute our experience of things and events in the currently present external situation we are exercising extended consciousness: “Extended consciousness has to do with making the organism aware of the largest possible compass of knowledge.” (Damasio, 1999, p. 198). It is extended consciousness that allows us to create an internal world in which we may suspend disbelief, as compared to a perceptual world experienced as outside the self. Extended

[3] Damasio refers to this as the ‘autobiographical self’. But because of its intrinsic dependence on extended consciousness, and because it consists of more than autobiographical memories and the self-conscious *idea* of self, we prefer to call this third layer the ‘extended self’.

consciousness relies on working memory, which can be seen as the ‘active scratchpad’ of mental life . It is in working memory that the internal world we are currently experiencing is largely created. Its main function is to allow us to consider possibilities not present in the current external situation. In contrast, core consciousness is directed exclusively to the here and now.

Extended consciousness gives us obvious advantages over organisms without it, such as the ability to plan and generally enact in the imagination possible scenarios of the future, as well as to increase the sophistication of learning from the past. Language depends on it, because we must retain linear sequences of symbols in working memory if we are to understand utterances, whether spoken or written, and then build an internal model of their meaning. But the advantages of extended consciousness depend on the fact that we can distinguish between the experience of the external world and the experience of internal worlds, both remembered and imagined. Confusions of the two indicate serious psychological problems, problems which, until recent times, would have prevented survival and the passing on of this condition.

As noted elsewhere (Waterworth and Waterworth, 2003b):

if we react as if the external world is only imaginary we will not survive long (think of this the next time you cross a busy street). And if we think that what we are merely imagining is actually happening, we may omit to carry out basic activities on which our survival depends (p. 2).

How then do we distinguish perceptions of the external world (perceptions which are themselves largely hypothetical mental predictions) from the purely mental constructions that constitute imagined situations and events? How, in other words, do we separate the internal from the external in our experiences? We suggest that presence is the feeling that evolution has given us to make this vital distinction; this is the biological purpose of presence.

### *2.2 Three layers of presence*

We associate a specific layer of presence with each of the three levels of self identified by Damasio (1999). Further, since each layer of presence solves a particular facet of the internal/external world separation problem (which is the purpose of the sense of presence) it is characterized by specific properties. In the following parts of this section, we outline the characteristics of each layer in more detail, by focusing on its particular characteristics (see also Riva *et al.*, 2004).

*The first layer: proto (proprioceptive) presence*

As already noted, the main activity of the proto self is a largely non-conscious mapping of the physical state of the organism. The evolutionary goal of the proto self is to predict the characteristics of the external world as it is experienced through sensorial inputs.

In this process, movement plays a key role. An adaptive movement is the evolutionary goal of the proto self, and it is only through movements that the proto self can embed properties of the external world into its proprioceptive representation.<sup>4</sup> These properties are the constraints generated by the coordinate systems that describe the body. In an evolutionary process that took millions of years, the proto self has developed to experience these constraints and use them to model the external world experienced through movement.

We consider *proto presence* to be *embodied presence related to the level of proprioception-action coupling* (self vs. non-self as other). The more the organism is able to couple correctly perceptions and movements, the more it differentiates itself from the external world, thus increasing its probability of surviving, thus driving the evolutionary development of proto presence.

A human example of a situation in which proto presence would play a large role might make this clearer. Imagine yourself trying to walk along a rather narrow log to cross a small river. To succeed, you must not be much concerned with the rest of the world around you, the broader surrounding environment, nor with your internal thoughts, plans and reflections. Rather your attention will be focused externally, and especially on the orientation and movement of your body in relation to the very immediate world outside.

*The second layer: core (perceptual) presence*

The core self is a transient conscious entity, ceaselessly re-created for each and every object with which the organism interacts. The evolutionary goal of the core self is the integration of specific sensory occurrences into coherent percepts. This is done through a coherent real time world-model with its own internal logic. Such perception depends very largely on knowledge derived from past experiences of the individual and from evolutionary history.

What is the role of core presence in this? As we have indicated, distinguishing the *present* from the *imaginary* is essential for survival in

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[4] In this, we echo Sheets-Johnstone's perspective (Sheets-Johnstone, 1998) on the role of movement in the evolutionary origins and development of consciousness. We consider that as movement implies consciousness, so does it further imply the need for an ability to distinguish in consciousness between self and other.

the here and now. Core presence is a product of *the activity of selective conscious attention made by the self on perceptions* (self vs. current external world as other). The more the organism is able to identify the external world and its current tasks in that world as separate from the self, the greater its probability of surviving.

We suggest that core presence is needed mainly when there is a significant change in the level of core affect; a major shift in the level of core affect activates the possibility for a high level of core presence. Core affect is not dependent on reality judgment: it responds to the contents of consciousness whether based on reality or imagination. This is why core presence evolved: to enable this essential distinction between the imagined and the actual.

As an example of a situation where core presence would have a relatively large role, imagine that you have been walking along an undemanding footpath, passing through unexceptional, rather barren, scenery for quite some time. Suddenly, you find yourself on a large, flat, grassy promontory, providing a wide open view of a beautiful valley, hills and a river ahead, with a wonderful sunset in progress. Your attention shifts almost exclusively to the perceptual aspects of the scene before you, and for a while you experience a relatively high degree of core presence.

*The third layer: extended (reflective) presence*

What is the role of extended presence? The possibility of defining internal goals and tracking their achievement is the element that allows the final shift in the evolution of the self: from meaning-as-comprehensibility to meaning-as-significance. In this vision, the role of *extended presence is to verify the significance to the self of experienced events in the external world* (self relative to the present external world as other). The more the self is present in significant experiences, the more it will be able to reach its goals, increasing the possibility of surviving.

Imagine yourself about to take the final penalty kick in a football match, the outcome of which will determine not only the match, but a major international championship. This is the most important kick of your entire career as a footballer, one that will affect your future and that of your club for years to come. If you succeed in not being distracted by *thinking about* these aspects, the significance of the event will result in an enhanced degree of extended presence while actually taking the kick, adding extra meaning to the perceptual and bodily experiences involved in carrying out the necessary actions successfully.

Presence is maximized when all three layers are integrated around the same external situation, whether this is physical reality, virtual reality, or a mixture of the two. When the layers are stimulated by conflicting content, however, presence will be reduced. In an awake, healthy animal in the physical world, proto-presence and core presence will rarely if ever be in conflict. This is an aspect of presence in the physical world that is very hard to duplicate with interactive media such as VR. In fact, in VR there is always some degree of conflict between these two layers and, when it is severe or the participant is particularly sensitive, so called ‘cyber-sickness’ (essentially a form of motion sickness) is a common result. In an animal possessing extended consciousness, such as humans, there will also almost always be some conflict between core presence and extended presence resulting in less than maximal presence.

### *2.3 Conscious attention and the three layers*

The sense of presence allows us to calibrate the current contents of consciousness on a continuum from total presence to total absence. Total absence is the feeling of complete absorption with the internal world of thought and imagination (the self), whereas total presence is the feeling of complete absorption in the external world (the other). Maximum presence is minimum absence from an experiential perspective, and vice versa. In people, two main factors determine how present or how absent a person feels in a specific situation: (i) the extent to which the three layers described above are integrated around the same content (as outlined in the previous section) and (ii) the extent to which conscious attention is focused on one layer or is more diffuse.

Because the three layers of presence were added progressively over the course of evolutionary development, all three layers of presence may be engaged by the external but not by the internal world (to which only extended presence applies). In other words, absence only exists for organisms possessing the capacity for extended presence, and the combinations of the two factors (above) for presence are therefore not just the converse of those for absence. More specifically:

- We experience maximum presence in a situation when the three layers are integrated around the same content and conscious attention is focused. This situation might occur, for example, when an expert sports person performs.
- We experience maximum absence when conscious attention is focused but the layers are not integrated. An example of this



might be when one is fully engaged in day-dreaming, or in solving a difficult logical problem, while walking along an undemanding footpath.

- When the layers are integrated but attention is unfocused, less than maximal presence results. An example might be a novice learning a new physical skill.
- When attention is focused but the layers are not integrated, we experience less than maximal presence. This could be the case when we are driving a car while conducting a conversation.

### 3. Individual Differences and Disorders in Presence

The extent to which an individual tends to cognitively engage with the external world rather than with an internal world corresponds to aspects of individual personality. For example, we might expect that extrovert personalities in general experience - or seek to experience - higher presence than introvert personalities. Similarly, elderly people might be expected to experience less presence in common situations than the young. Although not much work has been carried out on the relationship between presence and personality, there is some evidence to support these conjectures. Laarni et al. (2004) present evidence of a positive relationship between experienced presence and extraversion, impulsivity and self-transcendence. Since Eysenck's (1967) classic characterization of the extravert as a person predominantly engaged with events in the external world, rather than the internal world of thoughts and imaginings, this is to be expected from our view of presence as a focus on the present, external environment. The same is true of impulsivity, since according to Laarni *et al.* (2004) impulsive individuals are better able to shift their attention in external space.

We see an external attentional focus in realising an *intention to act* in the world as the prime determinant of the feeling of presence, rather than action *per se*. Overt actions are therefore often indicators of presence, but actions can be automatized, reflex, or otherwise unconscious — or at least not bearers of intention. We need to know (to feel) when we are intending to act. Also, it has frequently been pointed out that we may experience high presence when dreaming (e.g. Biocca, 2003). In dreaming, as in waking, we experience presence according to intended actions. When dreaming while asleep our actual motor systems are immobilized while we dream to prevent damage to ourselves and those around us. In the rare cases that this defence fails, the results are shocking: we may wake up in a state of paralysis (failure to turn the defence mechanism off), or we may act out deeds totally

against our normal waking nature (failure to turn the defence mechanism on); see for example, Ohayon *et al.* (1999). But, we suggest, again as in waking life, we do not always feel very present when dreaming. Rather we may move between degrees of relative presence and absence while dreaming (as suggested by Moller and Barbera, 2006), and individuals can be expected to vary in this, as they do for waking presence. While the sense of dream presence may be experientially similar or even identical to waking presence, it differs from both physical presence and mediated presence in the low level of sensory involved in the process.<sup>5</sup>

The feeling of presence is not normally separated out in the experience of the subject. Rather, we experience directly significant *variations* in the level of presence. Winograd and Flores (1986) refer to *breakdowns*, which can be understood as a sudden change in presence and a disruption in action. When, during an action, an object or an environment suddenly becomes part of our consciousness rather than the action itself, a *breakdown* has occurred.

Why do we experience these breakdowns? Our hypothesis is that such breakdowns are an evolutionary indicator used to maintain the adaptive quality of behaviour. The sudden change in the feeling of presence tells us that something is going wrong. Errors derived from the difference between the desired state and the actual state can be used to update the model and improve performance.

From a computational viewpoint, this can be achieved through a forward-inverse model (Riva, 2009):

- First, the agent produces the motor command for achieving a desired state (intention) given the current state of the system and the current state of the environment;
- Second, an efference copy of the motor command is fed to a forward dynamic model that generates a prediction of the consequences of performing this motor command (action);
- Third, the predicted state is compared with the actual sensory feedback (perception). Any detected difference produces a breakdown.

Presence and absence are both absorption states, the former based around the current perceptual flow, the latter around imagined events and situations not currently occurring in the physical surroundings. When awake, we do not normally confuse what we conceive in

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[5] Direct electromagnetic stimulation of the brain may be one way to induce something similar.

imagination with what we perceive as the external world. It is our sense of presence that supports the making of this distinction; the strength of feeling of presence provides feedback on whether our attention is focused appropriately for intended actions to be successful. Following from this, many common psychological problems, such as phobias, depression, anxiety, paranoia, debilitating shyness and so on, can be seen as arising from an imbalance in the relative levels of presence and absence. Specifically, we suggest that most of these problems arise as the result of too little presence, sometimes in only specific situations, sometimes more generally. The sufferer focuses too exclusively on their idea of what is happening and their own place in it (their internal model of the situation or world), at the expense of experiencing their own, relatively unreflective, presence in the external situation or world.

When a person experiences a panic attack, for example, she firstly becomes aware of the situation she is in (with a high degree of presence), which evokes a feeling of anxiety. She starts to reflect on the feeling and so the attention is re-directed from the external world to the internal world, for example to thinking about herself and her specific discomfort, creating a strong feeling of absence. According to dialectic behaviour therapy<sup>6</sup> (Kåver and Nilsson, 2002), one way to deal with a panic attack is for the person to direct more attention to different aspects of the external world, which will give rise to an increased and more appropriate feeling of presence.

To lose the sense of presence is to lose one's sense of being in the world, and is both an unnatural and a distressing condition. There are two obvious ways for the presence mechanism to fail: we may mistake the external for the internal or the internal for the external. The feeling that what is external is actually internal is sometimes a characteristic of depersonalization/derealisation. The individual may feel that the physical world and their actions in it are not real. They do not feel present in the world around them. A lack of definite and appropriate presence and/or absence could relate to weak central coherence, a lack of adaptive switching between the two could relate to executive function problems, whilst a tendency towards confusion between presence and absence could relate to meta-representational failure.

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[6] Dialectic behaviour therapy is a clinical method developed by Marsha Linehan at the University of Washington in Seattle. The term "dialectic" conveys the emphasis of the therapy of enhancing dialectical thinking pattern to replace rigid, dichotomous thinking. It substitutes 'both/and' for 'either/or' and sees truth as an evolving product of the opposition of different views. In essence, this approach stresses the importance of the interplay between mental work to change the individual and the acceptance of current experiences.

Recent neuropsychological research emphasises that most of the functioning of the motor system occurs without awareness. Nevertheless, we are aware of some aspects of the current state of the system and we can prepare and try out movements in imagination. These mental representations of the actual and possible states of the system are based on two sources (Blakemore *et al.*, 2002): sensory signals from skin and muscles, and the stream of motor commands that have been issued to the system. The experience of presence is generally the outcome of a match between these two sources: I feel myself to be present in an external world when the sensory consequences of my motor commands match their contents (Riva, 2009).

Consider the strange condition named *anarchic hand* (Della Sala, 2006). In *anarchic hand*, patients seem to be aware of the actions of their anarchic hand but do not attribute its behaviour to their intentions: the complex movements of one hand are apparently directed towards a goal and are smoothly executed, yet this is unintended (Della Sala, 2006). This condition suggests that the recognition of an intentional action can be separated from the awareness of its authorship: the patients affected are aware of intentional actions of the anarchic hand, which they know to be their hand, yet they disown them. According our view, if the forward dynamic model is not able to generate a prediction of the outcome of the intention, there is a breakdown in presence and the subject will not recognize the movements as their own (Riva, 2008a).

In another disturbance — *echopraxia* — found in some schizophrenic and autistic patients, the subject makes an impulsive and apparently automatic imitation of other people's gestures. The imitation is performed immediately — irrespective of the meaning or the nature of the gesture — with the abruptness and speed of a reflex action. This condition suggests that the patient, who recognized an intentional action in the other, mistakenly attributes it to himself or herself. According our view, if the forward dynamic model is able to generate a prediction using the other's intention, the subject will recognize the movements as their own (Riva, 2008a) and feel presence through their actions.

Frith and deVignemont suggest that we attribute mental states to our self or to others by adopting either an *egocentric* or an *allocentric* 'stance' towards mental representations. We can relate this distinction to that between presence and absence, where presence reflects an egocentric stance, absence an allocentric one. Experienced changes in levels of presence or absence inform us of our own stance, so that we can function adaptively. For instance, Frith and deVignemont suggest

that people with Asperger's syndrome suffer from a disconnection between a strong and naive egocentric stance (presence) and a highly abstract allocentric stance (absence). Even the hallucinations and delusions that may typify schizophrenia can be seen as a disturbance in error-dependent updating of inferences and beliefs about the world (Fletcher and Frith, 2009): in other words, as the inability to experience the distinction between presence and absence.

As might be expected, presence also has a role in psychotherapy. We find that most therapeutic approaches are permeated by one of two different models of change: bottom-up or top-down (Safran and Greenberg, 1991). The two models of change are clearly related to the presence/absence distinction: the top-down approach (allocentric, through absence) usually involves exploring and challenging tacit rules and beliefs that guide the processing of emotional experience; the bottom-up approach (egocentric, through presence) begins with a specific emotional experience and leads eventually to change at the verbal-representational and conceptual level. These two models of change are focused on two different cognitive systems, one for information transmission (top-down) and one for conscious experience (bottom-up), both of which may process sensory input. The existence of two different cognitive systems is clearly showed by the dissociation between verbal knowledge and task performance: people learn to control dynamic systems without being able to specify the nature of the relations within the system, and they can sometimes describe the rules by which the system operates without being able to put them into practice.

The conventional psychotherapeutic framework generally takes the top-down, allocentric route, through absence. It can be crudely described as 'imagining evokes emotions and the meaning of the associated feelings can be changed through reflection and relaxation'. The alternative is a bottom-up, egocentric approach through presence, where 'experience evokes emotions that result in meaningful new feelings which can be reflected upon' (Kåver & Nilsson, 2002). The conventional framework is limited by the secondary nature of the feelings evoked, based on the internal world route (the 'as if body-loop'). As Damasio (1999) suggests on the basis of neurological findings (page 294), 'the "body-loop" (bottom-up) mechanism of emotion and feeling is of greater importance for the experience of real feelings than the "as if body-loop" mechanism' (top-down). The alternative approach should be more effective, because by using VR effectively it can take the external world route (Riva, 2008b). The 'body-loop'

mechanism of feeling and emotion is directly experienced in the mediated presence invoked in a convincing VR environment.

Most psychotherapies have taken the allocentric (top-down) route to emotion, simply because until the advent of customisable VR the bottom-up approach was not practical or safe. The unfortunate result is that even when exploiting new interactive technologies, psychotherapy has tended to do so within a framework that fails to capitalize on the biological priority of what evokes strong presence, using VR only to provide a fully controllable environment where reactions to a specified external situation can be evaluated (see, for example, Freeman *et al.*, 2008).

#### 4. The Future: Consciousness and Mediated Presence

More and more of our experiences are mediated by digital information and communication technology, and it is reasonable to see the future of the human sense of presence as reflecting the rapid development of ever more pervasive digital technologies which will increasingly mediate our experiences in the future. As we increasingly come to rely on mediated experiences, the circumstances for our feelings of presence will change. The ways in which our sense of presence develops in the future will thus reflect the evolution of consciousness through technological mediation.

##### 4.1 *The future evolution of consciousness*

The future effect on consciousness of the rapid evolution of ever more pervasive digital technologies has been interpreted by some authors (e.g. Clark, 2003) in terms of three inter-related arguments. The first is that the technology in general is increasingly part of our selves: not only embedded devices such as pacemakers or electrodes on the brain, but also carried devices such as mobile phones and even laptops. The second is that tangible or ‘embodied’ interaction characterizes our future with information technology (Dourish, 2001).<sup>7</sup> The third is that the individual is in some ways an abstraction; the mind is extended by information technology beyond the body, through extended perception and ‘distributed cognition’ (e.g. Hutchins, 1995). Some versions of these views are challenged when we consider the sense of mediated

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[7] In tangible interaction, physical objects are used to represent virtual entities and are manipulated bodily (usually manually) to interact with information systems, creating a kind of mixed reality space. For example, images may be projected by a computer system onto the surfaces of physical objects or manikins, while movements of these or other objects may also be tracked and interpreted as significant actions by the human user.

presence as reflecting the continuing need to distinguish self from other, which suggests that only some kinds of digital technology will become part of the self. From this perspective, we can predict which kinds of technology will become part of the self, and will remain part of the other, the non-self.

When deprived of the electronic tools we have become used to and dependent upon, we naturally feel at a loss, at least temporarily, and this is one of the main arguments in favour of technology as part of the extended self. The loss may feel as if a part of memory has been erased, as when the address book on ones mobile phone suddenly disappears due to an electrical fault. But it may also feel as if some aspect of ones world no longer exists, for example when the internet connection is down and ones normal interactions there are not possible. These are quite different psychological effects that reflect the sense of presence in operation. We do feel strong presence in some kinds of mediated environments, such as video conferences and VR, and relatively strong presence in cinemas and even some web-sites. But we do not feel present within an electronic address book; nor would we want to.

The strength of the feeling of presence experienced is a potentially powerful factor in understanding the extent to which technology has become experientially internalised as part of the self. Information can be said to be 'realized', i.e. given concrete form, either internally in the mind, or externally, in the physical world. When information must be realized internally to be given form and understood, such as that expressed in the abstract symbols of language, any information technology involved in its expression is experienced as part of the other. A character in a novel, for example, is in this sense realized in the mind of the reader and not on the page; the technology involved — the book — remains external. In contrast, when information is realized externally, as concrete forms in or as a surrounding environment in which one can act directly, the technology may become part of the self. An action-based computer game is one common example. The expert player acts directly in a virtual world which is realized externally, while the technology creating the world effectively disappears from view — in what we have termed *perceptually-seductive technology* (Waterworth, 2001). To be part of the self, information technology must create or modify an external other of which it is not perceived to be a part;<sup>8</sup> this will be an other in which, or with which, we can feel consciously present.

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[8] This is similar to the more familiar case of physical tools, such as hammers or tweezers, which may or may not become 'embodied' in use. The most famous example is probably

The mobile phone, now with multiple functions including internet, television and other media access, is the most obvious example of information technology penetrating ever more pervasively into our everyday lives, and affecting our feelings of presence. And 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 VR, 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 sometimes a conflict between self and other, presence and absence, and at other times a conflict between presence here and presence there. Assessing the feelings of presence, over time and in different situations, potentially can elucidate the psychological processes at work.

There are clear technological trends suggesting that presence will increasingly be experienced in relation to an external world in which the physical and the virtual are blended, rather than in conflict as has generally been the case up until now. Blends of the proximal and the distal already occur in some situations, such as those provided by some videoconferencing systems. As of now, these happen in specific physical places. But the trend towards mobile interactive media access seems inevitable, and we can anticipate mediated meetings of physically distant and proximal people, each experiencing a consistent blended physical-virtual reality including all participants. For this to work, interaction devices will need to be sensitive to both the situation and context of their use, and the state of their users. Presence levels will then need to be adjusted dynamically during the management of blended streams of incoming and outgoing information, tailoring the contents of consciousness to situational demands and user preferences (Waterworth & Waterworth, 2006). Presence-related psychological and technological research will be needed to achieve such capabilities.

#### *4.2 First, second and third person presences*

Natural, unmediated presence is almost always from a first person, ego-centric perspective.<sup>9</sup> We see changing experiences of the body as a key aspect of the future development of mediated presence, not least the potential to experience events from a wide variety of observational

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the blind man's stick of Merleau-Ponty (1945, 2005). The tool becomes part of the body's perceptual system, and the other begins at the point of the tool's physical application.

[9] Out-of-body experiences are the rare exception.



perspectives. In such second and third person perspectives, viewpoint and the body are separated: the body is not seen from a first person perspective, but the observer may still have ego-centric feelings of presence.

A first person perspective has previously been seen as a key ingredient in evoking strong mediated presence, and is the norm in VR, where we view the mediated world as if physically embodied there ourselves (to some degree). We move our physical head and the virtual view changes accordingly; we move our physical arms and hands and see a representation of these body parts, depicted as if they are collocated with the internal image we have of our physical body, move accordingly. But just how important is this collocation? Some studies of precise dextrous work in VR designed for accurate manual manipulation (for surgeons, for example) suggest that hand-image collocation is not a very strong factor in accurate task performance, whether one is working in two *or* three dimensional space (Waterworth, 2000; 2002). One reason is that we seem to be very adept at mapping 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 airplane without much difficulty (though only after some practice). Future research will try to understand how body-virtual image collocation, or lack of it, affects our sense of presence and the nature of our feelings of personal embodiment.

Standard perceptual effects such as ‘the rubber hand illusion’ (Botvinick & Cohen, 1998) have been successfully reproduced in VR and, with reduced vividness, mixed reality situations (IJsselsteijn *et al.*, 2006). As is well known, the body image can be remarkably flexible, and may be ‘stretched’ well beyond the confines of the biological body. It is possible for VR to achieve a kind of “sensory rearrangement” resulting in modified experiences of one’s own body (Biocca & Rolland, 1998; Castiello *et al.*, 2004; Riva, 1998; Riva, *et al.*, 2001).

More recently, methods for inducing dramatic out of body experiences have been reported (Ehrsson, 2007; Lenggenhager *et al.*, 2007), using relatively simple technology. In these cases, it was found that if at least some tactile stimulation is correlated with visual information (of an externalised body), the two may be psychologically integrated into a profoundly altered experience of self. As we argued earlier, presence is generally the result of a good match between predicted and actual sensory feedback. In this case, if the sight of the external body being stimulated (by touch) is correlated with sensory feedback of

actually being touched on a corresponding part of the body, we can observe representations of ourselves from the outside while simultaneously experiencing *individual presence as the observed person*. This is a truly novel form of presence for most people, but is likely to become common in the future.

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 (Turtle, 2005). But what happens if our physical body movements are closely coordinated with those of the avatar? Increasingly in animation movies and special effects movies the onscreen character's bodily actions are modelled from those of an actor, though not yet in real time. 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 (Ratan *et al.*, 2007).

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? We think that presence research will play a key part in advancing our understanding of all these future developments.

## 5. Conclusions

For organisms in a natural environment, it is vital to pay conscious attention and respond rapidly to present threats and opportunities. We have suggested that the sense of presence as a mental faculty was designed by evolution to ensure that organisms know when they are attending to things in their here and now that might affect their survival. This is the case even though they use much of the same mental machinery to generate internal worlds and experiences of them; or rather, because they do use much of the same mental machinery to generate internal worlds and experiences. And to do this, they need to *feel directly* when they are attending to the current external world, and this is the feeling of presence. The feeling of presence is thus analogous to the feeling of emotion; it is informative, direct, and has a long evolutionary history. It is closely bound up with the intention to act, of mental and bodily readiness for action.

We have described the natural, unmediated sense of presence as the feeling of being somewhere in the world, in the present. Presence in people is 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). The strength of the feeling of presence thus reflects the extent to which conscious attention is focused on the non-self, the other, and variations in the strength of this feeling provide vital information to an organism for its survival. Through evolution, this fundamental ability of all conscious organisms has developed in humans into the ability to distinguish external, physical events and situations from events and situations realized mentally, in thought and imagination. This is a necessary distinction that cannot be made on the basis of emotional appraisal or reality judgments, because imagined situations trigger the same emotional responses as physical situations (Russell, 2003) — and may also be judged real or unreal (as may physical events).

The strength of the human feeling of presence is determined by two main factors: the extent to which conscious attention is tightly focused or more diffuse, and the degree of integration of different layers of presence derived from three levels of the functioning of the self: proto (proprioceptive) presence, core (perceptual) presence, and extended (reflective) presence. Maximum presence occurs when attention is tightly focused, and the three layers are integrated. Minimum presence, which we term absence, occurs when attention is tightly focused but the three layers are not integrated. Failures or maladjustments of

the presence ability have predictable consequences in various forms of psychological distress that can be understood in terms of our model. It is from the experienced distinction between presence and absence that the therapeutic potential of new information technology derives.

In the not-too-distant future, we expect almost all of our experiences to be mediated by information technology to some degree, and any consideration of the future of human consciousness needs to take account of the coming importance of mediated presence. Mediated presence is the feeling of being in an external world, in the realization of which technology plays a role. 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 information is realized internally, as with abstract forms of representation, any technology involved is experienced as part of the other. To be part of the self, technology must create or modify an external other of which it is not perceived to be a part. The external world will increasingly be an integrated blend of the physical and the virtual, the distal and the proximal. This brings the potential to choose between multiple perspectives on our own sense of self in relation to the world around us; the potential to experience first, second and third-person presence in the world.

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