

The Layers of Presence: A Bio-cultural Approach to Understanding Presence in Natural and Mediated Environments

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ABSTRACT

This paper proposes a bio-cultural theory of presence based on four different positions related to the role and structure of presence, as follows. First, presence is a defining feature of self and it is related to the evolution of a key feature of any central nervous system: the embedding of sensory-referred properties into an internal functional space. Without the emergence of the sense of presence it is impossible for the nervous system to experience distal attribution: the referencing of our perception to an external space beyond the limits of the sensory organs themselves. Second, even if the experience of the sense of presence is a unitary feeling, conceptually it can be divided in three different layers, phylogenetically different and strictly related to the three levels of self identified by Damasio. In particular we can make conceptual distinctions between proto presence (self vs. non self), core presence (self vs. present external world), and extended presence (self relative to present external world). Third, given that each layer of presence solves a particular facet of the internal/external world separation, it is characterized by specific properties. Finally, in humans the sense of presence is a direct function of these three layers: the more they are integrated, the more we are present. In the experience of optimal presence, biologically and culturally determined cognitive processes are working in harmony—to focus all levels of the self on a significant situation in the external world, whether this is real or virtual.

INTRODUCTION

WHAT IS PRESENCE? According to Steuer¹: "Presence is closely related to the phenomenon of distal attribution or externalization, which refer to the referencing of our perception to an external space beyond the limits of the sensory organs themselves." Since this statement was made, several different authors have acknowledged that presence should be considered as a neuropsychological phenomenon evolved from the interplay of our biological and cultural inheritance.²⁻¹⁰ Nevertheless, except

for some preliminary attempts,^{5,11} no theory found in the presence literature has been able yet to include this phenomenon within a truly psychological framework. To overcome this limitation, presence is here delineated as an evolved bio-cultural mechanism that helps the self in organizing the streams of sensory data: the more it can differentiate the external world, the more we experience a sense of presence.

In the following paragraphs, we will try to describe the rationale of this hypothesis and its consequences. Particularly, even if we experience the sense of presence as a unitary feeling, conceptually

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presence can be divided into three different layers, phylogenetically and functionally different, strictly related to the three levels of the self identified by Damasio.¹² According to this view, the highest possible degree of presence is achieved in states of consciousness characterized by the integration of these three layers. In a later section, we present a more detailed characterization and a few different examples of these states of intense, integrated presence.

Presence, evolution, and culture

With the term “evolutionary psychology” (EP), a relatively new theoretical paradigm is described whose main goal is to analyze how the evolved cognitive processes of our psyches continue to penetrate a wide-ranging area of our present-day behavior.¹³ According to Bereczkei,¹⁴ the evolutionary approach to psychological phenomena entails recognizing certain features of human behavior that have been designed by natural selection to be useful for survival and reproduction in the environment in which humankind evolved. Using this approach, we can explain a wide variety of seemingly different behaviors and support a new kind of understanding of human nature. Within this vision, an evolved psychological mechanism can be described as a set of processes inside an organism that¹³:

- Exists in the form it does because it (or other mechanisms that reliably produce it) solved a specific problem of individual survival or reproduction recurrently over human evolutionary history
- Takes only certain classes of information or input, where input can be (a) either external or internal, or (b) actively extracted from the environment or passively received from the environment, and (c) where the input specifies to the organism the particular adaptive problem it is facing
- Transforms that information into output through a procedure (e.g., a decision rule) in which output (a) regulates physiological activity, provides information to other psychological mechanisms, or produces manifest action and (b) solves a particular adaptive problem

If many researchers have no problem in accepting that some key psychological features are the result of some evolutionary process, they are less ready to accept the application of the same approach to presence. Considering presence simply as a characteristic of a given medium, frequently misleads them into believing that the novelty of our modern environment *precludes* any study of presence as adap-

tive because humans today live in a culture unlike the Pleistocene environment in which human nature was shaped. However, the human psyche has evolved as a device for dealing with individual and social problems in the ancient environment, and these problems frequently resemble those faced by modern humans. As Alexander¹⁵ states: “I am suggesting that we are addicted to soap operas (and all other condensed and elaborate social dramas we call theater) because our ancestors literally endured similar circumstances in small groups of relatives and friends for thousands of generations, in which nothing was more important than experience and skill in manipulating the people and events involved, and such experience and skill came from observation as well as actual participation in particular events.”

The words of Alexander also outline the importance of artifacts in the adaptation process. In fact, the adaptation strategy of our species is based on social learning and on the production and use of artifacts, material or symbolic.¹⁶ This strategy was supported by specific biological features, such as an upright bodily position, opposable thumbs, and the impressive growth of brain structures in both mass and complexity. As suggested by Crook,¹⁷ humans evolved specific psychic processes, defined as awareness of the external world and awareness of one’s own internal state. The symbolic representations of the external world and of individuals themselves were formalized by means of descriptions and behavioral rules stored in the individual’s central nervous system (intrasomatic level) and in material tools, books, and artistic and religious artifacts (extrasomatic level).

Within this vision, we suppose that the ability to feel “present” in a virtual reality system—an artifact—basically does not differ from the ability to feel “present” in the real world. One of the main ideas expressed in this paper is the link between presence and its evolutionary role.¹⁸ In more detail, we suppose that presence is an evolved psychological mechanism, created by the evolution of the central nervous system in its attempt to embed sensory-referred properties into an internal functional space.¹⁹ As noted by Waterworth and Waterworth,¹⁹ the appearance of the sense of presence allows the nervous system to solve a key problem for its survival: how to differentiate between internal and external states. If, in relatively simple organisms, this separation involves only a correct coupling between perceptions and movements, in humans it also requires the shift from meaning-as-comprehensibility to meaning-as-significance. Meaning-as-comprehensibility refers to the extent to which the event fits

our view of the world (for example, as controllable or nonrandom) whereas meaning-as-significance refers to the value or worth of the event for us.²⁰

The emergence of extended consciousness

For organisms in a natural environment, it is vital to pay attention and respond rapidly to present threats and opportunities. Our emotional and cognitive life is built on this evolutionary substrate. But as the self evolved, imagined situations became increasingly important to survival and biological success.

According to recent psychological theory, perceptions are to a large extent guesses of what is out there now and predictions of what is about to happen. A way to put this is that perceptions are in some ways rather like hypotheses of science—predictions of unsensed features of objects and of futures that may not happen.²¹ They are never certainly true and often wrong. Yet the guesses of hypotheses are the nearest we ever get to reality. If perceptions are internal predictions, how can we differentiate them from other internal processes, such as conceptual modeling experienced as mental images?

According to current neurobiological work, evolution created two different levels of consciousness to solve this problem¹²: core consciousness and extended consciousness. Core consciousness is what we presumably share with many nonhuman animals—a simple biological phenomenon, the scope of which is the Here and Now. This basic, integrated representation of one moment and one place is independent of language, reasoning, and memory.²²

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.” According to Damasio,¹² extended consciousness emerges from:

- The gradual build-up of memories of the organism’s biography (the experiences of the “coreself”). Each autobiographical memory then becomes an object, which takes part in inducing and enhancing core consciousness.
- The ability to hold active, simultaneously, and for an extended period of time many images that collectively define the “autobiographical self” and the object it is interacting with.

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 consciousness relies on working memory,¹² which can be seen as the “active scratchpad” of mental life.²³ 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—the present.

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.

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 by Waterworth and Waterworth⁹: “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.” 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? We are suggesting that presence is the feeling that evolution has given us to make this vital distinction.

The layers of the self

According to this view, what is the role of self? Damasio proposes important conceptual distinctions between a preconscious precedent of self and two distinct notions of self-consciousness^{12,24}:

- *Proto self*: A coherent collection of neural patterns that map, moment by moment, the physical state of the organism
- *Core self*: A transient entity which is continuously generated through encounters with objects
- *Extended self*: A systematic record of the more invariant properties that the organism has discovered about itself (Damasio refers to this as the

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“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 refer to this third layer as the “extended self.”)

In this vision, the basis for a conscious self is a feeling state that arises when organisms represent a non-conscious proto-self in the process of being modified by objects. In essence, the sense of self depends 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.²⁴ 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. The extended self centers the flow of our interactions with perceptual objects on itself, thereby making them our own experiences (Fig. 1). In summary, the presence of *you* is the feeling of what happens when your being is modified by the acts of apprehending something.²²

Brain mapping

As we have just seen, core self and core consciousness have their origins in a mapping of body states and are about two facts: the organism relating to sensory streams and the fact that this relation causes a change in the organism. It follows that a key starting point for a theory of presence is a de-

scription of how the brain maps its sensorial inputs, and, most importantly, the dynamics of their relationship.

To understand how these components are related we can use an example: the way our self experiences our first view of the Colosseum in Rome. We receive sensory signals from our eyes, ears, nose and sense of touch that are mapped by the proto-self—the feeling of something happening. Some microseconds later, this leads to perceptual activity which is monitored by the core self and becomes the content of core consciousness—the feeling of something happening to me. A few microseconds more are required for the activation of extended consciousness—knowledge of the feeling that something happening to me. Some milliseconds later, it adds dispositional records of that place (or similar places), records which typically include stored sensory, motor response and emotional data.¹² If these records are also part of autobiographical memory—the organized record of the main aspects of our biographies—we may consciously recognize the place because we studied it in architectural history; and we may have emotional ties because we associate the place with special memories (our most recent experience of the Colosseum was while watching a preferred movie: “Gladiator”). The result is a single conscious experience integrating perceptions, emotions and feeling. Once the event has ended, it is restored in dispositional space with new data about our most recent experience.

In the previous paragraphs we outlined how the result of this process is a higher level of self—the

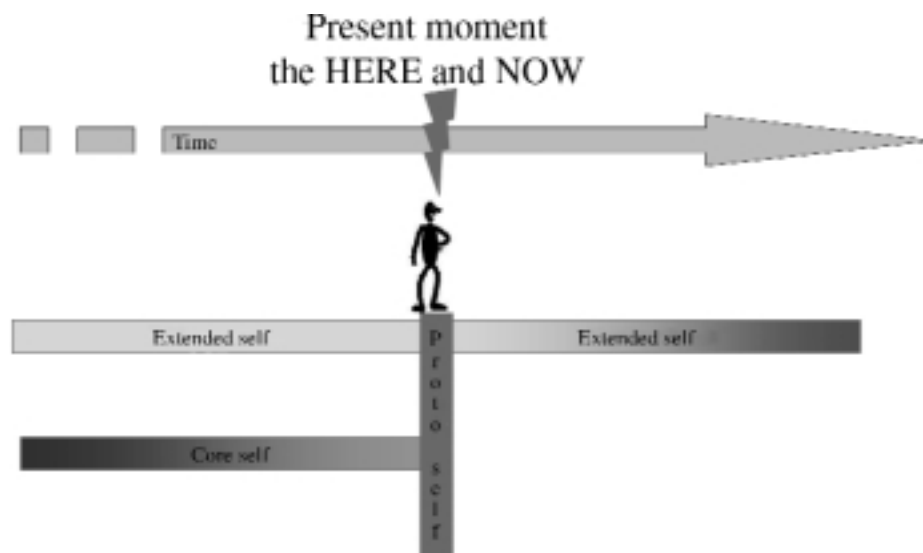


FIG. 1. The three layers of the self.

extended self—created by extended consciousness, which generates the experience of having a permanent identity. However, a central nervous system is able to differentiate between internal and external events well before the appearance of the extended self. As noted by Llinás, even an adult lamprey is able to create an internal functional space providing continuity between the sensory derived properties of the external world and subsequent motor input.¹⁹ And this is done by simply experiencing: just by moving into the environment the lamprey is able to experience the unevenness of the terrain and adapt its motor behavior to it.

Is the presence of a lamprey in an external world similar to our presence in the Colosseum? Even if both share the possibility of recognizing some features of an external world and adapting to it, the answer is surely no. According to recent neurobiological theories this difference can be explained phylogenetically in relation to the evolution of the self.¹² Lampreys only have what Damasio defines as the proto self: a coherent collection of neural patterns that map, moment by moment, the physical state of the organism.¹²

THREE LAYERS OF PRESENCE

One of the main ideas expressed in this paper is the link between presence and self. In more detail, we suppose that presence is the result of the evolution of the central nervous system in its attempt to embed the sensory-referred properties into an internal functional space.¹⁹ As noted by Waterworth and Waterworth,⁹ the appearance of the sense of presence allows the nervous system to solve a key problem for its survival: how to differentiate between internal and external states.

We hypothesize that it is possible to associate a specific layer of presence with each of the three levels of self identified by Damasio¹² and outlined in the previous section. Further, given that each layer of presence solves a particular facet of the internal/external world separation, it is characterized by specific properties:

- Self versus non-self (proto presence)
- Self versus present external world (core presence)
- Self relative to present external world (extended presence)

In the following parts of this section, we will try to outline the characteristics of each layer in more detail, by focusing on its peculiar characteristics.

First layer: proto presence

As we have seen, the main activity of the proto self is a non-conscious mapping of the physical state of the organism. What is the evolutionary goal of the proto self? To predict the characteristics of the external world as it is experienced through sensorial inputs.

As suggested by Llinás this can be done even by a lamprey.¹⁹ How? According to Llinás,¹⁹ the steps identify by the latest neurobiological studies are:

- The comparison of the sensory referred properties of the external world with a separate internal sensorimotor representation of those properties
- The transformation/utilization of this premotor solution into finely timed and executed movements

In this process, movement plays a key role (Fig. 2). On one side, an adaptive movement is the evolutionary goal of the proto self. On the other side, it is only through motility that it can embed the properties of the external world in its sensorimotor representation. These properties are the constraints generated by the coordinate systems that describe the body: in an evolutionary process that required millions of years the proto self experienced, through movement, these constraints and used them to model the external world. In this vision how can we define the sense of presence possessed by the proto self (“proto presence”)? Tentatively, we can say that the more the proto self is in the body, the more it is different from the external world. More precisely we can define proto presence as an embodied presence related to the level of perception-



FIG. 2. Proto presence.

action coupling (self vs. non-self). 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.

Second layer: core presence

In Damasio's model, the second level of self is core self, a transient but conscious entity, ceaselessly re-created for each and every object with which the brain interacts. What is the evolutionary goal of the core self? The integration of specific sensory occurrences into single percepts. According to Gregory,²¹ this is done through a coherent world-model that evolves in real time according to its own internal logic. In such a vision, perception depends very largely on knowledge derived from past experiences of the individual and from evolutionary history.

During waking consciousness, this model is modulated by the senses, but it persists even when sensory input is temporarily cut off: close your eyes and you'll still be keenly aware that the Colosseum is in front of you. As far as your inner model is concerned, the Colosseum is still there; and as that inner model is used to generate motor commands, any movements you choose to make (such as searching for a taxi) will be adjusted to take the presence of the Colosseum into account.

A critical point here is the identification of what drives the flow of core self contents, given the lack at this stage of cognitive structures like "goals" and "beliefs". A possible answer to this question comes from recent research on emotion. According to Russell,²⁵ at the heart of emotions, moods, and any other emotionally charged events, there are states experienced as simply feeling good or bad, energized or enervated. These states—that he defines as "core affect"—influence reflexes, perception, cognition, and behavior and are influenced by many causes, both internal and external. Core affect per se is object free (free-floating), but through attribution can become directed at an object.

In our view, one of the main activities of the core self is to track changes in core affect, in proportion to its rapidity and extent. When the change is significant, it fills consciousness. When the feeling weakens or stabilizes, it recedes into the background. As noted by Russell²⁵: "Core affect is a continuous assessment of one's current state, and it affects other psychological processes accordingly. A change in core affect evokes a search for its cause and therefore facilitates attention to and accessibility of like-valenced material . . . Decisions thus in-

volve predictions of future core affect . . . Core affect is involved in motivation, reward, and reinforcement."

However, there is a critical point, as also noted by Russell²⁵: "Core affect responds to the contents of consciousness whether based on reality or fiction. It varies with thoughts, imaginings, daydreams, memories, and anticipations."

Why is core affect triggered by any conscious content, independent of whether it is external or merely imagined? The answer is related to the evaluative process: the future and all other alternatives to present reality can only be imagined. By imagining the future, one brings an ancient mechanism (core affect) to bear on organizing future behavior. Responding to imaginary events is useful, since the response allows one to evaluate different possible future outcomes. In other words, we evaluate imagined future outcomes by experiencing the emotional responses that such outcomes would actually produce in us in reality.

As suggested by Farber, the core self has two functional states²⁶: while "online"—actively synchronized with the external world—it can be used to predict what will happen next or what the likely outcomes of different actions will be, and while "offline," it can model scenarios from memory or imagination, or germinate the realistic (if disordered) worlds of our dreams. On the neurological side, this is also reflected by the shared neural substrate used in both imagined and executed movements.^{27,28} This link is supplied by the "mirror neurons" found in the Broca's area of the human brain, which fire in response to observing specific movements as well as during execution of the same movements.²⁹

As noted by Ramachandran³⁰: "The discovery of mirror neurons in the frontal lobes of monkeys, and their potential relevance to human brain evolution—which I speculate on in this essay—is the single most important "unreported" (or at least, unpublicized) story of the decade. I predict that mirror neurons will do for psychology what DNA did for biology: they will provide a unifying framework and help explain a host of mental abilities that have hitherto remained mysterious and inaccessible to experiments . . . Mirror neurons can also enable you to imitate the movements of others thereby setting the stage for the complex Lamarckian or cultural inheritance that characterizes our species and liberates us from the constraints of a purely gene based evolution." http://www.edge.org/3rd_culture/ramachandran/ramachandran_index.html.

However, this model only works if the nervous system can differentiate between internal (imagined)

and external (perceived) states of affairs. As we have seen, distinguishing the present from the imaginary is essential for survival in the here and now.

How is this done? Neurobiological research suggests the existence of two specific processes: cognitive binding and temporal coherence: In Llinás' approach,¹⁹ cognitive binding is done by the core self through the temporal linking of the independently operating neural mechanism included in the proto self. By inducing temporal coherence to different neural structures, the core self can produce a shift in attentional focus. This shift is also able to differentiate between dreaming and waking: in dreaming the intrinsic activity of the proto self does not correlate sensory inputs with ongoing thalamocortical activity (the thalamocortical system is considered the site of the core self) making them invisible to the core self.³¹

In these processes what is the role of core presence? Core presence is the activity of selective attention made by the self on perceptions (self vs. present external world): the more the organism is able to focus on its sensorial experience by leaving in the background the remaining neural processes, the more it is able to identify the present moment and its current tasks, increasing its probability of surviving (Fig. 3).

According to what we have said, core presence is needed mainly when the core self tracks a significant change in the level of core affect. When this happens, it is critical for the core self to focus on its sensorial experience by leaving in the background the remaining neural processes. In this sense, a shift in the level of core affect activates the possibility for a high level of core presence.

As we have just seen, core affect is not dependent on any reality judgment: it responds to the contents of consciousness whether based on reality or fiction. It is core presence that allows the organism to make this essential distinction.

Third layer: extended presence

The result of the activity of the extended self is extended consciousness. But what is the role of extended presence? The goal hierarchy model of personality and motivation³² can provide the theoretical underpinning for answering this question. Cropanzano et al.³² described personality as an interrelated series of goals that direct and organize an individual's behavior. In their model, which has many similarities with the description of the extended self of Damasio,¹² goals are arranged hierarchically from abstract orientations (analogous to traits) at the top, through values, self-identities, and ultimately down to concrete, behavioral goals. Abstract goal orientations, such as a tendency to approach positive stimuli or avoid negative stimuli, are mapped onto distinct response styles that serve as directional orientations. As noted by Brett and eWalle,³³ response styles do not offer the specificity to make behavioral predictions, but instead determine the types of goals that individuals will set. These lower level goals regulate the specific behaviors selected for performance.

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. Meaning-as-comprehensibility refers to the extent to which the event fits with our view of the world (for example, as just, controllable, and nonrandom) whereas meaning-as-significance refers to the value or worth of the event for us.²⁰ 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). The more the self is present in significant experiences, the more it will be able to reach its goals, increasing the possibility of surviving (Fig. 4).

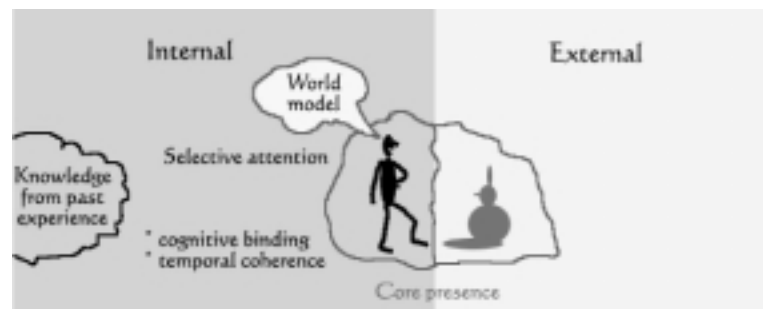


FIG. 3. Core presence.

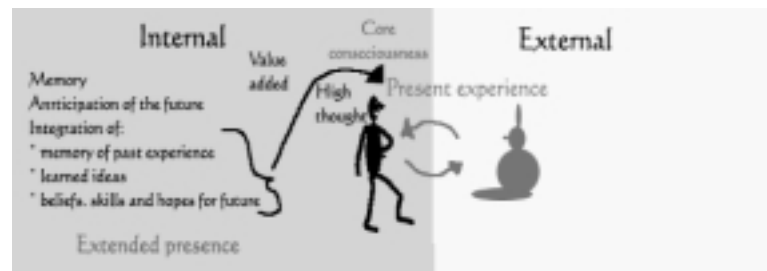


FIG. 4. Extended presence.

Presence and emotion: an important but neglected link

Emotional engagement and presence are often confused, as if they were the same thing. As indicated above, we consider that emotion and presence are intimately related, but not identical; we can feel emotional engagement without feeling much presence, and vice versa. So what exactly is the link between presence and emotions? According to our model, emotional processes directly influence two of the three layers of presence: core presence and extended presence.

One of the main activities of the self is to track changes in core affect (feeling good or bad, energized or enervated), according to their rapidity and extent. When this happens, it is critical for the self to focus on its sensorial experience by leaving in the background the remaining neural processes. In this sense, a change in the level of core affect activates a higher level of core presence, needed to separate between reality and fiction. As underlined by Russell,²⁵ core affect is not dependent by any reality judgment: it responds to the contents of consciousness whether based on reality or fiction. It is core presence that allows the organism to make this essential distinction.

For extended presence, too, the link with emotions is critical. As we have seen, core affect can exist without being labeled, interpreted, or attributed to any cause. One of the main activities of the extended self is the perception of affective qualities. But activity of the extended self does not always result in high extended presence; a focus on the external world is also needed. The extended self is, in general, as concerned with the imaginary as with the real. When in a state of high presence, the extended self is preoccupied with the present external situation. But at many other times, imagined and recalled events and information (which often include a self-conscious focus on the *idea* of self) occupy the self, and this will be indicated by low extended presence. In this sense, varying levels of extended presence also reflect the possibility of separating

the imagined (including ones self-conscious idea of self) from the real (experienced in relation to its significance to the self). And this explains why maximal states of presence are associated with a loss of self-consciousness (in the sense of a focus on the idea of oneself).

In summary, we can expect two levels of influence of emotional processes on the degree of presence: (a) a shift in the level of core affect activates a higher level of core presence; and (b) an easy attribution of the shift results in a higher level of extended presence. If we feel high core presence we are more likely to behave as if events are real, and this is the mechanism that is to some degree fooled by virtual reality. Positive reality judgments will tend to increase extended presence. When core presence is not integrated with extended presence, experienced presence will be lower than when it is, and will tend to extend for shorter periods of time. The ways in which the three layers of presence may be more or less integrated, and the implications of this for designing mediated experiences which invoke presence, are the topics for the remaining sections of the paper.

FOCUSED PRESENCE: INTEGRATING THE THREE LAYERS

In this section, we apply our three-layer theory of presence to try to understand how the sense of presence varies across different situations, and in particular the different ways in which aspects of mediated experience affect presence. From that, we outline the potential of this view as a tool for designing particular types of experience with predictable degrees and types of presence.

Focus, locus, and sensus

Waterworth and Waterworth⁸ outlined a three-dimensional model of experience in relation to

presence, consisting of focus, locus, and sensus. Principally, the model was intended to provide a design space, in which potential and actual interactive media applications could be placed, as an aid to both design and evaluation. Focus describes the nature of an observer's attention, specifically whether attention is mostly directed towards present events (in the real or a virtual world)—in which case the model predicts a high degree of presence—or is mostly directed towards internally-generated scenarios (in imagination) which are not currently present in the world. Waterworth and Waterworth⁸ referred to this latter, reflective state of mind as absence, corresponding to a low degree of presence.

We can now extend and refine this concept of focus in light of the three levels of presence proposed here. Specifically, we suggest that focus can be seen as the degree to which the three layers of presence are integrated towards a particular situation. The more integrated the layers, the higher the degree of experienced presence. Presence would be maximized when the contents of extended consciousness are closely aligned to those of core consciousness and of proto consciousness, which will arise when the three levels are working in concert to produce a strong focus on the present environment. The pivot for this integration is core presence. Absence of mind thus arises when extended consciousness is minimally concerned with the current situation or situations with which core and proto consciousness are involved.

From an evolutionary perspective, the real world has priority and is the background against which mental life is framed. The proto self exists moment by moment through our monitoring of our internal and external environment. To maintain our bodies in the world we need to know both their internal state and their precise relations to the world immediately around them. Much of this is unconscious and automatic, we only become specifically aware of processes such as digestion or proprioception when things do not function normally, within limits acceptable for the stability of the organism. This awareness arises as the events are integrated into core consciousness, as described earlier.

One of the main reasons for current interest in presence is that it may be evoked by both the real world and by media. The locus dimension⁸ captures the extent to which the observer is attending to the real world or to a world conveyed through media. The biological purpose of presence means that it is dominated by the current state of the body, and perceptions of the current state and position of the body in relation to the world in which the body is located. Any mediated presence is in competition with pres-

ence in the real world. "Breaks in presence"³⁴ are an example of rapid shifts of presence between the real and a mediated world. In other words, they seem to be temporary changes in the locus of experience, although Spagnolli and Gamberini³⁵ present evidence that they are more a temporarily wider distribution of presence over the locus dimension—taking in both the real and the virtual worlds.

The history of media and their effects is complex and beyond the scope of this paper. We will simplify for present purposes by suggesting that some traditional non-electronic media, such as books, verbal accounts, and letters, principally address extended consciousness. This limited capability was mirrored later by electronic media such as text documents, e-mails, and telephone calls. All of these produce a conceptual model in the reader or hearer that is usually not closely or immediately related to his or her current situation in the real world. In other words, they do not elicit core or proto presence. Because of this, they produce a relatively low degree of presence integration and are low on the focus dimension (and the degree of experienced presence is low). Traditional more pictorial media forms such as drama, painting and sculpture were often successful in evoking a sense of core presence and sometimes also a sense of extended presence with which it was integrated to a greater or lesser degree. Again, this is mirrored by more recent electronic media such as television, computer graphics, and animations. Still, the proto level of presence is not addressed by such media and, because of this inherently restricted focus, the degree of experienced presence is correspondingly limited.

The third dimension of Waterworth and Waterworth's⁸ model, sensus, refers to the level of consciousness or attentional arousal of the observer, and we can also interpret its effects on presence in terms of our three layers of presence. Arousal will affect such factors as degree of activity of the organism, and the effect is likely to be passed upwards, to the core self, which may then become more actively engaged in the world. Conversely, emotional arousal of the core layer will tend to impact downwards on the proto self, which will become innervated to cope efficiently with the current situation. At the level of extended consciousness, attentional arousal will tend to be determined by the significance of what is experienced, the meaning of current events in terms of interest or emotion.

Mediation and the three layers of presence

Because we are always in the real world, even when engrossed in media or in thought, proto pres-

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ence is probably never totally divorced from the current physical situation and state in which we find ourselves. Most mediated experiences do not attempt to address the individual at the level of proto consciousness, since the technical demands of eliciting presence are less the higher the layer invoked. As already stated, absence of mind arises when extended consciousness is minimally concerned with the current situation, or situations, with which the other two layers are involved. A well-written novel can readily engage extended consciousness, while core consciousness will be very little affected, and proto consciousness not at all. Overall, presence will not be focused, and the degree of experienced presence will be relatively low. Some researchers suggest that a novel may provide the technological minimum for presence in media.³⁶ Since we view presence as a solution to the problem of determining what is happening to the self at the present time, we suggest that extended presence does not exist without core consciousness. Core consciousness drives the problem solution; the more it is able to integrate the three layers, the more convincing the answer to the problem.

As we move down from extended consciousness to core consciousness, the technological demands on the medium increase. Whereas conceptual modeling can be relatively slow, perceptual models and the predictions they provide must be created fast, since this core level is evolutionarily designed to support what may need to be very rapid interactions with the real world. To mimic this natural interactivity involves rapid response times between a medium and its user, and often involves detailed inspectability of aspects of any displayed information. More generally, information must be displayed in concrete forms that can be accepted by core consciousness as realistic. Proto presence has the most demanding technological requirements, and was the last of the three layers to be addressed through media. It functions at the level of proprioception, spatial and internal monitoring, which may reflect the primal role of these processes in the evolution of consciousness.³⁷ As yet, our ability to simulate the demands of this layer is far from complete, but the development of partial simulations—such as current virtual reality—implementations—is the reason for the current interest in presence. This is because inclusion of the proto layer generates a quantum leap in mediated presence.

Proto presence is based on proprioception and other ways of knowing bodily orientation in the world. In a virtual world this is sometimes known as “spatial presence” and requires the tracking of body parts and appropriate updating of displays.

Core presence is based largely on vividness of perceptible displays. This is equivalent to “sensory presence” (e.g., in non-immersive VR) and requires good quality, preferably stereographic, graphics and other displays. As already stated, core consciousness is the pivot for judgments that something from the world outside is impacting on the self, on the life of the organism. As with the extended presence layer, if proto consciousness is integrated with core consciousness, proto presence will be involved in the feeling of presence, thus strengthening the overall sense of presence. The extent to which these two levels are integrated produces what is usually called degree of immersion. Extended presence requires intellectually and/or emotionally significant content. Integrating the three layers amounts to fooling the system into a conviction that something significant is happening to the self in the here and now.

The different layers of presence may be less than perfectly integrated in several ways, including the following:

- If you experience a VR without a tracking system, you can have high level of core presence (vividness), a high level of extended presence (engagement), but no proto presence (spatial presence).
- If you read a good book while sitting in a comfortable, safe place, extended consciousness will be engaged by media (engagement), but the other layers will not be involved.
- If you are in an immersive VR, but are preoccupied with personal worries (perhaps because the mediated content is not very engaging), proto (spatial) and core presence (vividness) will be invoked by the medium, but not extended presence.
- The same situation with particularly uninteresting content of the VR but no dominating personal worries (low engagement) may tend to produce frequent “breaks in presence” (a change or spreading of position on the locus dimension).

We can see changes in the locus of presence, such as Slater’s¹¹ “breaks in presence,” as illustrating how core consciousness attempts to integrate the three levels. Content entering core consciousness will remain there for as long as it can be integrated with the content of the other layers. If competing contents appear at either of the other two layers, a change in locus is possible. The probability and duration of such changes depend on extended consciousness; attention is likely to be captured by whatever is most relevant to the goals of the extended self, whether this is a stimulus from the real

world or a mental event such as a sudden thought. Even the occurrence of a new vivid stimulus, such as a loud sound (attracting core presence), or a break in bodily continuity such as a cable obstructing movement in a VR (attracting proto presence) will only have temporary effects. Once extended consciousness has judged the event as no longer relevant, the self will revert to the previous content of core consciousness.³⁵

OPTIMIZING PRESENCE

We have suggested that presence should be considered a layered experience, created by the evolution of the central nervous system in its attempt to embed the sensory-referred properties into an internal functional space. However, if presence is really an evolved psychological mechanism, it should exist independently of a given medium. More in particular, it cannot be considered as a simple response to media. This approach has three important corollaries:

- In the real world the level of presence is not the same in all the situations. For instance, if I'm attending a lesson in university, my level of presence can be lower or higher in relation to the interest I have in the topic discussed.
- There are exceptional situations in real life that have an optimal level of presence. In these situations all the three layers are activated giving to the subject a full sense of control and immersion.
- It should be possible to design mediated situations that elicit exceptionally high presence.

Are these corollaries true? If in general most presence researchers agree that in real life the level of absorption and attention is not the same in all the situations, it is more difficult to accept the second point. However, some suggestions about the characteristics of this higher level of presence come from recent researches into the concept of flow, which we outline in the next section. This is followed by a description of the potential for exceptional presence through mediated experience.

Optimal presence and the concept of flow

Csikszentmihalyi^{38,39} defined "flow" as an optimal state of consciousness characterized by a state of concentration so focused that it amounts to absolute absorption in an activity. According to Csikszentmihalyi,⁴⁰ when people are in a flow state, "[they] shift into a common mode of experience

when they become absorbed in their activity. This mode is characterized by a narrowing of the focus of awareness, so that irrelevant perceptions and thoughts are filtered out; by loss of self-consciousness; by a responsiveness to clear goals and unambiguous feedback; and by a sense of control over the environment . . . it is this common flow experience that people adduce as the main reason for performing the activity."

Starting from this definition, different authors have tried to define flow in an operational way. For Ghani and Deshpande,⁴¹ the two key characteristics of flow are (a) total concentration in an activity and (b) the enjoyment which one derives from an activity. Moreover, these authors identified two other factors affecting the experience of flow: a sense of control over one's environment and the level of challenge relative to a certain skill level. In Hoffman and Novak,⁴² flow is defined in terms of the experience of flow (intrinsic enjoyment, loss of self-consciousness), behavioral properties of the flow activity (seamless sequence of responses and self-reinforcement), and its antecedents (skill/challenge balance, focused attention, and telepresence). If we compare these definitions with our three layer model of presence, we can find many interesting similarities.

Our three-layer, evolutionary model of presence suggests that maximal presence arises when proto consciousness, core consciousness and extended consciousness are focused on the same external situation or activity. Maximal presence thus results from the combination of all three layers with an abnormally tight focus on the same content (Fig. 5), so that attention is directed exclusively towards the current external situation. We suggest that this is compatible with the flow concept, and indicates one approach to designing mediated experiences of exceptional presence.

Normal, everyday levels of presence arise from a split of attentional resources between layers of differing content, with some attention being directed to the current external situation. Minimal presence results from a lack of integration of the three layers, such that attention is mostly directed towards contents of extended consciousness that are unrelated to the present external environment—a psychological state of *absence*.⁸

Designing optimal presence

For us, optimal presence in a mediated experience arises from an optimal combination of form and content. The form must provide the means for a convincing perceptual illusion, but the content

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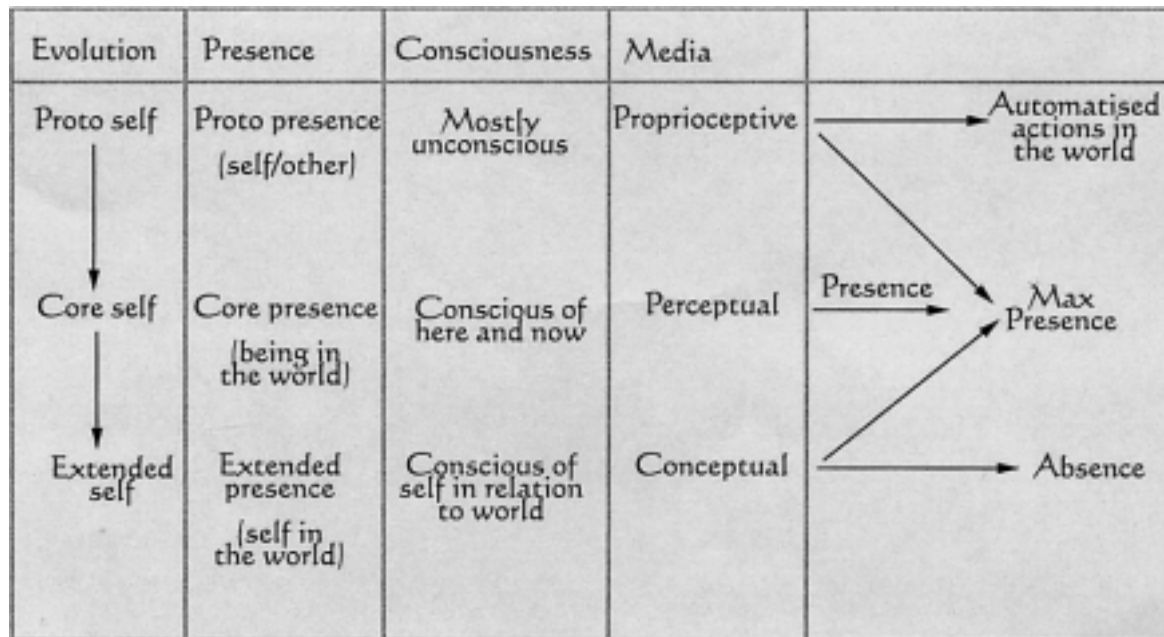


FIG. 5. Layers, media, and mental states.

to) the form for the illusion to happen convincingly. We suggest that proto presence is determined only by form, core presence by both form and content, and extended presence only by content. The integration of presence can occur in either the real or a virtual world. In the case of a virtual world, we need to provide both appropriate form and meaningful content. Presence in the real world depends only on content, on what we experience as happening to us in the here and now, since the form is provided and is always appropriate.

To optimize experienced presence in virtual environments we must design in a way that allows integration of the three layers (Fig. 1). As we have said, this is technically demanding at the lower levels. We need to provide as much immersion as possible, integrating proto (spatial) and core (sensory) presence. To integrate extended presence, the events and entities experienced in the virtual environment must have significance for the participant. For us then, maximal presence arises from an optimal combination of form and content. The form must provide the means for a convincing bodily and perceptual illusion, but the content should be integrated with (and so attract attention to) the form for the illusion of mediated presence to happen convincingly. We do not think we always feel presence when attending to something, internal or external, nor that the internal and external are always competitive in producing presence. On the contrary, the internal, "imaginal" content (of extended consciousness) may

either enhance or detract from the overall sense of presence. An example of enhancement is a typical computer game, where game designers strive to ensure that content and form are well integrated. Optimal presence arises when the contents of extended consciousness are aligned with the other layers of the self, and attention is directed to a currently present external world.

We can identify at least three ways of approaching the design of optimal mediated presence: digital participation, mediated flow, and embodied immersion. In these situations, the organism responds as if what happens in a mediated environment is real, in the fullest sense, and of immediate significance.

Digital participation can arise if we design a role for the participant as a performer in an interactive drama⁴³ seen from a first person perspective. If the performer becomes emotionally and intellectually engaged by the events in an appropriately immersive environment, extremely high levels of presence can be achieved.⁴⁴ A feature of this state of participation is a corresponding loss of self-consciousness: not that the self is not present—it is maximally so—but that an internal model of the self is not the focus of extended consciousness. In this respect, digital participation resembles the flow state and during which extended consciousness is also not preoccupied with the idea of self.

Trevino and Webster were the first authors to study mediated flow.⁴⁵ According to them, this represents the extent to which (a) the user perceives a

sense of control over the computer interaction, (b) the user perceives that his or her attention is focused on the interaction, (c) the user's curiosity is aroused during the interaction, and (d) the user finds the interaction intrinsically interesting. As with digital participation, events are experienced from a first person perspective.⁴⁵

Embodied immersion is our term for a style of interaction that uses bodily movements not only for consciously-monitored control over the environment, as in standard computer interactions, but also for more direct, automatized inputs from the immersant. The pioneering work in this area was carried out by Char Davies in the mid-nineties.⁴⁶ In *Osmose*, for example, breath and balance are used to control navigation, while in *Ephémère* visually dwelling on a portrayed "organic" form causes it to age before the eyes of the immersant. As with the examples digital participation and mediated flow, this style of first-person mediated experience results in a loss of self-consciousness and, as with the others, we see this as an approach to eliciting maximal levels of presence.

Petranker⁴⁷ distinguishes between "narratives," which are usually expressed in the third person and which we tell or are told to us, and "stories," which we inhabit from a first person perspective. For us, maximal presence arises when we fully "inhabit" the "story" of what is happening to us right now. Narrative, by its nature, is a distancing from the present. To design for maximal presence is to create stories we can inhabit as fully as possible. These stories are located in immersive environments and elicit embodied, unselfconscious and engaged participation from all three layers of the self.

CONCLUSION

In its earliest evolutionary form, presence was the sense that something was happening outside the organism in the here and now, something that could affect the organism, as opposed to being part of the organism. Initially, this may have been based in sensation (in proto consciousness) of something acting on the organism's boundary with the environment.⁴⁸ Later on in evolutionary (and neurological) terms, sensation led to perception, and presence emerged as the feeling (in core consciousness) of being in an external, perceptible world in which things happen in relation to the organism. Later still, internal modeling (in extended consciousness) allowed attention to be directed towards non-present, imagined worlds, experienced as being inside the organism (specifically, in the head).⁴⁹ To be useful

in assessing possible scenarios, presumably their main evolutionary purpose, these imagined events evoke similar emotional responses as external events would, but not the same feeling of presence.

Once we could imagine situations and events, it became advantageous to discriminate imagined, internal, hypothetical worlds from perceived events in the physical, external world—a discrimination that we suggest is based on the evolved form of presence. It is interesting to note that there may have been an intermediate period when this discrimination was not reliably made in this way⁵⁰ and when internal thoughts were perceived as the commands of Gods. But as consciousness extended to encompass both the outside world and an evolving internal, conceptual world, the survival advantages for organisms still reliably able to make this discrimination are obvious, and presence emerged in its current, evolved form. (In abnormal cases, as Damasio¹² points out, a reversion to something like this state indicates serious pathology: "It is as if, without the sense of self in the act of knowing, the thoughts one generates go unclaimed because their rightful owner is missing. The self-impooverished organism is at a loss as to whom those thoughts belong."¹³⁰)

By this evolutionary view, presence does not discriminate between the real and the virtual, but between the internal and the external. Clearly, evolution could not have equipped us to feel the difference between what is really present externally and what we perceive as present because of technological mediation. We can mostly tell the difference with existing virtual environments because of technical, or formal, limitations in the way the environment is coupled to the organism. But still, virtual realities do attempt to engage the organism in the same ways that the real world does, and they are more or less successful in this. The extent to which they evoke presence is to a large degree the extent to which they succeed. But this is not only a matter of emotional or intellectual engagement—which can also be stimulated by imagined situations. We may come to confuse a virtual experience with a real one because they are, in principle and as far as the organism is concerned, the same. They both evoke presence, the perception of a world surrounding the organism.

We have suggested that the purpose of presence is to provide a basis for the organism to separate events that occur only within the self from external events that may act on the self. Presence is experienced as a unitary feeling, a feeling of being in a world that exists outside of the self but in which the self is situated. We have suggested that contribu-

tions to the intensity of this feeling can come from three layers of the self, and we refer to these as proto presence, core presence and extended presence. The more the three layers are integrated (focused on the same events) the stronger the intensity of the presence feeling. The difference in presence experienced through different media can be explained by the fact that many media influence only a limited number of layers. In a compelling book reading only extended consciousness is involved, and with a movie experience we can modify both core presence and extended presence but not proto presence. Only in immersive virtual reality are all the three layers of consciousness modified by the media experience, and immersive environments are unique amongst media in their ability to produce a sense of presence as high as the maximal levels experienced in the physical world. And this is why virtual reality may be more effective in psychotherapy than purely imaginal techniques, at least for certain conditions. But, as in the physical world, immersion does not guarantee high presence.

To optimize experienced presence in virtual environments we must design in a way that integrates the three layers of presence. As we have seen, this is technically demanding at the lower levels. We need to provide as much immersion as possible, integrating proto (spatial) and core (sensory) presence. But if what is happening is not of interest or importance to the individual, the layers of presence will not be integrated and presence will be relatively weak. To integrate extended presence with the other layers, the situations experienced in the virtual environment must have immediate significance for the participant. We have suggested three design routes to achieving this: digital participation, mediated flow, and embodied immersion.

It might appear paradoxical that the focusing of self that underlies maximal presence also implies a loss of self-consciousness. But in optimal presence, biologically and culturally determined cognitive processes are working in harmony to focus all levels of the self on events unfolding in the present situation in which the organism is situated. This does not include experiencing the internal construction—the idea of self—that we sometimes call self-consciousness. To *be* oneself is to lose sight of the *idea* of oneself.

REFERENCES

1. Steuer, J.S. (1992). Defining virtual reality: dimensions determining telepresence. *Journal of Communication* 42:73–93.
2. Mantovani, G., & Riva, G. (1999). "Real" presence: how different ontologies generate different criteria for presence, telepresence, and virtual presence. *Presence, Teleoperators, and Virtual Environments* 8:538–548.
3. Riva, G., & Davide, F. (eds.). (2001). *Communications through virtual technologies: identity, community and technology in the communication age*. Amsterdam: Ios Press. Also available: www.emergingcommunication.com/volume1.html.
4. Riva, G., Davide, F., & IJsselsteijn, W.A. (eds.). (2003). *Being there: concepts, effects and measurements of user presence in synthetic environments*. Amsterdam: Ios Press. Also available: www.emergingcommunication.com/volume5.html.
5. Schubert, T., Friedman, F., & Regenbrecht, H. (2001). The experience of presence: factor analytic insights. *Presence: Teleoperators, and Virtual Environments* 10: 266–281.
6. Slater, M. (2002b). *Siggraph 2002 course notes on understanding virtual environments: immersion, presence and performance*. San Antonio, TX: ACM—Siggraph.
7. Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): speculations on the role of presence in virtual environments. *Presence: Teleoperators and Virtual Environments* 6:603–616.
8. Waterworth, J.A., & Waterworth, E.L. (2001). Focus, locus, and sensus: the three dimensions of virtual experience. *CyberPsychology & Behavior* 4:203–213.
9. Waterworth, J.A., & Waterworth, E.L. (2003). The meaning of presence. *Presence-Connect* 3 [On-line]. <http://presence.cs.ucl.ac.uk/presenceconnect/articles/Feb2003/jwworthFeb1020031217/jwworthFeb1020031217.html>.
10. Zahoric, P., & Jenison, R.L. (1998). Presence as being-in-the-world. *Presence, Teleoperators, and Virtual Environments* 7:78–89.
11. Slater, M. (2002a). Presence and the sixth sense. *Presence: Teleoperators, and Virtual Environments* 11:435–439.
12. Damasio, A. (1999). *The feeling of what happens: body, emotion and the making of consciousness*. San Diego: Harcourt Brace.
13. Buss, D.M. (1995). Evolutionary psychology: a new paradigm for psychological science. *Psychological Inquiry* 6:1–30.
14. Bereczkei, T. (2000). Evolutionary psychology: a new perspective in the behavioral sciences. *European Psychologist* 5:175–190.
15. Alexander, R.D. (1990). Epigenetic rules and Darwinian algorithms. *Ethology and Sociobiology* 11:241–303.
16. Massimini, F., & Delle Fave, A. (2000). Individual development in a bio-cultural perspective. *American Psychologist* 55:24–33.
17. Crook, J.H. (1980). *The evolution of human consciousness*. Oxford: Oxford University Press.
18. Riva, G., & Waterworth, J.A. (2003). Presence and the self: a cognitive neuroscience approach. *Presence-Connect* 3 [On-line]. Available: <http://presence.cs.ucl.ac.uk/presenceconnect/articles/Apr2003/jwworthApr72003114532/jwworthApr72003114532.html>.

19. Llinás, R.R. (2001). *I of the vortex: from neurons to self*. Cambridge, MA: MIT Press.
20. Janoff-Bulman, R., & Frantz, C.M. (1997). The impact of trauma on meaning: from meaningless world to meaningful life. In: Power, M., Brewin, C.R. (eds.), *The transformation of meaning in psychological therapies*. New York: Wiley, pp. 91–106.
21. Gregory, R.L. (1998). *Eye and brain: the psychology of seeing*. New York: Oxford University Press.
22. Metzinger, T. (1999). The hint half guessed. *Scientific American* 11:184–189.
23. Baars, B.J. (1988). *A cognitive theory of consciousness*. New York: Cambridge University Press.
24. Dolan, R.J. (1999). Feeling the neurobiological self. *Nature* 401:847–848.
25. Russell, J.A. (2003). Core affect and the psychological construction of emotion. *Psychological Review* 110: 145–172.
26. Farber, I. (2001). The world within the skull. *Nature* 413:776–777.
27. Jeannerod, M., & Decety, J. (1995). Mental motor imagery: a window into the representational stages of action. *Current Opinion in Neurobiology* 5:727–732.
28. Jeannerod, M., Arbib, M.A., Rizzolati, G., et al. (1995). Grasping objects: the cortical mechanisms of visuomotor transformation. *Trends in Neuroscience* 18: 314–320.
29. Rizzolati, G., & Arbib, M.A. (1998). Language within our grasp. *Trends in Neuroscience* 21:188–194.
30. Ramachandran, V.S. (2000). Mirror neurons and imitation learning as the driving force behind “the great leap forward” in human evolution. *The Edge* 69 [On-line]. Available: www.edge.org/3rd_culture/ramachandran/ramachandran_index.html.
31. Llinás, R.R., & Pare, D. (1991). Of dreaming and wakefulness. *Neuroscience* 44:521–535.
32. Cropanzano, R., James, K., & Citera, M. (1994). A goal hierarchy model of personality, motivation and leadership. *Research in Organizational Behavior* 15:267–322.
33. Brett, J.F., & eWalle, D.V. (1999). Goal orientation and goal content as predictors of performance in a training program. *Journal of Applied Psychology* 84:863–873.
34. Slater, M., & Steed, A. (2000). A virtual presence counter. *Presence: Teleoperators, and Virtual Environments* 9:413–434.
35. Spagnolli, A., & Gamberini, L. (2002). Immersion/emersion: presence in hybrid environments. Presented at Presence 2002: Fifth Annual International Workshop, Porto, Portugal.
36. Slater, M. (2003). A note on presence terminology. *Presence-Connect* 3 [On-line]. Available: <http://presence.cs.ucl.ac.uk/presenceconnect/articles/Jan2003/melslaterJan27200391557/melslaterJan27200391557.html>.
37. Sheets-Johnstone, M. (1998). Consciousness: a natural history. *Journal of Consciousness Studies* 5:260–294.
38. Csikszentmihalyi, M. (1990). *Flow: the psychology of optimal experience*. New York: HarperCollins.
39. Csikszentmihalyi, M. (1994). *The evolving self*. New York: Harper Perennial.
40. Csikszentmihalyi, M. (1977). *Beyond boredom and anxiety*. San Francisco: Jossey-Bass.
41. Ghani, J.A., & Deshpande, S.P. (1994). Task characteristics and the experience of optimal flow in human-computer interaction. *The Journal of Psychology* 128: 381–391.
42. Hoffman, D.L., and Novak, T.P. (1996). Marketing in hypermedia computer-mediated environments: conceptual foundations. *Journal of Marketing* 60:50–68.
43. Nath, S. (2001). Emotion based narratives: a new approach to creating story experiences in immersive virtual environments [MA thesis]. London: Central Saint Martin’s College of Art and Design.
44. Waterworth, J.A., Waterworth, E.L., and Westling, J. (2002). *Presence as performance: the mystique of digital participation*. Presented at Presence 2002: Fifth Annual International Workshop, Porto, Portugal.
45. Trevino, L.K., & Webster, J. (1992). Flow in computer-mediated communication. *Communication Research* 19:539–573.
46. Davies, C. (2003). Landscape, earth, body, being, space and time in the immersive virtual environments osmose and ephémère. In: Malloy, J. (ed.) *Women in new media*. Boston: MIT Press.
47. Petranker, J. (2003). Inhabiting conscious experience: engaged objectivity in the first-person study of consciousness. *Journal of Consciousness Studies* 10:3–23.
48. Humphrey, N. (1992). *A history of the mind*. New York: Simon and Shuster.
49. Velmans, M. (2000). *Understanding consciousness*. London: Routledge.
50. Jaynes, J. (1976, 1990). *The origin of consciousness in the breakdown of the bicameral mind*.

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