G. Riva, M.T. Anguera, B.K. Wiederhold and *F. Mantovani* (Eds.)
From Communication to Presence: Cognition, Emotions and Culture towards the Ultimate Communicative Experience. *Festschrift in honor of Luigi Anolli*

5 Media Presence, Consciousness and Dreaming

Henry J. MOLLER, Joseph BARBERA

Abstract: Advances in media and communication technology have opened up new avenues for understanding consciousness through observation of behaviour in virtual environments. A convergence of progress in cognitive neuroscience and computer science should consider the powerful role of conscious and unconscious states as an interface between self and virtual worlds. In this chapter, we review the premise of presence as a dimension of consciousness from both a phenomenological and neuroscientific perspective. Working from a model in which dreaming consciousness is considered the most archetypal form of media technology, dreams are discussed as a useful metaphor for virtual reality. We argue that presence can be equally compelling whether experienced via self-generated simulation during the process of dreaming, or through an externally generated media simulation. Attempts to use media technology in a therapeutic context need to consider clinical aspects of mechanisms involved in both normal and clinical/pathological aspects of consciousness. A speculative therapeutic approach, "dream simulation therapy", is discussed as a future possible area of study. Dreaming consciousness reminds us that the key factor in approaching an ultimate technology-mediated presence experience is the sum rather than its parts: a subjective/affective state of being.

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5.1 Introduction

Advances in media and communication technology have opened up new avenues for understanding consciousness through observation of behaviour in human-machine interfaces, described as "virtual environments" once accepted by the user as indistinguishable from "real" experiences [1]. Has the time come to place the phenomenon of presence as a unique state of consciousness in the context of current neuroscientific understanding? As multidisciplinary research of presence continues to evolve, we propose that valuable lessons about the elusive nature of defining this phenomenon can be learned from the field of somnology.

Some would argue that dreams are in fact both the most vestigial yet also the most sophisticated virtual environments that our perceptions allow for. Sleep research has greatly advanced our evidence-based scientific understanding of conscious states, allowing for a unified model of the phenomenology and neuroscience of dreaming. Particularly within the past decade, a movement has emerged to reunite the more descriptive/psychoanalytic with the neuroanatomic/psychophysiologic approaches to consciousness [2-5], recognizing that rather than representing competing theories of Mind/Brain, an integrated approach is able to incorporate complementary elements of both to form a more unified picture. Central to this advanced understanding has been the study of the phenomenology and neurobiology of dreams. Following this approach, we review here the premise of presence as a dimension of consciousness, whether experienced via self-generated simulation during the process of dreaming, or through an externally generated media simulation. A speculative therapeutic approach, "dream simulation therapy", is proposed as a future possible area of study of this field. Our intent is bridge what is currently known about consciousness vis-à-vis dreaming and media technology, particularly when used in a therapeutic context.

5.2 Dreaming Consciousness as Semiotic Experience

Marshall McLuhan boldly predicted a state where "We have extended our central nervous system itself in a global embrace, abolishing both space and time"[6]. More recently, Frank Biocca proclaimed:

"Virtual Environments have less to do with simulating physical reality per se, rather it simulates how the mind "perceives" physical reality. A cyclotron of the mind can only be created by perfectly simulating the medium of the mind." (p. 2, [7]).

If a true state of "virtual reality" presence, indistinguishable from "physical" reality can be considered the ultimate communication experience, then from an evolutionary perspective, dreaming can be understood as the most archetypal form of virtual reality. Let us consider how we define what qualifies as media communication. Before virtual

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environments, there was the less well-defined concept of "multimedia". Before multimedia, there were media stimulating individual senses, in particular, the visual or auditory senses. Before we were able to create these through technologies such as cameras, audio recording devices or even the printing press, hand-produced facsimiles were used in attempts to communicate the sensory, emotional and cognitive/semantic aspects of experiences. The tradition of interpersonal communication in humans has always been about one individual's attempt to recreate, re-enact or describe their experiences to another individual. These experiences, encoded in infinitely interconnected "bits" of perceptual inputs constantly modify our pre-existing states of consciousness, consisting of memories, learned behaviours and expectations. As will be discussed later, there are some theories regarding evolutionary advantages of dreams used as an ancient biological defense and communication mechanism to make sense of and prepare for a variety of "real-world" experiences during the earliest human eras of communication [8,9].

Much of psychoanalytic theory and practice, with its historical emphasis on decoding complex messages embedded in our dreams, is in fact based on the deciphering of communication between self and the outside world, but this approach has fallen out of favour in the scientific community largely because of lack of provable hypotheses. However, the field has left as a residue a fascination amongst clinicians, philosophers and popular culture regarding hidden meanings of dreams [10]. Conversely, within discussions of semiotic aspects of multimedia communication, representational systems, both in the aural and visual modalities are ultimately processed within the central nervous system (CNS) through complex decoding processes. For example, Jerome Bruner [11] classified semiotic systems into three types:

1. enactive- based on physical movement and learning of the responses (e.g. actions required for riding a bicycle).
2. iconic – depending on imagery and perception (e.g. photographs)
3. symbolic- using symbols which do not have a perceptual relationship with concepts they signify (e.g. words, a traffic light)

Analogous to our later discussion of the phenomenology of dream mentation and phenomenology in normal and pathological states, communication through dreams, whether understood as a form of self-to-self or environment-to-self communication can also be understood to employ this type semiotic organization, all of which ultimately serve as an unconscious conduit towards learning and information processing.

Semantics aside, a neuroscientific understanding of presence remains in its infancy. In a recent review of the taxonomy of presence from a communications perspective [12], Lee comments:

"in addition to usual pencil-and-paper measures of presence, we need to develop novel and unobtrusive measures of presence based on physiological responses, behavioural reactions, brain waves, and so on." (p. 47).

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That the scientific field of sleep research concerns itself intimately with the study of brainwaves in relation to conscious experiences is inarguable. There have also been exciting recent parallels to established models of consciousness research in terms of attempts to describe experiences in synthetic environments in neurophysiologic terms. While the field of somnology remains a relatively recent discipline, great advances have been made in terms of describing neural processes underlying the processes that allow for the unique perceptual experience of dreaming and other states of consciousness. By describing these in some detail, we aim to familiarize an audience truly interested in advancing the cognitive neuroscience of dreaming, or as per Antti Revonsuo's description, "inner presence" [9].

5.3 Dream Phenomenology

Wikipedia defines a dream as "the experience of images, sounds/voices, words, thoughts or sensations during sleep, with the dreamer usually not being able to influence the experience" [13]. The broadness of this definition is presumably meant to mitigate argument, although some may criticize its very all-inclusiveness and lack of specificity. Neilson for example distinguishes between non-specific "cognitive activity" in sleep, which may consist of "static visual images, thinking, reflecting, bodily feelings or vague fragmentary impressions"; from dreaming proper which is characterized by "sensory hallucinations, emotions, storylike or dramatic progression and bizarreness"[14]. Likewise, Hobson et al. argue against a broad definition for dreaming as "any mental activity occurring in sleep" [15] and for a narrower definition as follows:

"Mental activity occurring in sleep characterized by vivid sensorimotor imagery that is experienced as waking reality despite such distinctive cognitive features as impossibility or improbability of time, place, person and actions; emotions, especially fear, elation and anger predominate over sadness, shame and guilt and sometimes reach sufficient strength to cause awakening; memory for even very vivid dreams is evanescent and tends to fade quickly upon awakening unless special steps are taken to retain it." (p. 3).

In fact there is no generally accepted definition of dreaming, with definitions varying from study to study or no definition being provided at all. Even less consensus has been reached with regard to the phenomenology of dreaming. This may be a consequence of the universality of the phenomenon in question: it would hardly seem necessary to define something that each of us experiences on a more or less nightly basis (much as some researchers refer to "consciousness" without fully explicating it). Alternatively it may be a tacit acknowledgment that dreaming is in essence a subjective phenomenon and potentially indefinable outside of this boundary.

We will, as a preliminary step, describe some of the phenomenological characteristics of dreaming, occasionally stating the obvious, since it is sometimes only in stating the obvious that the remarkableness of this nightly phenomenon becomes evident:

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5.3.1 Sensory Experience

All sensory modalities may be experienced in dreams with visual being the most common, followed by auditory, kinesthetic, touch and to a significantly less degree gustatory and olfactory [16, 17, 18]. Hobson also emphasises the sense of continuous movement in dreams [19]. Sensations and perceptions in dreams are often described as "vivid", meaning they are experienced in a manner similar to waking life, or as "hallucinatory" meaning they are taken by the dreamer to be real.

The actual qualities of sensory experiences in sleep have been sparsely studied. Rechtschaffen and Buchignani studied the visual qualities of dreams by awakening subjects from rapid eye movement (REM) sleep and asking them to compare the visual imagery in their dreams to a series of photographs representing varying amounts of colour saturation, brightness/illumination, figure clarity, background clarity and overall hue [20]. The authors found that the visual qualities of most dreams (40%) were categorized by subjects as "normal" i.e. similar to external reality. Mild deviations, however, were not uncommon, particularly with regard to decreased color saturation and a loss of background detail. The authors speculate that the latter finding may be a function of dream processes focusing on cognitively important images (figures etc.) rather than less cognitively relevant background details. In other words, "high fidelity" is not a requirement of dreams in their simulation of reality.

Researchers in the 1950's had commonly reported that dreams were predominantly experienced in black and white, in contrast to earlier writers, and a marked change of opinion in the 1960's onward that suggested we dream predominantly in colour [21]. This may be a consequence of methodological differences between studies [22, 23]. Schwitzgebel, however, has put forth the intriguing hypothesis that the frequent reports of black and white dreams in the 1950's may have been the result of the prominence of black and white film media in the first half of the twentieth century [21]. Schwitzgebel repeated the methodology of a 1942 study on colour in dreams and found a significantly greater proportion of students in 2001 reported dreaming in colour in comparison with their 1942 counterparts [23]. Furthermore he found that cultural groups with longer histories of exposure to colour media also report more dreaming in colour [24]. The perception of colour in dreams would thus seem to be an example of media technology influencing our experience of dreaming, if not conscious experience in general. Schwitzgebel even goes so far as to suggest that as future media incorporates more "haptic" elements, the perceived presence of such elements in dreams (now considered rare) will likewise change [25].

That dream reality is not solely dependent on visual imagery is illustrated by reports of blind individuals that indicate the presence of vivid dreams in this group in the absence of visual imagery [22, 26]. Solms reported two cases of "non-visual dreaming" owing to brain lesion in the medial-temporal region, after having reviewed a number of similar cases in the literature [27].

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5.3.2 Narrative Structure

A detailed analysis of dream content is beyond the scope of this review, but it is evident that dreams contain a full range of settings, characters, objects, activities and social interaction; in fact all of the elements that might be said to encompass waking experience [18, 28]. Of more importance to the phenomenology of dreaming is that such elements do not take the form of isolated images and events, but rather within the context of a "narrative structure" i.e. a *sequence* of perceptions taking on a storylike quality [29]. Furthermore, Strauch and Meier in a dream series analysis found that the dreamer was present in all dreams (the "Dream Self"), with the dreamer usually taking on an active role [18]. The narrative structure of dreams is thus generally from a first-person perspective, with the dreamer experiencing him- or herself as moving through an environment and interacting with various characters and objects.

Of relevance to interpersonal and transpersonal aspects of presence, social interactions seem to be particularly common in dreams [18, 28]. Aggressive interactions have typically been felt to be more common than friendly ones, with sexual interactions placing a distant third [28]. Affective state during wakefulness has been reported as often correlating with themes and affective state experienced during dreams [25]. Strauch and Meier described that most social interactions in dreams were verbal rather than action oriented and usually centred on everyday "concrete themes" [18].

5.3.3 Bizarreness

Bizarreness in dreams, or the presence of the unusual or impossible (in comparison with waking life) may occur both with respect to their form and content [18]. Bizarreness of form may occur as disruption or rapid changes in the temporal sequence of dream images and themes. Bizarreness in content is represented by unusual or improbable combination of people, places and objects [15, 18, 29, 31-34]. While some authors have emphasized bizarreness as a distinctive feature of dreaming [29], other have not. Strauch and Meier felt that while all elements of dream experience could be subject to bizarre admixtures, this was neither general nor dominant [18]. Reinsel et al. found a greater level of bizarreness in waking fantasy than in rapid eye movement (REM) sleep [32].

5.3.4 Thought Processes

Rechtschaffen described the "single-mindedness" of dreams [35], a term which can be thought of as encompassing several elements of thinking within dreams. "Self-reflection" in dreams is generally absent or at best reduced. The dreamer is not only unaware that the reality he or she is experiencing is a dream (except in rare cases of lucid dreaming), but thought processes in general are simplistic and focused on the immediate dream content or theme [15, 18, 35, 36]. Dreamers lack "autonoetic awareness" or an appreciation of themselves as extending through time, with a sense of a continuous

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presence being maintained [14]. Reasoning, when present, is "ad hoc", arising after the fact to explain a particular incongruency [34]. Even if one does allow for the differences between cognition in dreaming and wakefulness to be more quantitative rather than qualitative [35, 36], metacognition is generally deficient [37, 38]. Such a narrowing of thought processes would account for the overall sense of coherence and narrative structure present in a dream despite the presence of otherwise bizarre elements. It would also account for the uncritical or "delusional acceptance" of the dream experience as real [34], much reminiscent of a state of immersion experienced in a virtual environment simulation [1].

5.3.5 Emotions

Emotions, while often underreported in dream reports and under-recognized by dream researchers [28], appear to be a prominent if not ubiquitous component of dream experience [39]. Emotions in dreams may take the form of specific emotions or generalized mood states [18, 40]. Intense emotions such as fear and anger may be experienced more frequently than more subtle ones such as guilt and disgust, and dreamers usually report only one emotion at a time [18]. Emotions in dreams likely exhibit the same single-mindedness as thought processes with a similar lack of self-reflection. While negative emotions are often reported as being more prominent than positive emotions [28, 30, 39], this may be the result of methodological issues, which once corrected result in an equal balance of reported emotions [39]. Specific emotions may be more negative in waking consciousness, and generalized mood states more positive [18], though this may relate to the increased ability to accurately label affective states while awake.

Although common experience suggests that emotions in dreams may be incongruous or disproportionate with dream content (either exaggerated or deficient), some authors have contended that emotions are almost always appropriate to the dream plot and may even determine/integrate dream images and plot features [39]. Kahn et al. have shown that characters in dreams are often identified by the emotions they evoke in the dreamer [41]. Given the potential ubiquity and primacy of emotions in dream experience and its potential relevance to analogous emotional experiences in other forms of presence, including synthetic, it is surprising how relatively unstudied this aspect of dreaming has been.

5.3.6 Memory

Born and colleagues have described sleep in general as crucial to the "off-line" consolidation of procedural memory [42], and have implicated REM sleep specifically in the formation and processing of emotional memories [43]. Memory deficits are a prominent feature of dreams [29], with dreams often not being remembered at all unless one is awakened in the middle of one, or quickly forgotten if not recorded. While this does not speak directly to the phenomenology of dreaming, it is noteworthy that while the dreamer perceives dreams as "real", this experience is not generally integrated into

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waking consciousness. This could, we hypothesize, be a protective mechanism to maintain a boundary between dreaming and waking experience (or simulated versus real world experience), without which a fragmentation of consciousness would result. One recent neuropsychoanalytic model has focused on the shared phenomenology of dream mentation and psychosis with aspects of virtual reality, in the sense that an individual's reality testing —and often, belief system— may be altered in such states [44].

5.3.7 Relationship to Waking Experience

Freud emphasised the effect of waking activity on dream mentation (the "day residue", [2]). Episodic memories however (accurate reproduction of specific events, characters and actions) seem to be rarely reflected in dreams, occurring in less than 2% of dream reports [14, 45]. Hartman noted that we rarely dream of the "3 R's": reading, writing and arithmetic, despite a large percentage of our waking lives engaged in such activities [46]. Schredl and Hofmann note that we rarely dream of using a computer (for either work or play activities) [47]. However, in a well-known experiment, Stickgold et al. found that subjects engaged in an extended Tetris playing paradigm reported experiencing stereotyped images at sleep onset consisting of falling and rotating Tetris pieces, but never images of a computer screen, keyboard, etc. [48]. The findings were similar in normals and in patients with amnesia secondary to bilateral medial temporal lobe damage (who could not even recall playing the game). Perhaps most convincingly, subjects developing blindness after the age of seven continue to experience visual dreaming over a lifetime [22].

Thus, overall, it seems that dreams are not a simple replaying of the day's events, but rather isolated fragments of waking experience, extracted and incorporated into conscious narrative in novel ways. Extracted elements may be those with emotional salience or those concerned with procedural learning [14, 43, 45].

5.4 Dreaming, Virtual Reality and Presence

Given the phenomenological characteristics of the dreams, it is not surprising that several authors have likened the dream experience to a form of virtual reality [14, 26, 44, 49, 50]. Foulkes has commented that while the dreamer creates dreams mentally, they are experienced as life rather than thought, and as perception rather than imagination [26]. Dreams, according to this perspective, take on the form of "credible world analogs", through which we move and interact with other individuals. In fact the simulation of reality is so complete, that for Foulkes the question is not why we accept it as real but "why we *shouldn't* believe it to be real." [27]. Neilson and Stenstrom describe dreaming as portraying "coherent virtual worlds" [14], noting:

"Dreams seem to take place in real, spatially coherent, environments with which the self interacts perceptually, for example, by orienting, seeking and assimilating sensory information, much as it does with the real world. The self also seems to engage realistic

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character in emotional and intellectual exchanges. Semantic information and a sense of knowing are often also present." (p. 1286).

Likewise Revonsuo describes dream consciousness as an "organized and selective simulation of the perceptual world" specifically referring to it as a form of virtual reality [49]. In an earlier paper Revonsuo even suggests that consciousness in general, be it in dreaming or waking, may be conceptualized as a virtual reality experience [50].

Lee defines presence as a "psychological state in which virtual (para-authentic or artificial) objects are experienced as actual objects in either sensory or nonsensory ways" [12]. Furthermore Lee delineates three types of presence – physical, social, and self; depending on the virtual objects being experienced as actual objects, be they physical objects, social actors or self/selves.

Dream experience, in the terminology proposed by Lee, may readily seen as exhibiting a high degree of presence in the physical, social and self domains. The dreaming mind, even in the absence of external perceptual inputs, is able to generate for itself an immersive environment that is taken by the dreamer to be completely real, perceptually and affectively. Furthermore the dreaming Mind/Brain accomplishes this without the need for either a high degree of fidelity ("vividness" as Lee puts it), or even elements corresponding directly to waking reality - dreams in their bizarreness are still taken to be real. This is a feat unmatched by any artificial immersive environment, akin to not only believing that a virtual environment is reasonably realistic, but is in fact a reality unto itself. Given that in the case of dreaming the brain is generating the very environment it perceives, such a standard may be unattainable by artificial - including digital/multimedia – means.

Lee [12] also distinguishes between three types of human experience: "real experience", the sensory experience of actual objects; "virtual experience", sensory or non-sensory experiences of para-authentic or artificial objects; and "hallucination", nonsensory experience of imaginary objects. Dream experience is most akin to "hallucination" in Lee's typology. Lee however proposes that hallucinatory experiences are neither real nor virtual, since the objects experienced are neither real nor mediated by man-made technology. As such, Lee argues, hallucination, along with real experience, is not pertinent to presence research. Certainly the sense of realness experienced during dreaming is complete enough that dreaming may be said to be not simply a simulation of reality, but an "experiential reality" in its own right [50]. Like Revonsuo [9, 49, 50], we would, however, argue with a proposition that claims nothing is to be gained in presence research by a study of the dreaming phenomenon.

Dreaming, firstly, may be regarded as a natural experiment in presence; in fact the "gold standard" by which other immersive environments may be compared. Secondly dreaming provides a unique window into the processes that determine how the brain organizes information (external and internal). Lee [12] himself has argued that one of the most important issues in the study of presence is the determination of the underlying, human-based mechanisms that make presence possible. In particular he expresses an interest in presence induced by low-tech, nonsensory media such as books, requiring significant self-generated cognitive "filling-in " processes to achieve presence.

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Revonsuo has commented that dreaming represents a specific, and perhaps more basic form of consciousness as it is dissociated from the effects of external input (an "unaltered" state of consciousness as it were) [50]. He further adds that whatever neurophysiologic mechanisms of the brain are active while dreaming, they are sufficient for conscious experiences to exist. Thus dreaming may offer important insights into consciousness in its most basic form, and the manner in which it organizes external information, be it via the "real world" or through selectively chosen media interfaces. These insights may in turn be used to design even more immersive artificial environments. Similarly, as we begin to create more realistic artificially immersive environments, this may provide insights into the dreaming process, as well as consciousness in general.

5.5 The Function of Dreams

5.5.1 Psychoanalytic Theory

Despite the universality of the dream experience, there continues to be little consensus as to what function, if any, dreams serve. Freud postulated that sleep represents a regression by which infantile wishes buried in the unconscious threatened to surface to conscious awareness [2]. Dreams, or the "dream-work" functioned to disguise such wishes, converting the latent content of infantile wishes into the manifest content experienced by the individual (through the processes of condensation, displacement and symbolization). Dreams, according to Freud, first and foremost acted as the "guardians" of sleep, preventing the individual from waking up in response to otherwise threatening infantile wishes [2]. Subsequent analytic schools have broadened Freud's view of the function of dreaming to include a more active problem-solving capacity [51, 52]. Fosshage for example describes the function of dreams as the "development, maintenance (regulation) and, when necessary, restoration of psychic processes, structure and organization" [52].

5.5.2 Neuropsychoanalytic and Neural Network Theory

The view of dreams as a regulator of drives or emotions has persisted in sleep research, albeit from a neuropsychological rather than depth psychological perspective. Solms has speculated that brain activation during sleep stimulates centres in the brain responsible for "appetitive interest" (in the limbic frontal white matter) [27, 53]. Rather than such centres being allowed to activate motivational motor systems that would otherwise awaken the individual, their influence is instead shunted toward perceptual systems (in the occipito-temporo-parietal junction) that instead produce dreaming. Thus the system driving dream production serves as the guardian of sleep as proposed by Freud [2], although in this model dreaming in itself does not seem to have any particular function. Hartman, by contrast, has proposed that dreams function to contextualize the dominant

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emotional concern of an individual by cross-connecting or integrating new material into pre-existing neural networks (such as after a significant trauma) [54, 55].

5.5.3 Threat Simulation Theory

Revonsuo, perhaps more than any writer, has emphasized the concept of dreams as a simulation of reality, and has directly incorporated this perspective into a theory of their function. Dreaming, according to Revonsuo is a biological defence mechanism, evolutionarily selected for its ability to simulate threatening events - the “threat simulation theory” of dreaming [49, 56]. Such a simulation allows for the rehearsal of threat recognition and avoidance, which in turn leads to increased survival of the organism (this would account for the instinctive appeal of certain immersive, first-person perspective, action-based video games). Other authors have suggested a broadening of the simulation theory of dreaming to include other adaptive functions such as play [57, 58]. Revonsuo comments that the rehearsal of threat recognition and avoidance may still strengthen implicit or procedural learning without the need to remember such a rehearsal upon awakening [49]. We would add that such a loss of memory of dream mentation upon awakening may be necessary, serving to prevent dream mentation from being integrated into episodic memory and potentially being confused with waking experience. In fact the function of dreaming may be not only to rehearse behavioural responses in a “safe place” but to do so in a manner that will not interfere with waking episodic memory. For the simulation to function maximally it should be taken for real, but ultimately not confused with the reality of the waking world.

5.5.4 Dreams as Nonfunctional Epiphenomena

Finally, some investigators, while attributing a potential function of REM sleep in brain regulation, see dreaming as epiphenomena in nature, the result of non-specific cortical activation or arousal [15, 28, 49]. In other words, the perceptual experience of dreaming, while interesting and potentially meaningful, in and of itself serves no biologically useful function. As Domhoff comments [28]:

“On the basis of current evidence, it is more likely that dreams are an accidental by-product of two great evolutionary adaptations, sleep and consciousness.” (p. 6).

5.6 REM, Non-REM and Wakefulness: Three States of Consciousness

We present here a broad and admittedly simplified overview of the neurobiology of dreaming in order to illustrate the potential value, if not the necessity of understanding dreaming in terms of fundamental neurobiological mechanisms underlying the experience of presence.

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5.6.1 Historical Aspects

A breakthrough in understanding of the biological underpinning of dreaming occurred only as recently as 1953 with the discovery of REM sleep by Aserinsky and Kleitman [59], seen as a key landmark in heralding in the era of biological psychiatry that many would argue prevails to this present day, supplanting psychoanalytic approaches to understanding psychopathology. Shortly afterwards, Michel Jouvet's discovery of atonia (muscle paralysis) during REM sleep in cats [60] prompted him to describe REM sleep as *paradoxical sleep* [61, 62], in which an organism is neither asleep nor awake, but under the influence of a "new" third state of the brain. In this state, an individual would experience perceptual phenomena analogous to being awake, but with sensory and cognitive gating systems operational during wakefulness altered, and motor response systems including speech production "paradoxically" incapacitated. Furthermore early studies demonstrated that patients awakened during this phase of sleep reported dream mentation, while those awakened at other times did not [63]. Thus the association between REM sleep and dreaming became established.

5.6.2 Polysomnographic Measurement and Sleep Staging

These early developments also led to the refinement of polysomnography (PSG), or overnight sleep recording, which has become the essential diagnostic instrument of sleep medicine [63, 64]. PSG consists of continuous and simultaneous recording of the following core parameters:
1. electroencephalogram (EEG) recording of brain activity;
2. electro-oculogram (EOG) recording of eye movements;
3. electromyogram (EMG) recording of muscle activity.

Auxillary physiological parameters such as respiratory or cardiac functioning throughout a sleep period are also commonly monitored in PSG [64]. Through use of PSG recording techniques somnology researchers have been able to define three distinct and separate states of consciousness:
1. waking consciousness, characterized by a high frequency, low-amplitude EEG activity and normal muscle tone.
2. nonREM (NREM) sleep, divided into four stages and characterized by a progressive slowing of EEG frequencies and increase in amplitude, relaxed EMG muscle tone and slow rolling to absent eye movements.
3. REM or "paradoxical" sleep, characterized by a mixed-frequency low-amplitude EEG pattern akin to stage I sleep (which is often thought of as the transition between relaxed wakefulness and sleep proper), rapid eye movements and an absence of muscle activity (muscle atonia). REM sleep, it is worth noting, is distinguished from NREM sleep through its relatively active EEG pattern, despite a high arousal threshold characteristic of sleep (hence the term "paradoxical sleep") and from a wakeful state by the presence of muscle atonia which prevents the activation of

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motor response systems in the face of cortical activation (a useful evolutionary adaptation that prevents us from physically acting out our dreams).

PSG allows for the recording of a typical cycling between NREM (stages 1-4) and REM sleep, with REM sleep periods occurring every 90-100 minutes and taking up 20-25% of the night. A typical nocturnal sleep pattern hypnogram for a healthy adult is shown in Figure 1, demonstrating the fluctuating nature of consciousness during sleep.

It has traditionally been held that awaking from REM sleep results in reports of full-blown dream mentation while awakenings from NREM sleep produce reports of more "thoughtlike" processes. However, the view that REM sleep is synonymous with dreaming has recently come under challenge. It has been estimated that 5-30% of REM awakenings do not elicit dream reports, while 5-10% of NREM awakenings elicit dream reports indistinguishable from REM reports (particularly at sleep onset). Thus REM sleep can technically occur without dreaming and dreaming can occur without REM sleep [65, 66]. It is fair to say, however, that in general, dreaming is most likely to occur under the conditions of REM sleep.

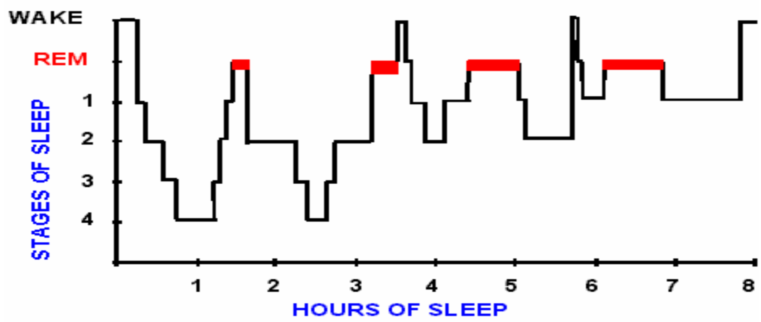

Figure 1: Hypnogram in a healthy individual, showing the dynamic nature of sleep stages, with dream-rich REM episodes (indicated by thick bars) recurring between non-REM sleep periods of varying depth at regular intervals. Note that longer periods of REM occur during the latter part of the sleep period.

5.7 The functional neuroanatomy of dreaming

Classic experiments by Jouvet in the 1960's isolated the centres that generate REM sleep to the pontine brainstem [67]. It is now known that cholinergic neurons located in specific nuclei (the laterodorsal tegmental nucleus and the pedunculopontine tegmental nucleus) are activated during REM sleep. These nuclei in turn send projections to nearby nuclei to produce rapid eye movements, downward into the medulla and spinal cord to paralyze muscle activity, and most importantly upward into the forebrain to produce diffuse cortical activation [15]. REM sleep, however, confined in its production to the brainstem is still only the generator of the process, leaving open the question of what areas of the forebrain are responsible for the generation of the complex conscious state

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known as dreaming. In a landmark study, Solms reviewed all reported cases of altered dreaming and neurological injury, prompting him to designate the following areas of the brain to be necessary for dreaming: the limbic system (the brain's core emotional centre), the medial occipito-temporal cortex (producing visual representations), the inferior parietal convexity (producing spatial cognition) and basal forebrain pathways (producing "appetitive interests") [27].

Neuroimaging studies have confirmed that during dreaming there is activation of the limbic and paralimbic regions and activation of specific cortical areas such as the associative visual and auditory areas [68]. Furthermore, dreaming seems to be associated with a *deactivation* of portions of the frontal cortex responsible for executive control, a finding which may account for the bizarreness of dreaming [15].

5.8 The Neurophysiology of Dreaming

5.8.1 The Activation-synthesis Hypothesis

Figure 2 illustrates the complexity of any attempt to anatomically delineate the dynamic process and experience of dreaming [15].

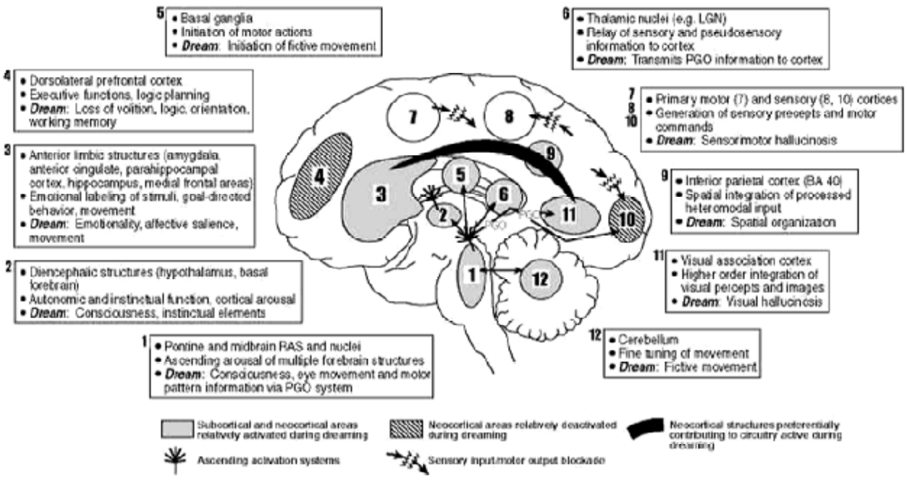

Figure 2 The Activation-Synthesis Functional Model of Dreaming
(reprinted with permission from Hobson et al, 2003)

One of the leading theories with respect to the neurophysiology of dreaming is the *activation-synthesis hypothesis*, a theory proposed by Hobson and McCarley in 1977 [69] and which has undergone substantial evolution over the years. This theory postulates that the process of dreaming is driven by REM sleep generators in the pontine brainstem which, as noted above, activate or send signals diffusely into the forebrain to a

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number of areas including the limbic system and selected cortical areas (in particular those subserving visual association and spatial cognition). Such internally driven signals are "chaotic" in nature, and in attempts to make sense of them, higher association areas in the brain synthesise or construct visual images and narrative plots around them. The end result is dreaming, with its unique phenomenology.
Further peculiarities of dreaming may be accounted for by decreased frontal lobe functioning and a shift to cholinergic (acetylcholine) neuromodulation during REM sleep from the aminergic (serotonin and norepinephrine) neuromodulation associated with wakefulness [15].

The activation-synthesis hypothesis has been a very influential model in understanding dream generation, but is of course not the only such model (for example, consider Solms' model as noted under the function of dreaming [27, 52]). One major controversy underlying competing models has been whether or not REM sleep is indeed the prime driver in the dreaming process.

5.8.2 The AIM Model of Conscious States

Dreams, similar to Biocca's conceptualization of media presence [7], obey not the laws of physics but the laws of the mind. The AIM (Activation-Input-Modulation) model was developed from the activation-synthesis model as an attempt to map conscious states onto an underlying physiological state space [15]. In this model, shown in Figure 3, conscious states in the Mind/Brain are determined by three interdependent processes which can be mapped along three dimensions . The three processes in the AIM model of conscious states include:

1. the level of brain activation ("A");
2. the origin of information input ("I") to the brain (external or internal); and
3. the relative levels of aminergic and cholinergic neuromodulation ("M") which determines information processing.

These three Mind/Brain processes are hypothesized to exist at discrete points along the construed three-dimensional state space. A high level of activation, predominantly external information inputs and high levels of aminergic modulation characterize wakefulness. REM sleep (and dreaming), by contrast, is characterized by a high level of activation, predominantly internal information inputs and high levels of cholinergic modulation (hence the particular characteristics of dreaming in comparison with waking experience).

5.8.3 Applications to Presence in other States of Consciousness

A number of other partial or dissociated states may also be mapped in a similar manner such as quiet rest (or waking fantasy), lucid dreaming, hallucinosis etc. [15]. This relatively simple model has proven useful in the understanding of dissociated conscious states. It may also prove applicable in the understanding of immersive states of consciousness involving multimedia displays, which would presumably involve

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intermediate positions along any of these dimensions. The presence induced by reading a riveting novel, for example, is predominantly internally driven, as the reader individualizes the information imparted through perceiving text characters via a neurocognitive "filling-in process" process. By contrast, the experiential state of an individual engaging in an immersive 3-dimensional software-generated environment via virtual reality goggles is predominantly externally driven. Thus, as fidelity and richness of perceptual information presented to an individual increases, the experience of presence is generated through different mechanisms using the AIM model. It remains clear, however, that a low fidelity simulation with a powerful affective impact imparts a strong feeling of presence.

It has been argued that in a virtual environment paradigm, there is a spectrum of immersion ranging from "presence" (completely engaged) to "absence" (completely disengaged) [70]. This can be applied to human-centred communication as well as engagement in media-related interactive tasks (see also the other chapters of this section). We have previously proposed that there may well be an electrophysiological correlate of absence, as defined by intrusion of EEG-defined sleep consciousness while engaged in a task [71].

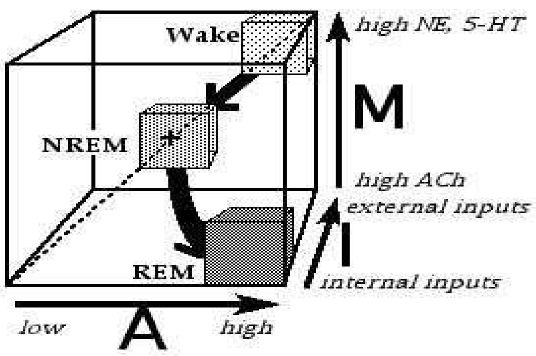

Figure 3: The AIM model.(NE=Norepinephrine, 5-HT=Serotonin, Ach=Acetylcholine.)
(reprinted with permission from Hobson et al, 2003).

Thus the term "absence", used by neurologists to define characteristic sleep-like EEG in certain types of seizures [72] could also be applied to the study of presence, even in the absence of epileptiform activity. As an individual is decreasingly engaged in a perceptual experience, he or she will retreat into a state of absence that is both a psychological/perceptual experience and a neurophysiologic state. If this transition from wakefulness is towards a non-REM sleep state, this is experienced in the form of brief fragments of microsleep intruding into waking consciousness [73]. If it is towards a state of REM sleep (as in states such as sleep deprivation or narcolepsy) this may be experienced as pseudohallucinatory dream mentation [74]. Conversely, as an individual

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becomes increasingly perceptually immersed and experiences presence, a transition in consciousness occurs that can be described in qualitative/subjective as well as physiological/objective terms [1, 71]. Thus it must be noted that any fluctuations in consciousness relevant to experiencing presence involve far more complex neurophysiologic phenomena than a simple linear absence-presence spectrum.

5.9 Therapeutic Considerations

5.9.1 Applications to Presence in Virtual Environments

As discussed, REM, NREM and wakefulness are widely considered to be three separate states of consciousness, with occasionally overlapping features. We have established that dreaming (widely associated with REM) can be considered to be an auto-generated virtual reality simulation [49, 50], useful for rehearsal of dealing with threats [56], consolidation of memory [42, 43, 48] and expanding behavioural repertoire through play [57, 58]. Virtual environments may be thought of as simulations of real-world (i.e. waking) experiences, but it becomes clear that without an appreciation of dreaming consciousness, it will become difficult to approach an ultimate understanding of presence. A key difference between an individual's experience while dreaming and engaging in a multimedia-generated immersive environment is the degree of interactivity that it possible [1]. As discussed, the neurophysiology of REM/paradoxical sleep states involves muscle atonia. Thus even though an individual may perceive him- or herself interacting with the environment either verbally or behaviourally while in a dream state, the actual body of the dreamer remains paralyzed. By contrast, an individual in an interactive virtual environment can experience a high degree of immersion/presence, and retain the capacities of speech and motor movement. More intriguingly, the digital nature of most immersive multimedia simulations allows such behaviours to be encoded and executed through a variety of mechanisms. Thus, for example, a "real-world" mouse click or movement with a cyberglove can generate the movement of a "virtual" limb, an entire avatar or any group of virtual objects assigned to a keystroke or manipulation of a hardware device.

5.9.2 Psychopathological Aspects of Dreaming and Sleep Pathology

A survey of dream phenomenology and sleep abnormalities in psychiatric disorders involving disturbances of affect indicates that REM sleep regulation plays a prominent role in the brain's attempt to regulate such disturbances [75-78]. Recurrent disturbing dreams, along with flashbacks and intrusive re-experiencing of a traumatic event are typical symptoms experienced by sufferers of posttraumatic stress disorder (PTSD) [76, 77]. Mellman et al have summarized some of the polysomnographic characteristics of PTSD, including earlier onset REM, increased dream mentation during the initial REM period, increased REM density and fragmentation of REM [76]. Vividness of visual flashbacks to an experienced trauma may inappropriately occur during wakefulness through similar dysregulation of the REM-sleep memory consolidation circuits [76]. The

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general implication appears to be that the brain's internally generated threat simulation defence is on one hand powerfully activated by an attempt to process the trauma an individual has experienced, but on the other hand, is pathologically caught in a reverberating circuit of being unable to use its normally functioning 'software'.
A medical analogy to this might be a chronically overactive immune response to an environmental disturbance, which if working appropriately serves a useful role, but if overwhelmed or inappropriate, ultimately causes more pathology than it removes.

REM abnormalities are also found in a number of other anxiety disorders, as well as major depressive disorder, with shortened REM latency, increased total REM percentage and REM fragmentation commonly seen as sleep markers of a failure of affect regulation [76, 78, 79]. Dream content in depressive disorders has also been described by Nejad et al. as frequently disturbing and frightening, with themes such as death, separation, natural disasters, falling, aggression, frightening animals or situations, homicide and suicide [30]. Cartwright et al.'s "broken dream" study investigated dream content in a group of women undergoing divorce [80]. The dreams of those divorcing without major mood upset were longer and dealt with a wider time frame than those of control subjects and depressed divorcees. They also dealt with marital status issues, which were largely absent in the dreams of the depressed group. On follow-up those who had been depressed showed positive dream changes in mood, dreamlike quality, and identification of dream self with the marital role. This study implies a "problem solving" simulation role for dreaming sleep, which can correlate with an auto-therapeutic function for the dreamer.

5.9.3 Dream Simulation Therapy

Perhaps it is no coincidence that "sleep fragmentation" is a term commonly used by somnologists to describe the brittle EEG sleep characteristics of depressed and anxious patients [76, 78]. If one accepts the hypothesis that disturbed dreams are in essence errors of the brain's software used to defragment perceptual experiences and consolidate these appropriately into long-term memory, it is reasonable to consider the eventual possibility of "corrective" therapeutic digital simulations of disturbed dreams in psychiatric disorders, given the advances made in simulation paradigms.

A future goal to strive towards would be a collaborative simulation protocol paradigm developed by therapist and patient. Here, an eloquent patient is able to convey a recurring dream and the therapist is able to develop a simulation protocol, which need not necessarily be high-fidelity but confer a sufficient sense of presence to be emotionally salient and therefore potentially therapeutic. PSG recording techniques allow the therapist/researcher to readily recognize when a patient is engaged in REM sleep through characteristic extraocular muscle movements. Using standard PSG or an ambulatory nightcap unit, as described by Cantero et al. and shown in Figure 4, this could readily be performed in an ambulatory setting [81, 82].

Once awakened, a patient can then be encouraged to describe dream content to the clinician, who might select a scene from a digital library, and with the aid of appropriate modelling/rendering software tools and feedback from the patient could construct a simulation paradigm that would match the dream content, and attempt to personalize it to

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the patient's experience. This might be performed in a graded exposure paradigm, with the difference from traditional cognitive-behavioural technique being the advantage of a recreation of an immersive experience that is experienced during dreaming.

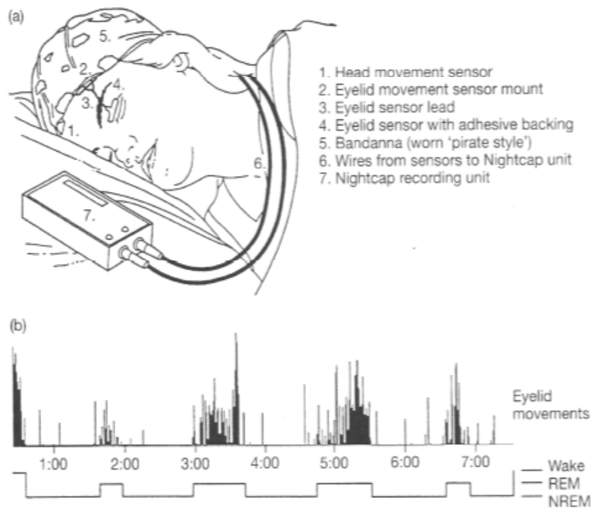

Figure 4: a) A nightcap unit is able to monitor sleep onset as well as REM sleep in an ambulatory setting, b) histogram plot of extraocular muscle movement detected using nightcap and computer-scored sleep stages. (Reprinted with permission from Hobson, 2002)

The key advantage of dream simulation therapy would be the high degree of control that patient and therapist would have on the manipulation of perceptual variables, a considerable advantage over more controversial dream-therapy techniques such a lucid dream therapy [83]. Furthermore, while recurrent auto-generated nightmares might frequently become derailed through the intrinsic pathology of the dream process in disturbed individuals, therapeutic use of immersive technologies allow the patient to persevere at different levels of affectively charged presence. In fact, verbally based dream rehearsal therapy has been used with some effect to treat recurrent nightmares in short-term psychotherapy [84]. Analogous to theories about use of virtual simulations in anxiety disorders, patients with alexithymia or restricted visual/imaginative capacities might benefit from such an approach that is able to provide a perceptual "filling in process" during therapy [85]. Successful outcome of dream simulation therapy would be increased level of mastery over dreams, with the dreamer becoming more of an active participant rather than passive observer, through practice gained in rehearsed therapeutic simulations. A reverse approach to this involves the delineation of specific neurocognitive processes occurring during high-presence immersive states induced by specific multimedia simulations (for example, salient immersive audiovisual imagery, whether aversive or hedonic) while awake, and to capture this data digitally through monitoring devices such as PSG/EEG or neuroimaging techniques. This requires

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gathering of multimodal subjective and performance-based response data from subjects in synthetic perceptual environments, and mapping these accurately to corresponding neurophysiologic data. We would stress that this is not currently feasible with any accuracy, although in recent years, attempts have been made to describe the elusive experience of presence in neuroscientific terms, including use of fMRI [86] and EEG monitoring [87, 88]. Once more reliable data regarding neurological commonalities underlying 'high presence' states contained in vivid or salient dreams and artificially generated immersive experiences becomes available, the next, and more ambitious step will become the introduction of externally generated virtual environments into unconscious sleep. This might occur through mirrored biofeedback mechanisms that would be able to store digitally recorded brain-state data (e.g. PSG/EEG patterns correlating with an immersive experience in a virtual environment), and to manipulate EEG amplitude, frequency and temporospatial patterns underlying dreaming consciousness to activate perceptual systems without waking up an individual.

Attempts have been made to affect sleep mentation through presentation of stimuli, intended to then subsequently affect dream processes. For example, Stickgold describes presenting auditory stimuli to sleeping subjects, with pure tones activating auditory processing regions, while subjects' names activated language centres as well as the left amygdala (thought crucial for processing emotionally salient perceptual information) as well as the prefrontal cortex [89]. The presentation of visual imagery to dreaming patients has not thus far been described during sleep, although during the process of parasomnia, there is a state dissociation-the brain is partially awake and partially asleep, with the possibility of both motor activity and intake of perceptual information without conscious awareness [90]. Outside of rigorous scientific scrutiny, there appears to be an emergence of industrial/commercial applications intimating this type of model that deserve mention [91]. In 2004, a Japanese toy manufacturer launched a product dubbed *Yumemi Kobo*- Japanese for "dream workshop", advertised to help individuals shape their dreams in specific predetermined directions. In this model, prospective dreamers are asked to look at a photo of what they would like to dream about and then record a story line using a combination of prerecorded video imagery, voice recording, along with lights, music and smells, which are activated for release during periods of rapid eye movement (REM) sleep. No data are available on this paradigm thus far.

5.9.4 Relationship to VR Therapy

Therapeutic virtual reality (VR) simulation for psychological indications historically stems from less complex anxiety disorders such as acrophobia and claustrophobia, with later established indications for fear of flying, driving and public speaking [92]. One of the most rapidly evolving therapeutic applications of VR simulation therapy involves the treatment of posttraumatic stress disorder (PTSD) [93, 94], which involves a more diffuse distribution of phobic responses paired with an experienced trauma, including dream abnormalities [76]. The content of PTSD dreams is often highly stereotyped, particularly if relating to a single traumatic event [76, 84, 95]. By contrast, the dream content of depressed individuals, while often profoundly immersive by VR simulation

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standards and frequently containing threat themes [30], tends to be more topically diffuse, and thus more difficult and time-consuming to artificially replicate. Use of personalized images, sounds or other media clips, semantically and affectively meaningful to the patient might be particularly useful to either incorporate into the simulation or to model the therapeutic environment, rather than using traditional imaginal-based cognitive techniques [77].

The challenge for a truly skilled "cybertherapist" using this methodology would thus be to unlock a remote and highly encrypted trauma that has triggered a depression using a combination of polysomnographic and simulation technologies. One might see irony in the apparent reliance on human-machine interfaces as a bridge to help the patient ultimately regain function and in domains of human-to-human function. If one, however, accepts the premise that everything we know and perceive about the "real" world is entirely subjective, and subject to our own creation of a simulated reality [50, 53], the precise mechanisms of activating or correcting these disturbances of consciousness matters less than their ability to generate a feeling of presence.

5.10 Connecting the Neuroscience of Dreaming and Media Presence

5.10.1 Theoretical Considerations

Some feel that the central place of face-to-face communication in the psychotherapeutic context will gradually erode in the multimedia era. We would argue that psychiatrists, psychologists and psychoanalysts with an interest in states of consciousness could find fertile ground for research and clinical interaction with their patients by being more aware of neurobiologic aspects of presence in multimedia displays. As display technologies continue to improve in fidelity, the ability to suspend perceptual disbelief in a prolonged state of immersion becomes increasingly relevant [96]. Is this more akin to waking consciousness, or REM sleep? To what degree does this depend on the amount of operator control in a human-computer interface? In therapeutic scenarios where the "virtual plot" is controlled by a separate agent such as a therapist controlling level of immersion, how analogous could this be construed to Jouvet's "paradoxical sleep" state [61, 62]? Conversely, designers of effective human-machine media communication interfaces need to appreciate the neurophysiologic complexities of presence. If currently there is an acceptance that there are three states of consciousness, i.e. wakefulness, non-REM sleep and REM sleep, where does artificially generated virtual reality experience, accepted as "real", fit into this spectrum? Is it appropriate to consider virtual reality as a "fourth state of consciousness", or is such taxonomy even necessary if one already accepts the notion of dreams as a unique self-generated simulation program?

5.10.2 Videohypertransference as Behavioural Outcome, Dreaming as Intermediary Process

When an individual begins to integrate simulated media experiences with a high degree of presence into his or her subsequent behaviour, whether through conscious or

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unconscious mechanisms, this could be described as videohypertransference [97], or perhaps more accurately multimedia-hypertransference. The example of Stickgold et al.'s experiment [48], in which Tetris images persisted into sleep consciousness, illustrates the role that dreams might play in such a transference process. Schutte et al. noted that young children who play video games tend to act similarly to how their video game character acted [98], and there is certainly abundant controversy surrounding immersive video games involving violence and antisocial behaviours [99]. On a less pessimistic level, the promise of VR or dream simulation therapy indicates a far more constructive and even transcendental role for using artificially generated media presence.

An intriguing question is whether increasingly immersive media experiences are likely to have an increasingly powerful influence on human behaviour, with sleep and dreaming being an unconscious conduit for this "learning" to occur [43]. It would be useful to gather more behavioural and neurophysiogic data about the bidirectional relationship between the types of consciousness an individual experiences in an immersive simulation paradigm and subsequent REM/dreaming episodes. This might be a more direct and controllable approach than attempts to examine effects on later waking behaviour, as dreams would appear to be one of, if not *the* key primary processes through which perceptual and emotional experiences are eventually integrated into behavioural changes.

5.10.3 Dreaming as Media Experience: Hot or Cool?

Ultimately, like any sort of simulation experience, dreams can be understood as a form of media affecting consciousness, both in current and evolutionary terms. McLuhan is credited with developing a "hot and cool" metaphor for defining media [100], based on the amount of information imparted on the consumer. In this taxonomy, orality is a "cool" or "low definition" medium because it presents very spare information. It therefore requires a lot of active participation on the part of the listener to decode the information for a strong experience of presence to occur. Writing, and particularly print, is "hot" because it presents a lot of information in high definition, although this does not necessarily imply an increased presence. McLuhan considered television "cool" because of the low resolution of its grainy picture, perhaps a controversial perspective in today's era of high-definition broadcast media. Improvements in computer simulation and digital communication technology will continue to strive towards approaching a "hot" high-fidelity model, with increasing involvement of integrated multisensory information including haptic, visual and auditory [25]. All of these experiences and more are already contained in the experience of dreams, which can be understood as both "cool" (requiring much active participation to extract the encoded information) and arguably, "hot" (with complex multisensory information presented in exquisitely "high definition") at varying times [20]. As with fluctuating states of REM density and intensity of dream state experience [20, 62, 63, 76], it is likely that there is some level of fluctuation even in highly immersive media experiences [86], as opposed to a continuous experience of presence. If dreams are to be understood as a form of media as well neurobiological events, this unique characteristic should be explored further.

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5.11 Conclusions

If presence is a "psychological state", as proposed by Lee [12] and by the other authors of this Section, then what is the phenomenology and neurobiology underlying this state? The functional neuroanatomy and neurophysiology of dreaming has already been well established. We believe that a key step in advancing the field of presence-mediated communication will be for researchers to follow along a similar path, using multimodal assessment tools such as neuroimaging and psychophysiologic monitoring, as well as subjective user feedback (see also the chapter by Coelho and colleagues). From our perspective of clinician-researchers interested in both psychotherapeutic and fundamental neuroscientific aspects of media technology, we have discussed to what degree immersive media simulation will progress towards a productive convergence with advances in neuroscience.

The rapidly evolving and multidisciplinary understanding of presence shows promise in contributing significantly to an eventual solution to the problem of consciousness by future science. This chapter has explored the notion of dreams occupying a unique virtual space in our consciousness that underlies integration of all communication experiences, particularly from an evolutionary and perceptual perspective [10]. We have established that presence is the key phenomenology underlying immersive experiences in both dreaming and immersive media simulations. Furthermore we have presented evidence for a conceptual model of dreaming as an auto-generated virtual reality simulation from a number of divergent neuroscientific, philosophical and psychological models of consciousness (see also the chapter by Riva for a further discussion).

In our discussion of clinical aspects of dream pathology and virtual environments, we have specifically taken note of potential fertile ground for collaboration between researchers in both fields, attempting to understand the phenomenon of presence from either perspective. As outlined earlier, it is hoped that this discussion can bridge these areas of ongoing research of cognitive neuroscience. The tantalizing possibility of being able to manipulate consciousness through multimedia presence has been presented in a speculative model of dream simulation therapy, which remains a future goal to strive towards, depending on technological advances. Having argued for an inclusion of the dreaming process in immersive experiences synthesized by the Mind/Brain in response to our experiences, we predict that with the evolution of media presence, there will eventually be a far less distinct boundary between which of these experiences are organic/real and artificial/virtual.

We have reviewed here diverse theories explaining both the phenomenology and neurobiology of dreaming consciousness, in order to provide a neuroscientific benchmark for the study of presence-related conscious experiences in the future of media technology development. We emphasized the powerful role of presence in the context of dream mentation as both a neurophysiologic substrate and conceptual metaphor for understanding psychological aspects of virtual environments. Dreaming consciousness reminds us that the key factor in approaching an ultimate technology-mediated presence experience is the sum rather than its parts: a subjective/affective state of being.

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