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Being There: Implications of Neuroscience and Meditation for Self-Presence in Virtual Worlds

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Abstract

New discoveries in neuroscience show that the human brain and body work together to experience and evaluate emotions and thoughts and to create a felt sense of presence in the material (or virtual) world. The brain engenders (creates) bodily feelings that represent emotions and thoughts. By directing attention to present moment bodily sensations we experience embodied presence. Practicing meditation increases the capacity and propensity to experience embodied presence. Virtual worlds are experienced by the human system that is deeply grounded in bodily sensations. In this essay we explore the implications of neuroscience and meditation for designing and studying self-presence in virtual worlds. We explain how presence is a dynamic, ongoing internal process that is the active result of sustained directed attention.

1. Introduction

What is it that experiences virtual reality? It's the same thing that experiences material reality. It's still the human system. Virtual worlds replace what one or more of our senses can perceive (usually eyes and ears) with designed stimuli. But it is our human system, our body and mind, which has the experience. External stimuli contribute to experiences. Our mind directs attention toward, perceives, interprets and integrates external stimuli and internal bodily sensations including thoughts and memories. While doing this, the mind evokes changes in the body, creating bodily sensations which themselves may be perceived and interpreted. These internal processes occur continuously.

Neuroscience and meditation are bodies of knowledge with a lot to say about the human system. Recent advances in neuroscience help to explain how the human system experiences presence. Meditation practices change the state of the body and mind and focus attention. As a result, we feel more present. Our experience is different. Neuroscience and meditation have profound implications for enhancing presence in and connection with virtual worlds. In this essay we will 1) describe a new neuroscience paradigm of mind-body experience; 2) relate that framework to how meditation works; and 3) consider implications for conceptualizing self-presence in virtual worlds. By applying meditation-based approaches to prepare the human system, it should be possible to design VR experiences in which users feel more deeply embodied, and experience heightened subjective feelings of presence.

2. Discussion

2.1 What We do With Our Mind Affects Our Body

What we do with our mind affects our body, our human system. Where we direct our attention constantly affects our body, regardless of whether we notice changes in bodily sensations. Stress is an obvious example of the mind affecting the human system. When we ruminate about a stressful situation, our body responds by tensing muscles, changing heart rate and breathing patterns, and releasing stress hormones (Logan & Barksdale, 2008; Riedl, 2012). Our mind may be so busy with self-reflective narrative thought that we are not conscious of these physiological changes. If we happen to direct attention to the body, we might notice we've been holding our breath or clenching our jaw.

2.2 We Can Use Our Minds to Change How We Feel

It is possible to purposefully direct attention to change how we feel. Rather than simply reading about how the mind can change the body, we invite you to participate in a short exercise intended to help you actually experience how directing your mind changes how you feel. Please take a full minute or more to engage with the instructions below. Spend about 10 to 20 seconds experiencing each instruction.

Think of one of your favorite places in nature.

Just pick the first place that comes to mind.

Bring yourself to that place in nature.

What do you see?

What do you hear?

What do you feel?

Notice how you are feeling right now as you connect with that place.

You just had a brief experience of remembering feelings you had in the past of being in nature. The experience changed the state of your human system – how your mind and body feel. Ecotherapy research documents emotional benefits of spending time in nature. You may have experienced a hint of one or more emotions such as pleasant feelings of calm and harmony, perhaps even a sense of increased energy and vitality (Berman, Jonides, & Kaplan, 2008; Ulrich et al., 1991). Like the previous section's discussion of physiological effects of stressful thoughts, thinking about being in a favorite place in nature also gets represented as bodily sensations, this time in pleasant ways including reduced blood pressure, reduced cortisol levels, reduced pain sensitivity, and more relaxed breathing (Keniger, Gaston, Irvine, & Fuller, 2013). Later in this essay we will discuss how meditation directs attention and changes the human system in somewhat similar ways.

2.3 Neuroscience Explains How Feelings and Thoughts Are Embodied.

Neuroscience discoveries contribute to understanding how humans experience emotional states, thoughts, and the subjective feeling of the moment. Sensitivity to and conscious awareness of bodily sensations vary across individuals, but we all receive sensory inputs from the whole body, including skin, viscera, muscles, joints, teeth, vestibular and endocrine systems, and more (Craig, 2014; Farb et al., 2015). This is known as interoception – the process of receiving, accessing, and appraising bodily sensations (Farb et al., 2015).

Interoception is a hidden, somewhat mysterious sensory process (Farb et al., 2015). The interoceptive pathway represents the current state of all aspects of the physical condition of the body (Craig, 2014). Some interoceptive signals can be easily perceived (if we pay attention to them) and are associated with strong affective feelings (such as fatigue, fullness, or pleasant social contact) that help guide emotional behavior. Emotional states map onto distinct somatosensory bodily regions that are culturally universal (Nummenmaa, Glerean, Hari, & Hietanen, 2014). Other interoceptive signals can be consciously perceived (again, if we pay attention to them) but the sensations feel somewhat vague. Examples include the sense that another entity is not trustworthy (Riedl & Javor, 2012), or the subjective sense of knowing a word before recalling it (Kikyo, Ohki, & Miyashita, 2002). Still other interoceptive signals are subliminal, involved in keeping the body alive without obvious or conscious connection to feelings.

Functional neuroanatomist Bud Craig's (2009, 2014) pioneering research shows that the Anterior Insular Cortex (AIC) is involved in all subjective feelings and plays a fundamental role in human awareness. His work represents a paradigm shift, a new way of understanding "mental" phenomena. The AIC engenders (creates) bodily feelings that represent emotions. The AIC also engenders (creates) bodily feelings that represent thoughts. Bodily feelings represent "sensations, perceptions, emotions, intentions, and thoughts" (Craig, 2014, p. 220). Our bodies physiologically embody thoughts and experiences. Those changes in bodily sensations provide emotional motivation that (if we learn to pay attention) can help guide decision-making. Craig argues that interoceptive awareness is the source of feelings of being alive, of our felt sense of self.

2.4 Virtual Experiences Affect the Human System, Not Just the Five Senses

Our minds interpret but they also constantly engender (create) bodily sensations, such as bodily responses to being in nature and to stressful thoughts. This means that user experiences in VR also take place throughout the body, not just the mind. When a VR system supplies visual and auditory sensory inputs, those external stimuli are components of a much larger integrative system of experience that is deeply grounded in bodily sensations. Visual and auditory sensory inputs are integrated with current bodily sensations and bring about new bodily sensations that reflect thoughts and emotions. This dynamic process produces our subjective feeling of the moment (Craig, 2014).

2.5 Neurologically, Attention to Bodily Sensations Creates the Feeling of Presence

As humans our bodies are the lens through which we experience life. But a lot of the time, we manage to ignore the bodily sensations of experience because our minds are off wandering somewhere else. Rumination is the dominant use of the mind, so much so that neuroscientists have labeled a wandering mind the "default mode" (Spreng & Grady, 2010). Ruminative self-focus including worry and self-criticism has negative mental and physical effects (Killingsworth & Gilbert, 2010) . On the other hand, focusing attention on present-moment sensations increases the feeling of being embodied and alive (Jazaieri et al., 2015; Killingsworth & Gilbert, 2010).

Neurobiologically, our feelings and thoughts are "embodied" in bodily sensations brought about by external and internal events. Neurobiological presence involves becoming consciously connected to the human system that is experiencing the reality. We feel more present when we direct

our attention to present moment bodily sensations. Embodiment (awareness of present moment internal bodily sensations) promotes an increased sense of bodily ownership, control, agency and presence (Craig, 2009, 2014; Farb et al., 2015).

2.6 Meditation Trains the Mind to Be More Embodied

Some of the neuroscientists who study interoception also look at the effects of meditation on interoceptive awareness. Studies show that meditation helps train the mind to quiet ruminative thought and heighten attention to the subjective experience of the moment (Farb et al., 2007; Kerr, Sacchet, Lazar, Moore, & Jones, 2013; Mehling et al., 2012). Regular practice of meditation "brings interoception forward" into daily life, as we strengthen interoceptive neuropathways and develop the capacity to connect to ourselves and our bodies (Farb, Segal, & Anderson, 2013). Ongoing meditation practice over time improves the capacity to activate the interoceptive pathway and the propensity to do so (Farb et al., 2015; Farb et al., 2013; Mehling et al., 2012).

Interoceptive awareness is one element of meditation. It is important to look at the process of meditation since understanding the process contributes greatly to a main focus of this essay, how the wisdom of meditation can inform quality of experience and effectiveness of virtual experiences. In the meditation tradition of the yoga sutras of Patanjali, as it is applied in yoga and clinical yoga therapy, meditation refers to practices that 1) regulate the human system and 2) refine the state of the mind so that the mind can be more receptive 3) in order to bring about a change in the human system as a result of the meditation experience (Bossart, 2007; Chandrasekaran, 2012; Desikachar, 1999, 2009). (See Figure 1.)

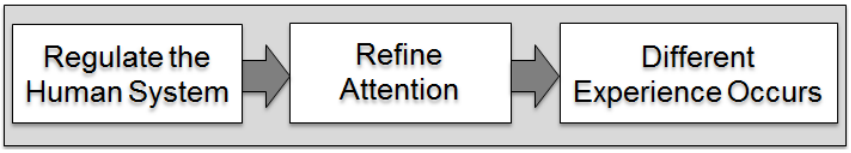

Figure 1: Three stages of meditation

When the human system is agitated, the mind is not refined. An unrefined mind is scattered and difficult to direct (Chandrasekaran, 2012; Desikachar, 1995). Meditation practices use different approaches to regulate the human system and still the fluctuations of the mind. This often begins with focusing attention on breath and other present moment bodily sensations. Focusing attention on the immediate physical sensations of the breath reduces self-focused narrative thought (Farb et al., 2007, 2013). This takes time. As the mind quiets during meditation, the interoceptive network is activated. We are more aware of our breath, emotions, and other bodily sensations. We feel more embodied. In this refined state, the mind becomes directable and we are better able to link with an object of meditation (such as a favorite place in nature) and to experience a change in our human system (Desikachar, 1995).

2.7 Beach VR Meditation for Embodied Presence

In 2014, Cubicle Ninjas released their innovative Guided Meditation VR prototype for Gear VR and the Oculus Rift that emphasizes being, not doing, in a virtual environment (Cubicle Ninjas, 2015). The demo, a precursor to their forthcoming commercial "relaxation app," features 10 minute guided meditations in four virtual environments. We are working with Cubicle Ninjas to add our own meditations to some of their worlds. Collaborating in this way leverages their VR world designs while giving us the opportunity to design the meditation experiences.

To explore the potential of meditation to increase the experience of embodied presence, we designed an experimental meditation that uses Cubicle Ninja's *Costa del Sol* beach environment. Our

Beach VR Meditation for Embodied Presence (Heeter & Allbritton, 2015) moves through six steps to help the player regulate the human system and direct attention to interoception (connecting with bodily sensations), so that they more deeply experience being at the virtual beach. Regulating the human system and refining attention are preparation, gradually stilling fluctuations of the mind and entering into a state of brain activity that differs from common resting or goal-directed neural activity (Bærentsen, 2015).

Preparation of the human system is a key component for effective meditation (Chandrasekaran, 2012; Desikachar, 1995). For that reason, our meditation goes through a process of regulation and refined attention, culminating in allowing a different experience to occur. (See Figure 2.) As the guide, Marcel instructs you where to direct your attention. 1) You begin by looking around at the virtual beach – the ocean, the beach, the palm trees -- and listening to the waves and the birds. 2) Then you connect with your body, feeling your hands, what you're sitting on, moving your fingers and shoulders slightly, feeling each movement. 3) You return your attention to the beach, more aware of both your body and the beach. 4) You close your eyes and concentrate on your breathing, noticing a slight rising on inhale, a slight lowering on exhale. 5) You open your eyes and feel yourself experiencing the beach. 6) In this state of embodied presence, the beach feels more vivid and you feel more fully there.

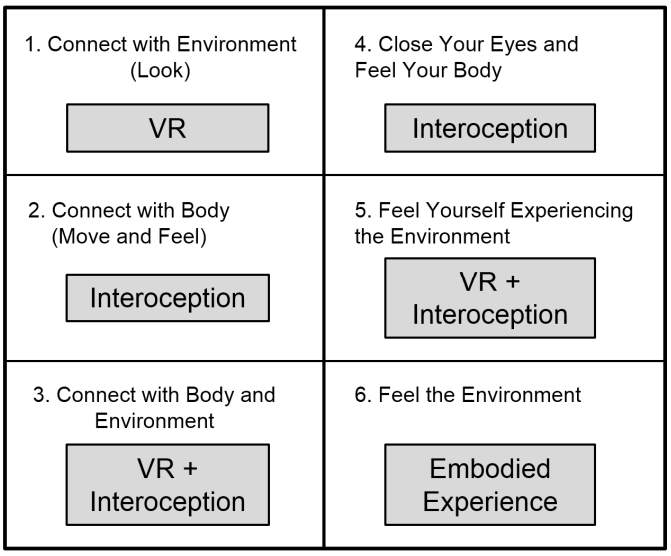

Figure 2: Six steps in the embodied presence meditation

2.8 Presence Has Been Defined Differently by VR Scholars

The ways VR scholars define presence and embodiment differ starkly from the neurobiological and meditative perspectives outlined in this article. Presence researchers typically conceptualize presence in virtual worlds as a successful illusion– the virtuality of an experience goes unnoticed (Lee, 2004) and the user "fails to accurately acknowledge the role of technology in an experience" (Riva, 2009). User characteristics (Heeter, 1992) and technology design characteristics contribute to this illusion (Slater, 1999; Slater & Wilbur, 1997). Embodiment refers to representation of self through an avatar in the virtual environment (Schultze, 2010).

2.9 Implications of Neuroscience and Meditation for the Concept of Presence in Virtual Worlds

In Schultze's (2010) review of concepts and theories of presence for information systems research on virtual worlds, the constructs of self-presence and presence "as a defining feature of the self" come closest to our current discussion. The review acknowledges the role of the body as an

information acquisition system, an information processing system, and a communication or display system. However, Schultze and others characterize presence as a human response to external events.

Instead, we suggest that *presence is the active result of sustained directed attention*. Earlier in this essay we defined neurobiological presence as awareness of present moment bodily sensations, including bodily sensations triggered by external and internal events (including thoughts and actions) as well as our reactions to those events. Thus, *presence requires focused attention on the rich soup of present moment bodily sensations we inhabit and engender.* It is a state that must be actively sustained (or repeatedly returned to) by the experiencer. Unless the mind and body are regulated, interoceptive awareness will be limited. The ability to focus attention on present moment bodily sensations is a skill that can be developed with practice (for example, through meditation) and a propensity strengthened by ongoing practice.

We also characterize presence as more internally than externally oriented. External events stimulate sensations. But presence is about how the user perceives and responds to internal and external events. Furthermore, *presence is a dynamic, ongoing internal process*. The user reacts and then reacts to their own reaction as well as to new external events.

2.10 The Importance of Meditation Design Expertise

We recommend that VR designers interested in adapting meditation approaches to enhance presence and researchers interested in studying them collaborate with a meditation expert. The ideas described in this essay are straightforward, but expertise in meditation design comes from years of training, personal practice, and experience designing and guiding meditations. Co-author Marcel Allbritton's training and work in mind body therapy integrates breathing, physical postures, and mental attention with holistic understandings of the system of yoga for healing based on the Yoga Sutras of Patanjali. His background includes a 3-year Yoga Therapy Training program, 2-year Yoga Therapy internship, additional classes and workshops in India and the U.S., and 7 years of seeing clients one-on-one as a Mind Body Therapist. Co-author Carrie Heeter is a presence researcher and game and VR designer who has been practicing meditation and studying with Allbritton and other meditation experts for more than three years. Meditation expertise is an essential ingredient in applying the wisdom of meditation to design virtual experiences for the human system.

3. Conclusion

VR experiences should be designed for the human system. Presence (in VR and in the material world) is a dynamic, ongoing internal process that is the active result of sustained directed attention. Presence requires focused attention on the rich soup of present moment bodily sensations we inhabit and engender. When a VR system supplies sensory inputs, those external stimuli are components of a much larger integrative system of experience that is deeply grounded in bodily sensations. Meditation typically involves directing attention to interoception and leads to increased interoceptive awareness. Interoceptive awareness promotes the feeling of agency, embodiment and presence in the material or virtual world.

The richness and depth of the experience of self-presence depends on preparation of the human system. Meditation practices help to change the state of the human system and still fluctuations of the mind in order to have a qualitatively different experience. Changing our human system changes what we are capable of experiencing. Meditation practices can be used to enhance or compliment VR experiences. For example, meditation experts could adapt meditation approaches to incorporate into and enhance VR experiences, helping regulate the human system and promoting interoceptive awareness. Meditation techniques could also be developed and used to prepare the human system prior to a VR experience. Meditation can be the central focus of a VR experience, as shown in the *Beach VR Meditation for Embodied Presence*.

References

Bærentsen, K. B. (2015). Patanjali and neuroscientific research on meditation. *Cognition*, *6*, 915. http://doi.org/10.3389/fpsyg.2015.00915

Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science*, *19*(12), 1207–1212.

Bossart, C. (2007). Yoga Bodies, Yoga Minds: How Indian Anatomies Form the Foundation of Yoga for Healing. *International Journal of Yoga Therapy*, *17*(1), 27–33.

Chandrasekaran, N. (2012). Principles and Practice of Yoga Therapy: A complete guide for learning and practice of yoga therapy. Chennai, India: VHP Publications.

Craig, A. D. (Bud). (2009). How do you feel — now? The anterior insula and human awareness. *Nature Reviews Neuroscience*, *10*(1), 59–70. http://doi.org/10.1038/nrn2555

Craig, A. D. (Bud). (2014). *How do you feel? An interoceptive moment with your neurobiological self*. Princeton, NJ: Princeton University Press.

Cubicle Ninjas. (2015). Guided Meditation App. Retrieved from http://guidedmeditationvr.com/

Desikachar, T. K. V. (1995). *The Heart of Yoga: Developing a Personal Practice*. Rochester, Vt: Inner Traditions.

Desikachar, T. K. V. (1999). *The Heart of Yoga: Developing a Personal Practice* (Revised edition). Rochester, Vt: Inner Traditions.

Desikachar, T. K. V. (2009). *In Search of Mind*. Chennai, India: Krishnamacharya Yoga Mandram.

Farb, N. A. S., Segal, Z. V., & Anderson, A. K. (2013). Mindfulness meditation training alters cortical representations of interoceptive attention. *Social Cognitive and Affective Neuroscience*, *8*(1). http://doi.org/10.1093/scan/nss066

Farb, N. A. S., Segal, Z. V., Mayberg, H., Bean, J., McKeon, D., Fatima, Z., & Anderson, A. K. (2007). Attending to the present: mindfulness meditation reveals distinct neural modes of self-reference. *Social Cognitive and Affective Neuroscience*, *2*(4), 313–322. http://doi.org/10.1093/scan/nsm030

Farb, N., Daubenmier, J., Price, C. J., Gard, T., Kerr, C., Dunn, B. D., … Mehling, W. E. (2015). Interoception, contemplative practice, and health. *Consciousness Research*. http://doi.org/10.3389/fpsyg.2015.00763

Heeter, C. (1992). Being there: The subjective experience of presence. *Presence: Teleoperators and Virtual Environments*, *1*(2), 262–271.

Heeter, C., & Allbritton, M. (2015). Playing with Presence: How meditation can increase the experience of embodied presence in a virtual world. In *Foundations of Digital Games*. Asilomar, CA. Retrieved from http://carrie.seriousgames.msu.edu/docs/playing-with-presence.pdf

Jazaieri, H., Lee, I. A., McGonigal, K., Jinpa, T., Doty, J. R., Gross, J. J., & Goldin, P. R. (2015). A wandering mind is a less caring mind: Daily experience sampling during compassion meditation training. *The Journal of Positive Psychology*, *0*(0), 1–14. http://doi.org/10.1080/17439760.2015.1025418

Keniger, L. E., Gaston, K. J., Irvine, K. N., & Fuller, R. A. (2013). What are the Benefits of Interacting with Nature? *International Journal of Environmental Research and Public Health*, *10*(3), 913–935. http://doi.org/10.3390/ijerph10030913

Kerr, C. E., Sacchet, M. D., Lazar, S. W., Moore, C. I., & Jones, S. R. (2013). Mindfulness starts with the body: somatosensory attention and top-down modulation of cortical alpha rhythms in mindfulness meditation. *Frontiers in Human Neuroscience*, *7*. http://doi.org/10.3389/fnhum.2013.00012

Kikyo, H., Ohki, K., & Miyashita, Y. (2002). Neural correlates for feeling-of-knowing: an fMRI parametric analysis. *Neuron*, *36*(1), 177–186.

Killingsworth, M. A., & Gilbert, D. T. (2010). A Wandering Mind Is an Unhappy Mind. *Science*, *330*(6006), 932–932. http://doi.org/10.1126/science.1192439

Lee, K. M. (2004). Presence, Explicated. *Communication Theory*, *14*(1), 27–50. http://doi.org/10.1111/j.1468-2885.2004.tb00302.x

Logan, J. G., & Barksdale, D. J. (2008). Allostasis and allostatic load: expanding the discourse on stress and cardiovascular disease. *Journal of Clinical Nursing*, *17*(7b), 201–208. http://doi.org/10.1111/j.1365-2702.2008.02347.x

Mehling, W. E., Price, C., Daubenmier, J. J., Acree, M., Bartmess, E., & Stewart, A. (2012). The Multidimensional Assessment of Interoceptive Awareness (MAIA). *PLoS ONE*, *7*(11), e48230. http://doi.org/10.1371/journal.pone.0048230

Nummenmaa, L., Glerean, E., Hari, R., & Hietanen, J. K. (2014). Bodily maps of emotions. *Proceedings of the National Academy of Sciences*, *111*(2), 646–651. http://doi.org/10.1073/pnas.1321664111

Riedl, R. (2012). On the Biology of Technostress: Literature Review and Research Agenda. *SIGMIS Database*, *44*(1), 18–55. http://doi.org/10.1145/2436239.2436242

Riedl, R., & Javor, A. (2012). The biology of trust: Integrating evidence from genetics, endocrinology, and functional brain imaging. *Journal of Neuroscience, Psychology, and Economics*, *5*(2), 63–91. http://doi.org/10.1037/a0026318

Riva, G. (2009). Is presence a technology issue? Some insights from cognitive sciences. *Virtual Reality*, *13*(3), 159–169. http://doi.org/10.1007/s10055-009-0121-6

Schultze, U. (2010). Embodiment and presence in virtual worlds: a review. *Journal of Information Technology*, *25*(4), 434–449. http://doi.org/10.1057/jit.2010.25

Slater, M. (1999). Measuring Presence: A Response to the Witmer and Singer Presence Questionnaire. *Presence: Teleoperators and Virtual Environments*, *8*(5), 560–565. http://doi.org/10.1162/105474699566477

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*(6), 603–616.

Spreng, R. N., & Grady, C. L. (2010). Patterns of brain activity supporting autobiographical memory, prospection, and theory of mind, and their relationship to the default mode network. *Journal of Cognitive Neuroscience*, *22*(6), 1112–1123. http://doi.org/10.1162/jocn.2009.21282

Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology*, *11*(3), 201–230. http://doi.org/10.1016/S0272-4944(05)80184-7