Ontological implications of Being in immersive virtual environments

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ABSTRACT

The idea of Virtual Reality once conjured up visions of new territories to explore, and expectations of awaiting worlds of wonder. VR has matured to become a practical tool for therapy, medicine and commercial interests, yet artists, in particular, continue to expand the possibilities for the medium. Artistic virtual environments created over the past two decades probe the phenomenological nature of these virtual environments. When we inhabit a fully immersive virtual environment, we have entered into a new form of Being. Not only does our body continue to exist in the real, physical world, we are also embodied within the virtual by means of technology that translates our bodied actions into interactions with the virtual environment. Very few states in human existence allow this bifurcation of our Being, where we can exist simultaneously in two spaces at once, with the possible exception of meta-physical states such as shamanistic trance and out-of-body experiences. This paper discusses the nature of this simultaneous Being, how we enter the virtual space, what forms of persona we can don there, what forms of spaces we can inhabit, and what type of wondrous experiences we can both hope for and expect.

Keywords: Virtual Reality, Virtual Environment, embodiment, ontology, Being, emplacement, immersion, presence

INTRODUCTION

Philosophers throughout the ages have sought to understand and explain our everyday state of Being in the world. In ancient Greece Aristotle believed that man was a philosophical animal - the only one capable of asking questions about the nature of his being. He himself defined Being through the lens of logic, which laid the foundations for modern knowledge, including that upon which today's computers are built. His thinking also precipitated a long period in which the mind dominated the body as the locus of Being.

In the 17th century (the Western world's Age of Reason) Rene Descartes argued that we can only really know that which is in our minds (cogito as the predicate of Being), believing the information from our sensory channels to be unreliable. The Western Age of Enlightenment that followed saw continued focus on the intellectual pursuits of man, with the body being relegated to a debased role. These intellectual pursuits led directly to the modern world of reason, logic, and machines in which we now live. The twentieth century as the Age of Information (from the telephone to computers), obviates the body even more.

These paths influenced thinking on the nature of our Being culminating, in the late 20th century, with technologists who advocated downloading the mind into a computer, where it could live forever.[1] This state of Being in the world, one presumes, would still allow continued development of the cerebral entity, via sensors that input to the sequestered brain/mind (as well as a steady supply of electricity!).

This would be necessary, because as modern neuroscience has shown, the brain/mind is formed by the patterns and actions of our body, and, without the physical form, there is no input into the mind. In other words, Descartes was wrong, states Antonio Damasio in his book, *Descartes' Error*.[2] We cannot exist solely as a disembodied mind.

> … the body as represented in the brain, may constitute the indispensable frame of reference for the neural processes that we experience as the mind; that our very organism rather than some absolute experiential reality is used as the ground reference for the constructions we make of the world around us and for the construction of the ever-present sense of subjectivity that is part and parcel of our experiences; that our most refined thoughts and best actions, our greatest joys and deepest sorrows, use the body as a yardstick.[3]

We typically interact with our computers via the screen, the keyboard and mouse, and other input and output techniques. Virtual Reality (VR) surpasses these forms of input by nullifying the barrier of the screen, allowing us to enter *into* a computer generated world. The created world is the virtual; the entering body the reality. The advent of this form of embodied interface in the late 1980s and early 1990s shattered accepted concepts of how we interact with our machines.

As Meredith Bricken, early doyen of virtual reality defines it: "The widest possible bandwidth of participation in cyberspace is enabled when we pass through the barrier of the computer screen to inhabit, fully sense, and interact directly with people and information."[4]

Virtual Reality propelled interaction into new embodied domains, allowing us to actually inhabit magical and ethereal worlds of our own creation —beyond the physical. In expanding the importance of the body VR also caused us to rethink the question of what it means to Be in the world, and how having bodies affects that Being.

MIND, BODY AND VR

For some time before VR's arrival, Twentieth Century philosophers such as Georg Hegel, Edmund Husserl, and Maurice Merleau-Ponty explained our Being in the world through its phenomenal aspects: what we perceive in conscious embodied experience allows us to understand the essence behind that experience. The lived body experience fuses the world of substance with the world of spirit (or mind). As Merleau-Ponty states, there must be an "I can" before there can be an "I know."[5] Philosophers are not the only prophets of embodiment. The belief in the co-dependence of our physical form with our cerebral life is being supported in more empirical domains such as neuroscience and cognitive science, to name just two. These researchers contribute to our modern understanding that our brain and its functioning, its ability to reason, and even its structure, are based on the actions of the body, and that absent such a body there can be no mind as we know it.

Neuroscientists Gerald Edelman and Antonio Damasio, among others, have shown that the body and how it experiences the world is responsible for the complicated interweaving of neuronal connections in our brain, out of which our mind– and perhaps consciousness itself–is constructed.[6] [7]

Cognitive scientists George Lakoff and Mark Johnson add that our mental concepts are built upon metaphors that are so deeply integrated into our embodied self that they are taken for granted. Phrases such as: life is a journey, these two names are close, face your problems, grasping the concept, I see what you mean, or weighed down by grief, all originate in a lived body experience.[8]

VR, unlike other media, includes our full embodied nature via its specialized equipment. As much as the Head Mounted Display (HMD) is maligned by some as being awkward or a "Face sucker" it provides something no other computer interface does. It integrates the person who experiences–whom I call the ***experient***–fully *into* the medium. Not only is the experient surrounded by the perceptual envelop of the virtual space, she is isolated, by means of the VR equipment, from any potentially distracting real world stimuli. What this means is that the signals reaching the participant's perceptual mechanisms are fully provided from, and by means of, the VR technology. Moreover, and just as vital to the integrity of the experience, is that the real world perceptual inputs are held at bay throughout the encounter

Thus, as experients perceive this encompassing environment to the exclusion of other signals, it becomes their immediate, secluded, and primary focal world. This is a protected state and is critical to the privileged nature of a virtual environment, or VE.

This privileged nature of how one experiences the form and content of the created world through a sense of total immersion is what I term ***emplacement***. Emplacement represents the twofold aspect of immersion by unifying the special characteristics of being able to go *within* the created, virtual space, with the coincident *exclusion* of the perceptual inputs of the ordinary world.

TOOLS OF EMPLACEMENT

Our investiture as humans is within lived 3D space, and it is the correspondence to that lived space that gives immersive environments a quality unlike any other cybermedium. VR equipment facilitates the phenomenon of emplacement with head mounted displays, tracking systems, navigational devices, manipulation techniques and gear, cutting edge haptics and even scent systems.

1.1 The head mounted display (HMD)

In early flight simulators, predecessors of modern VR, screens displaying visuals wrapped around the participant, showing what might be seen out the windows of an airplane cockpit. This setup worked for any "out the window" situation, such as for aircraft or vehicle simulators, but it was not suitable for close ground-based work, such as a soldier in an urban setting. For this type of setting, research had to focus on bringing a personal level of visuals to the person in the virtual environment (VE). This more body-centric point of view meant visual depth cues like stereo and parallax (most apparent at close range) now became important, where they had not been needed in the distant, wrap around views. By placing separate display units–one for each eye–within a head mounted display, two views of the simulated world corresponding to a person's natural binocular vision are sent to a person's ocular system. As these views are mathematically computed according to optical perspectival rules, they appear very convincing to the participant. The virtual images from the stereo displays enter our eyes just as our normal binocular vision does, following the same paths through our brains for processing by the visual system.

The HMDs used to deliver images to the eyes were fitted with a rubber baffle in the early days (often using repurposed SCUBA masks) so that extraneous light did not compromise the (somewhat limited) brightness of the images. A concomitant result of this screening was that it also created a hermetic visual seal. In addition, original helmet-style HMDs often had built in earphones that covered the ears, presenting only the scenario-appropriate sounds to the ears, and blocking extraneous sounds. These two factors–going within the virtual world and excluding the real one, had profound and, I suspect, unplanned, effects. For all intents and purposes, the real world ceased to exist in the mind of the participant–a magical state. One is not only in the real world, but also inside another space, not of that world but somehow contained within it, *pro tempore*. The experient is truly in two places at once, and yet can be fully focused on the virtual construct over the real--a phenomenological wonder.

All our perceptions are interpretations; there is a great deal of cognitive processing that happens once the brain becomes involved. In visuals, for example, we process what comes into our eyes from whatever source – movies, telescope or HMD – in the same way. Our brain takes in and interprets the photons that enter through our eyes based a combination of what we recognise (for that we rely on our stored memories) and the patterns we have developed over the years.[9] We can basically say therefore, that in VR, as in real life, we receive images through our eyes, use the same neural circuits to process them, they are matched to what we know and recognise, and we come up with similar interpretations about their structure and meaning.

Even though the low resolution of many HMDs may play a role in how well our brains interpret the virtual world, the HMD's *field of view* may be the most important aspect effecting emplacement. FOV is the amount of the forward facing world we can see with our head held still. In real life it subtends an angle of between 160 and 208 degrees. Each eye has its individual field of view, typically about 140 degrees, with an overlap of between 60 to 120 degrees, allowing binocular vision to form from the positional disparity of objects in the overlapped region.[10] By contrast, the field of view of most HMDs hovers around 50 to 60 degrees per eye. With the binocular overlap, the amounts to an effective view of approximately 35 degrees, an extremely narrow field of view when compared to our normal vision. While this will work to bring our perceptions into the virtual world, it does result in the VE participant experiencing the environment as if through blinders, without any natural peripheral vision. The amount of information provided by our peripheral vision is extremely important to our kinaesthetic understanding our position in space. Absent such peripheral vision, humans navigate through the world in an impoverished way. Several researchers have shown that this limitation has a negative effect on the quality of immersion and ability to perform in the virtual world.[11] [12] [13]

A wider field of view is therefore necessary to more closely align with our normal experiential expectations. In an experiment by James and colleagues, VEs of varying FOVs and resolutions were presented to participants.[14] While the studies showed that subjects had more physical disturbances for posture and balance, the researchers also asserted that people using the high resolution wide FOVs HMDs reported not only more self-motion perception, but also a corresponding larger feeling of presence.

HMDs that transcend this narrow FOV limitation in any sort of affordable way are only now becoming available. There have been a few previous instances of a wider-angle HMD, but the cost was extravagant: around $100,000. FakeSpace Research, a company with a long history of creating virtual display devices, has recently developed a new, lower cost,

wide FOV head mounted display[15] that has reinvigorated the initial excitement of this technology. Several other companies are following suit.

Other types of displays for virtual environments such as large screens, curved or table-top displays and the CAVE environment are excellent for many applications, but none serve shut out the real world, which I consider a critical requirement for full immersion/emplacement.

1.2 Tracking embodied interactions

In virtual environments a person's movement is through three-dimensional space, and therefore a device that provides three-dimensional data to the system is essential. Tracking systems (trackers) have been designed to capture and relay such positional information to the program in real time, as a person moves through the virtual environment.

This positional data from the tracker typically includes a location in a three axis (x, y, z) coordinate system as well as rotational information around each of these same axes. Each piece of this data is known as a degree of freedom (DOF), and thus a VR tracking system provides six degrees of freedom. Most HMDs are outfitted with an attached tracking unit on the top; with the resulting data used to determine which direction a person is looking so the system can compute the correct visual scene.

Kinaesthetic and vestibular systems

The result of even a single tracker body mapping in virtual environments leads to an interesting phenomenon: a person has the distinct sense that he or she is existing and moving within the virtual space. This is not an abstracted movement provided by mouse pushing and button clicking in front of a 2D screen. It is much more intuitive and visceral. The body being tracked, coupled with the use of 3D visuals, calls several body systems into play, which respond similarly to how they would moving in the space of the normal world. Our kinaesthetic (or proprioceptive) sense keeps us aware of our body parts and the moving or static positions they occupy.[16] Our vestibular sense is most affected by the tracking information, as it keeps us informed about our orientation, posture, acceleration, verticality, and movement.[17]

The embodiment mapped by the VR tracking system brings the body firmly into the virtual world. It is because of the tracking that the VE environment knows where we are, what we are looking at, what we bump into, how we hear directional sounds, and whether or not we are near enough to smell a virtual rose. While we may not have all the sensory cues in VR yet that real life affords, this embodiment enhances the perception of the ones that are available, making them all the more compelling. Turning our head in the virtual world and having what is in front of our eyes move as naturally as our accustomed vision is remarkable. Being able to tell where a sound is coming from and being able to follow it, or to hear it diminish as it gets out of range, builds a powerful sense of believability. We are not disconnected from our bodily nature; the VR world accounts for it, believes in it, and thereby provides a sensibility that no other digital media can.

1.3 Resonant Redundancy

It is commonly understood that our senses are easily fooled, as in the often-experienced illusion where people feel they are physically moving when sitting in a stationery train watching an adjacent train pull out of the station. All our senses (in this example visual and vestibular) use a feedback loop from the body to the brain and back that, in this case, fools the brain into believing it has moved. The explanation for such illusions seems to be that the perceptions received from the receptors that provide the brain with some information are supplemented and reinforced by other sensory systems.[18] Thus, even though a particular sensory signal may not be perfect, sensory redundancy (reinforcement) bumps up believability. Our sensory mechanisms work in the same way within a virtual environment. Thus, even the limited amount of tracking captured in a virtual reality system when coupled with the visual and auditory cues provided, is powerful enough to convince us we actually move through the virtual space. By bringing our bodily sensibilities into play in this reinforcing way, we become convinced that we have gone *into* a space, and that we have taken our bodily perceptions with us.

Because of this, virtual experience designers should give special consideration to the *combinatorics* of sensory information. The auditory channel supplements, enhances, and even makes up for failings in other senses, such as vision.[19] Smell is a large part of our sense of taste.[20] Vision often enhances our feeling of motion.[21] Skilfully combining sensory stimuli in VEs can cause the environment to appear richer, more believable, and more holistic than any single piece of VR equipment can support. It becomes, in essence, a gestalt encounter with multiple sensory

systems that provide a unified, complex whole. I have used these thoughts as guides in my own artistic VE practice, to create what I hope are more convincing environments.

1.4 The real effects of the virtual

There have been some notable studies that show VEs produce very real effects in participants. I will cite a few examples, though more are being done every year. The first shows how a significant number of human subjects respond to a virtual version of a known stimulus in the same way they do they real one, and the second uses animal subjects to show the correspondences between the perceptions of virtual and real space.

In the early 1960s, psychologist Eleanor Gibson described her now famous visual cliff experiment.[22] This showed that babies would refuse to cross a floor that appeared to drop steeply, even though the drop was just a visual illusion. Fred Brooks and colleagues at the University of North Carolina replicated a similar setup within a virtual environment. With 3D modelling tools they constructed a virtual sunken room surrounded by a ledge that was experienced with a stereo head mounted display. The stereo view reinforced the illusion that the sunken room was located about 10 feet below the participant's position. The visitor was instructed to drop a ball onto a target within the pit room and to do this he or she had to walk to and lean over the edge of the ledge. There was a small section of moulding on the floor that the feet touched that served to provide physical corroboration that there was a real ledge in the virtual space. Even seasoned VR veterans had difficulty overcoming the feeling that the pit was real. Physiological signals collected from the participants during the experiments showed that the virtual cliff provoked the same physiological responses as the traditional visual cliff or a corresponding real space.[23]

So convincing is the spatiality of VEs that even animals, whose understanding of such an environment would be direct (rather than overlaid with the metaconscious as would be the case for humans), are fooled. Recent scientific experiments have confirmed this. Rats, outfitted with a specially constructed HMD that recreates rat-centric vision, are able to traverse a virtual maze with no difficulties.[24] What fooled the rats into the spatial traversals they accomplished in a space that did not "exist," unless the experience correlated with the same perceptual and neural mechanisms that process reality?

Finally, the increasing use of virtual reality in clinical therapy to treat serious conditions such as Post Traumatic Stress Disorder experienced by returning war fighters is yet another testimony to the real effects achievable with immersive virtual environments.[25]

NATURE OF (VIRTUAL) BEING

Immersive virtual environments "work" via perceptual mechanisms that correlate to real world experience. A virtual environment, unlike a computer screen, has no predetermined "front" to face except where the participant chooses to turn and look. This situation makes virtual environments, at their core, a medium of spatiality. In such immersive spaces, there are distances to traverse, walls to bump into, and objects that appear slightly different to each eye so that they stand out in depth against the virtual backdrop. While the virtual space is most definitely an illusion, it is one that fools our entire perceptive being.

This includes the body as well as the mind. As mentioned previously, the critical role of our body in the experience of Being is now being recognized and confirmed by empirical evidence. Philosopher Merleau-Ponty describes the body as both the *generating* and *enduring* aspect of that experience. He declares that our world, based on our perceptions, must be grounded in the lived experience, which is, in turn, grounded in the body.

Edmund Husserl concurs with Merleau-Ponty's immediacy of the lived experience, and yet he conceives of the real world as a concrete entity:

> I am aware of a world, spread out in space endlessly, and in time becoming and become, without end. I am aware of it, that means, first of all, I discover it immediately, intuitively, I experience it.[26]

Husserl and Merleau-Ponty, however, in their phenomenological discourse, never envisioned a world that could exist both *within* the world of everyday reality and apart from it.

Immersive virtual environments, as a manifestation of such a world, therefore raise new issues *vis-à-vis* phenomenological thinking. Not only does the virtual space exist within another (physical or "real") world, virtual environments have introduced what can only be considered an entirely new mode of Being. This mode is embodied, to be sure, but it also splits the body into distinct aspects: the self/body goes into a simulated world, taking much of its physicality, sensory equipment, and kinaesthetic senses with it. Yet, in a very tangible way, the physical body concurrently remains in the solid space of the outside world, even as it also inhabits the veridical space within the simulation.

In spite of this split, there seems to be no ambiguity at the conscious level. I can be comfortable in this bifurcated self, and choose to favor one over the other, or allow them to coexist equally. If my physical body accoutred in the VR gear feels cold, or is encumbered by the weight of the HMD, then this aspect of my embodied self will come to the fore of my awareness. If I am engaged with the content of the virtual environment and center my attention on that, it does not mean I have abandoned the other aspect of my embodied self. I am able, somehow, to keep the two in their appropriate experiential places. I live in both simultaneously. This dualistic experience precipitates a change in the very structure of consciousness, as evidenced in Merleau-Ponty's view of color perception: "The first perception of colors, properly speaking then, is a change in the structure of consciousness, the establishment of a new dimension of experience, the setting forth of an a priori."[27] The first experience of the virtual has a similar effect on our consciousness.

Ken Hillis calls this "a quasi merger of embodied perception and externally transmitted conception" and believes that this merger happens because of the sensations that we experience.[28] But this is true of the real world as well. Only the source of our perceptions is different. When we sense the virtual world (e.g. once we are inside), the virtual environment provides the sensations that comprise the lived world, yet our physical body exists within its own lived world, which encompasses not only the real, but the virtual world as well.

Virtual environments, however, are not imaginal; they are real in the sense of the lived world. Erik Davis says "The concept is absolute simulation: a medium so powerful that it transcends mediation, building worlds that can stand on their own two feet."[29] It allows us to firmly situate ourselves in the virtual space.

1.5 The body emplaced within the virtual

This discussion and its focus on the lived experience lead directly into one of the quintessential qualities of virtual environments: they are mediated constructs. Yet they respond much as we expect the unmediated world to do. The convincing nature of the perceptions mediated by the VR equipment has caused many to reconsider what does and does not constitute a mediated environment. VR expert and psychologist Jack Loomis, among others, maintains that even the real world is mediated.

> The perceptual world created by our senses and the nervous system is so functional a representation of the physical world that most people live out their lives without ever suspecting that contact with the physical world is mediated…[30]

Whether or not one believes this to be true, it is certain that compelling virtual environments have raised new questions regarding concepts of mediation. As Frank Biocca says "The experience of compelling virtual environments has disturbed (our) common complacency."[31]

The relationship between the body and experience is direct and immediate, even entwined. Our body becomes the vehicle for sensory experience–that body which has itself been formed *of* experience. The body shapes who we become by compelling our neurons to form their intricate and scintillating patterns of connectivity. What we experience affects how we think, feel, and understand our place in the world, and it does this by forming the mind by which we make sense of it. This is true whether the sensations the body receives come from the external world, or the internal one of the virtual.

Merleau-Ponty says "To be a body, is to be tied to a certain world. Our body is not primarily *in* space: it is of it."[32] With VR we now have more than one world to which we can be tied. It is a world that is not our default, but which requires a willing compliance to enter within that world, to become emplaced.

1.6 The isochronic structure of emplacement

Given that our perceptual systems are focussed on and tracked throughout the virtual encounter, we experience immersive virtual environments as embodied beings. But where do we position the body that the participant leaves behind in the room? It is the living body, as it exists, breathes, and continues working where it is situated, but it is not the lived body, which is emplaced within the virtual environment. Yet at some level, the experient possesses knowledge of these two simultaneous bodies.

The act of emplacing one's body within the immersive environment signifies a shift to a dualistic existence in two simultaneous bodies. Hillis and others have discussed how participants enter into the world of the virtual "while leaving their bodies 'behind'."[33] Participants do not actually leave their bodies behind, though to a bystander or spectator the physical body may seem to be a form of shed detritus in the room. The body of the participant is synchronously subsumed into the virtual self that enters into the world within the screen, which is created in the mind from what the body experiences. Entering into a territory that is not quite imaginal, and yet not fully based in solid physicality, the self becomes involved, bodily, consciously, and subconsciously–in a perceptual dance with the virtual space.

This simultaneous Being within the real and the virtual worlds is an ontological situation humans rarely experience (with the possible exception of the phenomenal states shamans enter into in performance of their ritual duties.) The nature of Being in an immersive virtual environment thus constitutes a profound phenomenological shift. In the virtual environment, our self is present within a space that in itself does not exist, but that our senses readily believe is there. This duality of existence at our command brings about a fundamental change in the nature of Being.

In fact, the lived body has bifurcated and become two. What does this imply for the lived body? Does it inhabit both spaces equally? Do the isochronal embodiments affect our conscious Being equally? Are we semi-embodied in a virtual environment, or dually so, ontologically speaking? Are these diacritical states of embodiment, or complementary?

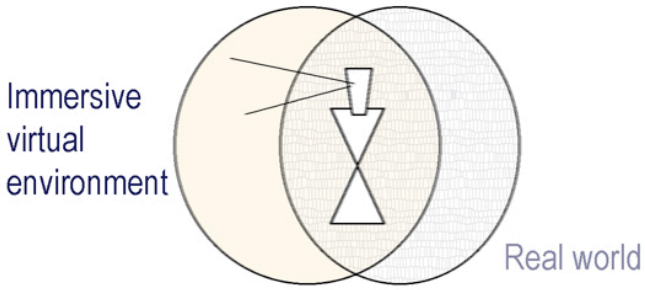

Figure 1. The bifurcated self–existing isochronically in both the real and the virtual worlds

Merleau-Ponty argues that the physical body is, in fact, not the full incorporation of the phenomenal body. He says "We actualise separately from the physical body, the body of the anatomists or even the organism of the physiologist, all of which are abstractions, *snapshots taken from the functional body*."[34] Experiencing the immersive virtual environment, our functional body is within, yet the physical body is not simply playing the role of a snapshot; it is the context for our functioning.

Even though "we" are inside the virtual space, we are also aware at some level that we are still in the physical world. Yet the experient can have meaningful experiences even while being aware of the bifurcated nature of this self-ness.

1.7 The question of Presence

Presence, as defined by scholar Kwan Ming Lee, is "the psychological state in which the virtuality of experience is unnoticed."[35] It is often considered the holy grail of virtual environment work, with researchers searching for the magic determinants that produce this phenomenal state. Presence has proven to be a difficult concept to define, and more difficult to predict and to measure.

There is a lingering question as to whether we can ever experience the mediated world to the exclusion of the real one given our ability to process inputs on multiple levels of consciousness. Due to the bifurcated Being existing isochronically during the VE experience, we are always, at some level, aware that we are having a mediated experience.

I believe that the concept of Presence will continue to prove difficult, if not impossible, to predict, measure, or quantify. Being phenomenological, its essence is not scientifically observable. What can be measured is twofold. We can measure the mechanisms by which an immersive experience is delivered, such as the resolution of the images, the aberrations of the optics, the speed of the frame rate, the data being gathered by the tracker. We can also measure the external phenomena of presence: how long a person remained in the experience, whether they became sim sick, if their pulse rate changed, if they had certain brain areas active. The precise nature of presence will remain elusive, because it is ineluctable, ineffable. It is, indeed, phenomenological.

This is the quandary that makes the concept of Presence so elusive. At some level we are aware of our dual perceptions. Because of this it takes an extraordinary amount of connection to the virtual experience to overcome, or momentarily forget, this dualistic state of Being. It is more than a simple "willing suspension of disbelief." Our body is receiving two sources of perception at once, perhaps not equally, but the physical body is not gone. It may be that someday, neural implants will allow us a means to overcome this dichotomy, but that day seems a long way off.

REPRESENTATION AND SPACE IN VIRTUAL ENVIRONMENTS

1.8 Forms of bodily representation

While the physical body and its sensory apparatus provide the means for our functioning in the virtual environment, how we are represented in that world also contributes to the ontological context of VEs. Early VR technology permitted only crude graphical representation of bodies called *avatars* (a name borrowed from Hindu mythology, where it denotes the incarnation of a spiritual being into bodied form). Avatars are more graphically sophisticated today, though not yet to the level of appearing what one might consider real. The question these visuals raise is not their verisimilitude, but whether they are helpful or distracting to the experient in a VR world. VR practitioners agree there is no single answer to this question.

Frank Biocca calls the choice-of-body representations a "psychologically profound issue."[36] The selection of a body image within virtual environments is not simply an aesthetic choice; it incurs distinct effects on the structure of one's perceptions within the experience, and therefore on the overall qualities of the encounter. Within most immersive environments, as they exist today, this choice is still made by the VE designer, though the myriad representational possibilities inherent in games may exert a strong influence on future decisions about representational form in virtual environments.

The primary modes of embodied expressions in contemporary VEs include: no avatar, a mirrored self, a partial or full graphical personification, and an observer's view of a graphical avatar that represents the self. I will discuss aspects of these as they relate to our ontological nature as emplaced in the immersive environment.

In the no avatar mode, views in the virtual world are computed with the camera lenses situated at the approximate location of each eye (as there is a wide range in the actual physical parameters of each experient). This corresponds to the mental model we have of the self that inhabits the physical world, but in a virtual form within virtual space. While we are perceptually aware of our physical bodies in the real world (seeing part of our nose or looking down and seeing our laps), not having a virtual representational body is not usually disconcerting. The exception is when we consciously look to see ourselves and don't, for example, when we look down to ensure correct placement of our feet upon a stair, and we see no corresponding virtual foot to place.

Yet this non-representation is the most common ontological modality used in virtual environments. Char Davies, creator of the ethereal and spiritual world of Osmose (1995) and Ephemere (1998), espouses this form, as I do in my own works of Virtopia (1992), DarkCon (2004) and The Memory Stairs (2007). Davies does this, as she says, to _____.[37]

The mirrored self is less commonly used in VEs. This form presents the participant with a view of himself as captured (typically) by video cameras or other devices that keep track of the body movements of an individual. The mirrored image is intuitive, in that we have become accustomed to such representations of self since we first learned to recognise ourselves in a mirror.[38] It is nevertheless a dualistic form, though, separating the representation from the physical body spatially, but not temporally. Such a representation is isochronic with the physical body, moving when and how the

experient himself moves. The most well-known example of the mirrored self form is the work of Myron Krueger, Videoplace (DATE) and its descendents.

Unlike Krueger's video image that is a spatially translated representation of a person's "own body" some VR creators elect to use a spatially coincident graphical avatar for portrayal of the body. In other words, the avatar appears to be *in* the space occupied by the person's mental construct of where they are in the VE. When such a body image is used, it raises vital questions concerning the form that image takes and its correspondence to the experient's own body. Designers are not yet able to create a specialized image for each individual without a great deal of advance planning, and therefore typically use a generic 3D model. The design of this model is up to the creator of the work. For example, it could be humanoid or not, or one could find their female self housed in body modelled as a male, which could cause some ontological dissonance.

Finally, there is the third person body representation. In this form of embodied image the participant inhabits an avatar, but at an experiential locus that is outside their perceptual self, appearing at some distance out in front of the experient's physical and imaginal core. It is obviously related and connected to the experient, in that its motions and actions may be controlled by the participant's actions and corresponding decisions. It is similar to the mirrored self, but with a body that corresponds less closely to the person's actual body.

Each of these forms of representation may overtly or subtly affect the nature of the experience one has within the virtual environment. VEs are not yet ubiquitous enough for researchers to conduct detailed studies that can compare the effects of representation, yet such studies would be very informative to help answer the question of the nature of Being within the virtual environment.

1.9 Space without limits

Virtual space is unencumbered by physical limitations, making for an endlessly varied palette of possibilities. While the space within a VE can simulate actual space, the most interesting creations take advantage of its fluid and flexible nature. Though computationally based on a Cartesian grid, the virtual space is a sensate space, encompassing a range of spatial considerations that extend far beyond a structural coordinate system. The nature of the virtual space also affects how we exist within it.

We can experience the space of virtual environments from many dimensions. Rather than being the one in which we primarily and naturally exist, the space of virtual environments requires both physical and mental compliance to enter into it — to become emplaced. Emplacement in a virtual environment demands this agreement at the start, and therefore virtual space is never neutral space. It is a unique space apart; it can function in many ways that real space cannot. Nonetheless, immersive environments have commonalities with many types of physical space, both in their characteristics, the agency afforded by them, and in how the spatial constructs affect us. Most of all, it is lived space, because we inhabit that space, as we do actual space, with our phenomenological Being.

The setting where most people experience a virtual environment today is in a computer lab or an art gallery, where the technology is set up. In this way, the space of the virtual is essentially a space within our normal space. The virtual space is what is *therein*, but not truly there, not a part of that world. It is its own world, and becomes perceptually and sensorially known only through dialogue with the technology.

For Henri Lefebvre, space embodies an "active-operational or instrumental role," being "knowledge and action."[39] It is powerful and produces significant relationships. Lefebvre argues that space, even as it produces these things, must, itself, be produced in turn. The production of the virtual space of a VE sets up this "active-operational role" by providing a stage on which relationships can emerge. This stage, this space, provides the potential for action, and *a priori* the emplacement of the experient, is nebulous and unformed. The acted-upon space and the emergent relationships that form afford the opportunity for meaningful experiences in VEs, an essential outcome of that production.

Our active engagement in virtual spaces through emplacement imbues that space with a valenced charge (affecting us in a positive or negative way). This charge is a large part of what transforms *spaces* into *places*, which are both meaningful and personal. Space become place (real or virtual) thus becomes the framework by which meaning is transferred.

Spaces and wondrous worlds. It is artists working in VEs over the past twenty years who have expanded the forms of space we can inhabit in virtual environments. From Davies ethereal… to Dolinski's interior landscape, to Rita Addisons empathetic world to the performative spaces of Brenda Laurel and Josephine Anstey's creations…..

Political Thiel… to the lost meories of my own Memory Stairs…

CONCLUSION

How we experience Being in a virtual environment, emplaced within its confines, elicits questions about what is real, what representations we project of ourselves, and the nature of space in the virtual world. Too often virtual experiences do not give the embodied nature of the experient enough attention and thus miss significant opportunities for a more convincing and solid encounter with the virtual. Our dually embodied Being (per Merleau-Ponty the functional body and physical snapshot thereof), brought about by our encounters with the virtual, creates a new form of Being.

As Maria Palumbo, (op. cit.: 65) says:

> In this way the body becomes an inter-media surface, the field for a dual experience between real space and virtual space which thereby acquires a new single dimension. And this dislocation of the corporeal experience can open the way to a new interrogation of the world and ourselves and, consequently, the possibility of imagining other possible kinds of space, other possible ways of being a body-that-becomes-space.[40]

Virtual environments have opened up new lines of ontological discourse. This paper is an attempt, not to provide all the answers, but to start to ask the important phenomenological questions I hope future scholars and artists will continue to address.

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