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The Design of Virtual Reality

Why Call It "Virtual Reality"?

The label "Virtual Reality" stuck to the new technology and just wouldn't let go. Since Jaron Lanier coined the phrase in 1986, it held the field through all opposition. Researchers at MIT shunned the phrase in the early 1990s. Instead of "virtual reality," they spoke of "virtual environments." The word "reality" in "VR" glowed with an aura similar to "artificial intelligence," and computer scientists had already been burned once before by boldly promising to deliver machines that could think. At the University of North Carolina, engineers under Frederick Brooks found "virtual reality" unscientific. They too opted for the more buttoned-down "virtual environments." Military scientists preferred "synthetic environments." Researchers at the Human Interface Technology Lab at the University of Washington in Seattle urged "virtual worlds." Against all protests, however, Lanier's phrase held its own. "Virtual Reality" continued appearing on successful grant applications as researchers conceded the power of VR to describe their holy grail. The poetic appeal of the phrase, its grandeur, struck the appropriate chord for the English-speaking community. Appropriate too was the subtle reference of the phrase to the historical origins of computing. The philosopher Leibniz was famous for his proto-computer as well as for his metaphysics of "possible worlds."

The philosophic echoes in the term "virtual reality" serve perfectly well to suggest today's ambiguous merger of life with computers.

Grammarians complain about the oxymoron "virtual reality," but the semantic twist of the phrase tells us as much about our tenuous grasp on reality as it does about the computerization of everything we know and experience. "Virtual" implies the computer storage model of life, software tricks, and the switch from industrial physics to information symbolics. Software now belongs to the substance of life. Life's body is becoming indistinguishable from its computer prosthesis.

Not surprisingly, the first steps in virtualization are appearing in children's toys. The next generation will take for granted the powerful transformation that makes us pause today. Entertainment, not philosophy, shows us the first merger of computers with reality. Arcade games, CD-ROM fantasies, and location-based theme parks beguile our human sense of presence. We find ourselves going back to the future, visiting the stars, and walking through Star Trek's Holodeck. More delight here than philosophy. Beyond the glint of the coins, however, we can see the outlines of a new kind of art. And this art is a reflective mirror where philosophic thinking captures a first glimpse of the coming ontology. This art may also help design virtual worlds that enhance rather than threaten our health and sanity.

The Joystick in the Mirror

Art holds a mirror to our deeper selves, displaying our fears, hopes, and doubts. Entertainment, by contrast, exploits a narrow range of excitement. The repeated stimulation of entertainment shrinks us, while the contemplation of art expands our scope. Because of its expanding scope, art reveals the meaning of our interplay with virtual reality entertainment.

As VR today develops mostly in the field of entertainment, the big picture of what VR could be tends to get lost in the rush for "content" to "fill" the new medium. It's up to artists to guard the visionary aspects of technology. Art nurtures infant technologies like virtual reality. Art lifts a mirror to show the power and peril of nascent technologies.

No accident, then, that art should preserve our ambivalent attitude toward technology. From its Greek origin, art is techne, the skill of making and producing. As primal making, art preserves the surprise of its own emergence. Rather than lose itself in the thrill of content, art lingers over its own birth, remaining ambivalent towards its own existence. In this way, art resembles its sibling, philosophy. Philosophy too dwells on its own origin, continuously re-defining itself.

Art parts company with philosophy and technology when the artist produces harmonious things. Then art becomes ars or joining (Latin) when the things produced show a splendid integrity. Compared to the harmonious products of art, the conceptual products of philosophy look pale and ineffectual while the products of technology often seem a maze of techniques for the sake of technique. We must design technology back into the essence of art. In that way, technology can recover its own meaning. Art and technology: two sides of the same cultural process. The joystick in the mirror.

Alternate World Syndrome

In March 1994, I spent six hours in Virtual Reality at the Banff Centre for the Arts in Alberta, Canada. There I donned a head-mounted display and for three hours on two evenings explored the "Virtual Dervish" created by Marcos Novak, Diane Gromala, and Yakov Sharir. My journal from that period reveals the discord I call Alternate World Syndrome.

> Three hours into the Virtual Dervish, my optic nerves are imprinted with brightly colored structures. After hours of immersion in the 360-degree simulation, I can later summon the computer-generated images with the slightest effort -- or see them sometimes in unexpected flashes of cyberspace. Hours later, I still felt a touch of perceptual nausea, a forewarning of the relativity sickness I call "Alternate World Syndrome." Everything seems brighter, even slightly illusory. Reality afterwards seems hidden beneath a thin film of appearance. Perceptions seem to float over a darker, unknowable truth. The world vibrates with the finest of

tensions, as if something big were imminent, as if you were about to break through the film of illusion.

Alternate World Syndrome (AWS) is an acute form of body amnesia which can become chronic Alternate World Disorder (AWD). Frequent virtuality can lead to ruptures of the kinesthetic from the visual senses of self-identity, a complaint we already know from simulator sickness and from high-stress, techno-centered lifestyles. AWS mixes images and expectations from an alternate world so as to distort our perceptions of the current world, making us prone to errors in mismatched contexts. The virtual world obtrudes upon our activities in the primary world, and vice versa. The responses ingrained in the one world get out of synch with the other. AWS shows the human being merging, yet still out of phase, with the machine.

The lag between worlds is not the same as the lag between the head-mounted displays (HMD) and the user's eye movement. The HMD lag comes from a timing defect which computer hardware development will eventually remedy. The AWS lag occurs between the virtual body and the biological body. The lag comes not from asynchronous interruptions within the virtual experience but from the sequential switching between worlds. A conflict of attention, not unlike jet lag, arises between the cyberbody and the biobody. A world, in the deepest sense, is a whole context of involvements based on the focal attention of the world's inhabitants. We feel a switch between worlds when we visit a foreign country, though the foreign world is cultural, not virtual. When a user identifies with a world, it then becomes an existential reality -- even if only a virtual reality.

AWS occurs when the virtual world later obtrudes on the user's experience of the actual world, or vice versa. AWS is simulator sickness writ large. Researchers who compare VR with military simulators remain pessimistic about the widespread use of VR. Many pilots cannot use simulators, and even those who train in simulators are grounded for days afterwards. Simulator experience counts toward upgrading a pilot's license to more powerful aircraft, but the hazards of simulator sickness exclude a large portion of pilots from upgrading their licenses in this way. Drawing on their studies of simulators, many military researchers believe

that the population at large could not regularly spend hours in virtual environments without suffering serious side effects.

AWS is technology sickness, a lag between the natural and artificial environments. The lag exposes an ontological rift where the felt world swings out of kilter. Experienced users become accustomed to hopping over the rift. Dr. Stephen Ellis, scientist at NASA / Ames and at the UC Berkeley School of Optics, says that his work in VR often has him unconsciously gesturing in the primary world in ways that function in the virtual world. He points a finger half expecting to fly (as his cyberbody does under the conventions of the virtual world). His biobody needs to re-calibrate to the primary world.

AWS is not an avoidable industrial hazard like radiation overexposure but comes rather from the immersion intrinsic to virtual world systems. Immersion is the key feature of VR systems. Virtual Reality in general immerses the user in the entities and events of the computer-generated world, and the immersion retrains the user's autonomic nervous system. The human learns to respond smoothly to the virtual environment, but the frequent re-adaptation to the technology affects the psyche as the virtual world injects its hallucinatory afterimages into the primary world.

Observe someone coming out of a VR system such as W Industries' Virtuality arcade games. Watch the first hand movements. Invariably, the user stands in place a few moments (unless hurried by the system's administrator), takes in the surroundings, and then pats torso and buttocks with the hands -- as if to secure a firm landing and return to presence in the primary body. The user feels a discrepancy on returning to the primary world. The discrepancy marks the gap between the virtual and the biological bodies. The virtual body still lingers in the afterimages and the newly formed neural pathways while the primary body resumes its involvement in the actual, non-virtual world.

The Bright Side of AWS

But there's a bright side to AWS. The only reason we have to worry about AWS is because VR has such awesome imprinting power. The virtual environment sucks in its users with a power unlike any other medium -- unless we include under media the religious rituals and sacred dramas that once gave art works their context. The fascination of VR recalls the linguistic root of the word "fascination," which comes from the Latin (fascinari) and which refers to someone's gaze being drawn repeatedly toward the dancing flames of a fire. From the viewpoint of human evolution, VR resembles the invention of fire. To understand the power of VR, we have to return to the cave. Or, I should say, both caves: the cave of the Paleolithic era, and the cave known as "Plato's Cave."

The earliest human beings learned to select items from their experience and then taught themselves to focus on those items of experience. Bison, horses, birds, all became prime items for early human vision, as well as targets for human consumption. From the cave paintings at Lascaux and Altamira (c. 14,000 B.C.), we know that humans have always enhanced their visionary powers through drawings and paintings. Because the caves gave them rest from the constant fight-or-flight stresses of survival, early human beings learned to sit by the fire and meditate, visualizing the realities cast by a flickering light on the shadowy walls of the cave. Fire first nurtured the human powers of visualization. Tending the dangerous fire forced humans to reflect on their activities and then to specialize and divide their tasks. A new human society emerged from the technology of fire and the visionary experiences of light in the cave. Fire was wonderful and dangerous.

Long after the Paleolithic age, the Athenian philosopher Plato (c. 427–347 B.C) made vision the keystone of reality. He followed Socrates in locating human intelligence in the ability to see things clearly with the mind's eye (Plato invented the term "mind's eye"). Plato gave a name to the mental forms that guide humans and he called them "ideas" (Greek idea means "shape seen," a term used by Greek sculptors). Ideas, according to Plato, govern reality -- whether they are the ideas in the mind of God or the ideas in the minds of human beings. Clear mental vision, according to Plato, is the responsibility of education in the truest sense -- not training or skill or social conformity. Only through ideas do human beings come in contact with "true reality" (Plato's term).

Plato's influence continued through the Renaissance and well into the modern period. Even when the physical sciences abandoned idealism for the sake of empirical experiments, Platonic visionary idealism still continued quietly in the background. Students of public speaking, like the rhetoricians mentioned by Frances Yates in her book The Art of Memory, used visualization techniques to enhance thinking on their feet. Renegade scientists, like Giordano Bruno and Isaac Newton, employed complex images and mental maps to focus their thinking. Many were considered heretics for dabbling in occult symbols, but all followed the lead of the first humans who bootstrapped intelligence by using images to internalize new realities.

Through the experiments of artists and of military trainers, we are coming into possession of an incredibly powerful visualization tool. In fact, to call it a tool may be to understate its power. VR may actually transform the way we learn and think and deal with things. Tools that transform us, like fire or the wheel or the automobile, become integral parts of our destiny, parts of ourselves. Such devices cause us to evolve and eventually mutate. VR will very likely transform the culture that uses it.

Educators and learners can channel this visionary device to bring us to a higher level of civilization. From the past uses and abuses of technology, however, we can safely guess that VR will bring negative as well as positive developments. Recall Plato's Myth of the Cave. In it, Socrates tells a story of enlightenment, but it is also a story about enslaving addiction, upheaval, homicide, and a vision so passionately beautiful that it brings death to the person who catches a glimpse and then dares to share it with others. We need to reflect again on this story of the Cave.

VR Does not Re-present, VR Tele-Presents

Everything in life is, of course, a risk. But no artifact so insinuates itself into the inner sanctum of the mind as computer-generated images. And when the images become virtual entities and virtual agents, then we find something very special about the environments generated by VR. We have always been able to immerse ourselves in the worlds of novels,

symphonies, and films, but VR insists that we move about and physically interact with artificial worlds. This sensory immersion is special feature of VR.

Sensory immersion has broad ontological implications. First, virtual entities are not representations. They do not re-present. They do not "present again" something that is already present somewhere else. Even telepresence robotics brings about a transformation of the remote entity, in which its properties become open to manipulation in new ways. The telepresent doctor reconstitutes the patient and thereby creates a new doctor-patient relationship through telepresence surgery. Virtual images are not like the images in paintings which we can mistake to be an outside entity and which the graphic image represents. In VR, the images are the realties. We interact with virtual entities, and we become an entity ourselves in the virtual environment. As in the medieval theory of transubstantiation, the symbol becomes the reality. This is the meaning of telepresence.

Telepresence is the cyberspace where primary entities are transported and transfigured into cyber entities. As another layer of reality, cyberspace is where the transported entities actually meet. They are present to one another, even though their primary physical bodies exist at a distance (the Greek teles). When a virtual world immerses a user in a virtual world, the entities encountered in the virtual world are real to the user -- within the backdrop of cyberspace. The user inhabits the world and interacts with virtual entities.

Granted that immersion belongs to VR, the question remains: How are users best immersed in virtual environments? Should users feel totally immersed? That is, should they forget themselves as they see, hear, and touch the world in much the same way we deal with the primary phenomenological world? (We cannot see our own heads in the phenomenological world.) Or should users be allowed and encouraged to see themselves as cyberbodies? Should they be aware of their primary bodies as separate entities outside the graphic environment? Or should they suspend physical experience? What makes full-body immersion? The different answers to this question split off into two directions. One goes into the CAVE at the Electronic Visualization Lab at the University of

Illinois in Chicago and another goes into the head-mounted displays of Thomas Furness, Frederick Brooks, and Jaron Lanier.

The HMD type VR is the most widely familiar as it uses the obvious hardware of helmet and datagloves. The projection type of VR is less widely known as it requires supercomputers to project its graphics. In five years the hardware will become more widely available so that the VR projection will be part of the home "edutainment" center. The projection type of VR derives from the early work of Myron Krueger and appears today in the CAVE at the Electronic Visualization Lab of the University of Illinois at Chicago. The CAVE is a surround-screen, surround-sound, system that creates immersion by projecting 3D computer graphics into a 10'x10'x10' cube composed of display screens that completely surround the viewer(s). Head and hand tracking systems produce the correct stereo perspective and isolate the position and orientation of a 3D input device. A sound system provides audio feedback. The viewer explores the virtual world by moving around inside the cube and grabbing objects with a three-button, wand-like device. Unlike HMD type of VR, CAVE users do not wear helmets. Instead, they wear lightweight stereo glasses and walk around inside the CAVE as they interact with virtual objects. Multiple viewers often share virtual experiences and carry on discussions inside the CAVE. One user is the active viewer, controlling the stereo projection reference point, while the other users are passive viewers.

Tunnel VR and Spiral VR

Philosophically, the difference between the CAVE VR and the HMD VR is profound. The HMD brand of VR produces what I call Tunnel VR or perception-oriented immersion. The projection or CAVE brand of VR, on the contrary, produces Spiral VR or apperceptive immersion. The VR that tunnels us down a narrow corridor of perceptions differs subtly but profoundly from the VR that spirals us into higher layers of self-perception.

Let me explain Tunnel VR and Spiral VR. Then I will clarify what I mean when I say that Tunnel VR is a perceptive immersion, while Spiral VR is an apperceptive immersion.

First, we need to distinguish perception from apperception. The term "apperception" arose in the late 18th century when Immanuel Kant first made the distinction. Perception goes toward entities and registers their color, shape, texture, and other properties. Percepts have sensory qualities we perceive with our eyes, ears, nose, skin, or kinesthetic sense. Apperception, on the other hand, perceives not only entities but also notices that which accompanies the perception of any entity: our self-activity. With perception we see something. With apperception we notice that we are seeing something. Apperception implies a reflectedness, a proprioception, a self-awareness of what we are perceiving. For Kant, this aspect of perception means that human beings enjoy a freedom and self-determination in their sensory activity that animals do not. Kant also believed that apperception makes possible a critical attitude toward what we perceive. Once we sense our separation from a stimulus, we can then enjoy the option of responding in various ways to the stimulus, perhaps even choosing not to respond at all.

The term "apperception" allows us to highlight the advantage one type of VR immersion has over the other. In perception-oriented VR, the head-mounted display shrouds the user's head much like the hood that covers the head of a pet falcon. Such falcon-hood immersion derives from not having a choice about where to look. The falcon grows tame under the hood because it is temporarily blind to the larger world. Likewise, the HMD immersion results from the primary body giving way to the priority of the cyberbody, and a tunnel-like perception of the virtual world results. In this sense, the HMD graphic environment is tunnel vision. The user undergoes a high-powered interiorization of a virtual environment but in the process loses self-awareness. (Discomfort alerts your attention but also detracts from an optimal and fully present awareness of self and world.)

In the CAVE or projection VR, the user typically experiences more than the perception of entities. The user enjoys an apperceptive experience. Because the user's body is immersed without having to adapt to the system's peripherals (heavy helmet, tight data glove, calibrated earphones), the CAVE immersion does not constrict but rather enhances the user's body. In turn, the projected immersion shows a different phenomenological landscape than perception-oriented systems. Most computer immersions are perceptive immersions. Typically, computer

graphics produce a representation of entities. They show us things we can then constitute with our imaginations. The immersion comes about through psychological suspension of selfhood.

Phenomenologically, HMD immersion renders entities directly. We see not only what the graphic images refer to, but we identify with them. Like the kid in the shoot-'em-up arcade game, we squint down the tunnel to lose ourselves in becoming characters in the game. In VR, we see virtual entities. Graphics refers us to things. But, like the pet falcon, we are directed by HMD VR exclusively toward the entities, into a tunnel-like perceptual field in which we encounter the graphic entities.

Apperceptive immersion, on the other hand, make us feel ourselves perceiving the graphic entities. Our freedom of bodily movement permits us to remain aware of ourselves alongside computer-generated entities. Apperceptive VR directs us towards the experience of sensing the virtual world rather than toward the entities themselves. To put it simply, HMD VR creates tunnel immersion, while apperceptive VR creates a spiral telepresence that allows us to go out and identify with our cyberbody and the virtual entities it encounters and then return to our kinesthetic and kinetic primary body, and then go out again to the cyberbody and then return to our primary body, all in a deepening reiteration. The spiral of telepresence can work like a conical helix that ascends upwards, taking us to new dimensions of self-awareness. Instead of "Tron," we have the Mandala system. Instead of "Mortal Kombat" or "Doom," we have "Myst."

Not by accident was the first commercial style of projection VR named "Mandala." The mandalas of Asian art oscillate between outer perception and inner self-awareness. Unlike the hero of the film "Tron," we do not entirely lose ourselves in Mandala immersion. In the realm of CD-ROM design, "Doom" or "Mortal Kombat" channel our energy down single paths of identification while the charm of "Myst" is to stun us repeatedly into becoming more aware of our lostness, of our powers of exploration, of our sense of mystery. Of course, current multimedia CD-ROMs work only by analogy to VR. Present-day CD-ROMs show only the desktop, through-the-window view of a virtual world, and as such always remain an abridged and diminished form of virtual experience.

Nevertheless, the issue of interactivity in multimedia seems also to fall under the critical issue of perception / apperception.

HMD systems allow us to go "through the window" and engage computerized entities, but apperceptive systems like the CAVE allow us to go further. If we could employ both hardware systems in the same proximate framework, then we could both enter cyberspace and at the same time celebrate the free play of our physical bodies.

The difference between perception and apperception VR systems means more than an ergonomic difference, however. The difference goes beyond physical comfort. Users often appreciate the freedom of movement possible with unencumbered VR, and the word "unencumbered" expresses that freedom. But "non-encumbered" remains a merely negative definition, telling us only what this type of interface is not. By apperceptive VR, I suggest a positive definition of one of the crossroads facing VR development.

From the viewpoint of user phenomenology, the difference is one of the felt experience of the self. One supports a focused self and the other supports an expansive self. When we are not strapped into a helmet and datasuit, we can move about freely. The freedom of movement goes beyond feeling unshackled. It also means our spontaneity becomes engaged. Just watch for a few minutes the users of projection VR, how they turn and bend and move their bodies. Then contrast this with HMD users. The difference lies not only in the software or the environment rendered. The difference lies also in the hardware-to-human interface.

The creators of the CAVE implicitly grasped this. By referring to Plato's Cave -- Thomas DeFanti fondly and frequently makes that reference, -- the inventors at EVL recognize the human issue. The human issue concerns the freedom embedded in the hardware-to-human interface of VR. Around 425 B.C., the philosopher Plato wrote, in Book VII of The Republic, a story he heard from his teacher, Socrates. Socrates' story of the Cave framed a centuries-old debate about the status of symbols, images, and representations. In Socrates' parable, the people chained to the floor of the Cave enjoy no physical mobility, and their immobilized position helps induce the trance that holds them fixed in its spell. They see shadows cast by artificial creatures ("puppets") held up behind them. The puppets have

been created by human beings who want the prisoners to accept the shadows as the only real entities. The Cave consequently becomes a prison rather than an environment for spontaneous behavior. Plato's Cave is a dungeon, not to be confused with the caves of Lascaux. Similar to Plato's Cave, the HMD VR can facilitate a higher level of human productivity and an information-rich efficiency -- whether for flying aircraft, undergoing training, or holding meetings in a corporate virtual workspace -- but it does so by exacting a human price.

Socrates ends his story by having one of the prisoners escape from the CAVE. Someone unchains the prisoner who then walks out the dark dungeon and then glimpses for the first time the sunshine and the light of real entities like trees and rocks and flowers. For Socrates, the sunshine was the sphere of thinking and mental ideas. As long as the person stays fixed in a purely receptive mode, chained to indirect perceptions, the mind lives in the dark. By climbing out the Cave into the sun of well-thought ideas, the prisoner ascends to the primary and true vision of things.

Cyberspace, as described in my The Metaphysics of Virtual Reality, is "Platonism as a working product." With its virtual worlds, cyberspace transcends the physical by replacing it with the electronic heaven of ideally organized shapes and forms. To balance this Platonism, we must revise the Cave metaphor. To escape from tunnel VR, we must re-discover the primary world, so that this world vitalizes the body that already exists outside electronic systems. Our liberation is to enhance and deepen our awareness of the primary body by directed use of the cyberbody.

From the perspective of user somatics, the difference between apperceptive and perceptive VR is one of the primary body versus the cyberself construct. The term "somatics" derives from Thomas Hanna. Hanna defined somatics as the first-person experience of one's own body -- as opposed to third-person accounts of one's body from a scientific or medical point of view. Somatic awareness is the line where conscious awareness crosses over into the autonomic nervous system, breathing, balance, and kinesthetic bodily feedback. The more we identify with a cyberself graphic construct, the less primary body somatics we preserve. Human attention is finite. When our attention becomes stretched and

overextended, we feel stress. The HMD tunnel may provide the greatest tool for training and for vicarious experience, but it exacts the greatest price on the primary body.

Tai Chi Telepresence

The reconstruction of the self through Virtual Reality signals the highest risk in human evolution. If every technology extends our senses and our physical reach, then VR extends us to the maximum because it transports our nervous systems into the electronic environment. If our contemporary culture already stresses and even overextends our finite capacities, then the VR tunnel holds great dangers. We may lose our way in the tunnel. We may lose part of our selves, our health, our body-mind integration down the tube. At the least, we may face a subtle AWS or a more acute AWD.

At the opposite pole of Tunnel VR stands what I call "the Tai Chi body." The Tai Chi body arose in health practices of ancient China where a series of exercises cultivated a unified meditative awareness. The exercises circulate "chi" or internal psycho-physical energy. A description of the typical Tai Chi body appears in this brief excerpt from my journal of a few years ago when I described the moments of wordless unity.

> The pre-dawn air was pale gray and the ocean breezes cool near Venice Beach in Los Angeles. Every morning for the past several months, I opened the same rickety wooden gate to walk into the backyard of Master Tung, Tai Chi man and Taoist teacher. Quietly I took my position among the ten or fifteen human figures standing like statues under the fragrant eucalyptus trees.
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> Feet parallel, knees relaxed, spine straight, weight sunk into the balls of the feet, arms outstretched with hands open but relaxed, eyelids nearly shut. Begin letting go of all thoughts, forgetting everything, listening only to the inhale and exhale of the breath. Sink down, letting go of muscle tension, releasing worries and desires, gradually merging the attention with the body. Every few minutes, teacher Tung makes the rounds to adjust the posture, and each time a burst of energy shoots from

> foot to crown of head. The attention wedded to a relaxed body generates a feeling of inner power, of expanding, radiant energy.
>
> By the time the hour is over, the sun's patterns are flickering through the eucalyptus leaves onto the grass with an incredible but gentle brilliance. Sounds of birds and lawnmowers emerge slowly in the distance. Other students are stirring and moving about in the slow martial movements of Tai Chi Chuan. Awareness of the clock returns gradually.
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> Later that morning, driving on the freeway, or sitting at the computer, or lecturing in the classroom, I feel the sudden pull of body/mind unity reclaim my nervous system: unnecessarily taut muscles let go, clenched fingers release, breath comes full and supportive.
>
> Or I catch myself in a moment of haste moving as if I were no more than a bundle of competing mental intentions, the body twisting with one limb this way and one limb that, without coordinating breath with action, and without making the most of my center of balance. The memory of Tung's garden adjusts me.

Tai Chi is a Chinese Yoga that arose in a martial arts context hundreds of years ago. It sews together attention and physical body so as to increase the felt internal body energy called "chi" (chee). The cultivation of chi enhances health, joint flexibility, and biofeedback.

What I suggest is that we learn to use Tai Chi -- or something like it -- to capitalize on the fundamental differences between projection VR and HMD VR. Right now, the two VRs stand in opposing camps in the VR industry. Each type of VR may eventually have its appropriate range of applications, but the two camps might also coalesce into a more effective and healthful system. Let me describe one possible scenario in which the two VRs might merge in the service of the Tai Chi body. From an evolutionary standpoint, the Western technological system may need help from outside cultures in order to lessen its negative aftereffects.

Here's one possible scenario. Because time spent in HMD VR tends to constrain human attention into perceptive tunnel immersion, and because every technological advance exacts a price or trade-off, we should allot a corresponding amount of time for projection or CAVE VR. We

should combine projection VR with HMD VR just as we combine a decompression chamber with scuba diving. Scuba divers check time tables to find a ratio between time spent undersea and time needed in a decompression chamber. They then spend a certain amount of time in the decompression chamber so their deep-sea diving will not cause the scuba diver to suffer internal injury. Similarly with VR. The VR user should have a corresponding decompression procedure after spending a couple hours in HMD VR. The CAVE VR provides an analogous decompression in that projected VR allows the technology to smoothen the transition from cyberbody to primary body. Rather than feel an abrupt shock between cyber and primary worlds, the user brings attention back into the primary mind-body and re-integrates the nervous system.

A Virtual Tai Chi master invites you into the CAVE after you release your focus from HMD applications. The Tai Chi Expert is a computer-generated composite that models the movements and postures of actual Tai Chi masters. The computer-generated master teaches not only a series of movements, but also adjusts meridian circulation, does push hands, and even spars with sporting users. Such a VR decompression chamber could link users to the primary world smoothly with an intensity that reclaims the integrity of conscious life in a biological bodies. The procedure can help offset the disintegrating aspects of reality lags and AWS. The VR experience can grow into a health-enhancing rather than health-compromising experience.

If wisely applied, art can weld the tunnel and the spiral into a single system, so the system might bring humans to a higher state of well-being. A combination of apperceptive with perceptive immersion might foster balance. The harmony of both types of VR immersion could produce virtual environments for engendering more alert and self-aware human beings.

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