Epoch of plasticity: The metaverse as a vehicle for cognitive enhancement

ABSTRACT
This article discusses simulation as an optimal vehicle for brain plasticity, a primary and distinct area of neuroscience and essential to human enhancement. By speculating on second-order enhancement cybernetics, the article links the 3D, virtual world of the metaverse to an epoch of plasticity, and also frames the practice of enhancement as taking place in this epoch. An arguable key issue of simulation and enhancement is the tension between desire and feasibility: a desire for greater than human attributes and what is technologically feasible for designing and developing such post-biological attributes. For example, a person may desire to have 24-hour remote brain integration with the metaverse but this is not feasible because (1) the technology has not been developed to do this safely; (2) the costs of research and development of artificial general intelligence and nano-robots to build a metabrain integration with the metaverse is vastly expensive; (3) patents have to be secured and take time; (4) the FDA may intervene preventing a human from integrating the brain with the net or metaverse. Further, while a person may desire to be an ‘upload’ he or she has to face similar circumstances: (1) the technology has been developed to integrate the brain and computer safely; (2) the costs of R and D are enormous; (3) the ethical and moral issues are predominant; (4) this new construct for ‘personhood’ may have a social and ideological impact.

KEYWORDS
enhancement metaverse second-order cybernetics plasticity
This article discusses simulation as an optimal vehicle for brain plasticity, a primary and distinct area of neuroscience and essential to human enhancement. By speculating on second-order enhancement cybernetics, the article links the 3D, virtual world of the metaverse to an epoch of plasticity, and frames the practice of enhancement as taking place in this epoch. An arguable key issue of simulation and enhancement is the tension between desire and feasibility: a desire for greater than human attributes and what is technologically feasible for designing and developing such post-biological attributes.

ENHANCEMENT IN BRIEF

Human enhancement has varied interpretations. For the purposes of this article, I define enhancement as an intervention that brings about a system’s improvement by increasing its capabilities beyond a natural state of wellness. Enhancement can be categorized as therapeutic enablement for curing and/or restoring health to what may be traditionally considered as a state of normalcy; selective transition (i.e., cyborg and trans-human) for improving human physiology beyond the suggested normal; and optional transformation (i.e., post-human and whole brain emulation or upload) in copying cognition onto non-biological platforms for extending or expanding life indefinitely.

The historical context of enhancement suggests that the technological interactions of computer-based systems have aimed to extend human senses, cognition and mobility. For this reason, enhancement can be linked to cybernetics (Wiener 1965), the theory of second-order cybernetics (Bateson 2002, Steier 2005), the Biological Computer Laboratory (von Foerster 1974), and the concept of the cyborg (Clynes and Kline 1960). Framing enhancement as linking to second-order cybernetics suggests that the observer is the agent of the system being enhanced. Therefore, one could say that this type of enhancement is actually a do-it-yourself (DIY) process. With this in mind, an essential first step of enhancement is logic – the rationale to identify the zone where our desires and what is feasibility intersect (Stock 2003: 97).

Methods for human enhancement will most likely be developed through the converging domains of sciences and technologies that are affixed to nanotechnology, biotechnology, information technology and cognitive science (NBIC) (Roco 2006; Roco and Bainbridge 2003: 224–227). A more current categorical system would include robotics and artificial intelligence,
as well as engineering tools and programming software that engages augmented experience. The increase in wearable technology and the variety of interface platforms give rise to an identifiable, automorphic praxis of DIY enhancement and introspection about what we are, where we are, our relationship to the environment, and our effect on the environment (see figure 1).

SIMULATION AS AN OPTIMAL VEHICLE FOR BRAIN PLASTICITY

There is an interdependent relationship between the metaverse and the field of human enhancement in that both incite plasticity. The media of virtuality and ‘immersivity’ are adaptive mechanisms for building new simulated experiences. Active participation in simulation, as in any number of task-oriented environments, assists the brain’s reorganization of neural pathways, regardless of age.

It was once believed that as we aged, the brain’s networks became fixed. In the past two decades, however, an enormous amount of research has revealed that the brain never stops changing and adjusting. Learning, as defined by Tortora and Grabowski (1996), is “the ability to acquire new knowledge or skills through instruction or experience. Memory is the process by which that knowledge is retained over time.” The capacity of the brain to change with learning is plasticity.

(Chudler n.d: 1)

The human brain consists of approximately 100 billion interconnected neurons, which communicate through synapses. The synaptic connections between neurons strengthen or weaken so that the flow of information is changed according to the environment. The reverberations of neuronal circuits (incoming nerve impulses) stimulate a consecutive series of biochemical changes between neurons, which cause branches and synapses in building short-term memories. This synaptic plasticity is what neuroscientists consider the cellular substrate for learning and memory. As the brain learns new skills, data is stored in the brain’s short-term memory and is temporarily available; then, over time, this moves to long-term memory (Tortora and Grabowski 1996) (see figure 2).

The metaverse consists of millions of interconnected data structures that are communicating through electronic codes. The codes are stored on interconnected servers, which house short and long-term memory. The connective intelligence of the metaverse may not be what is desired by many users in forecasting a type of noospheric intelligence; nevertheless, its feasibility harnesses a diverse collection of independent intelligences and a ‘wisdom of crowds’, as its plasticity continues to emerge.

Focusing in on the separate but integrated behaviours of cognition and programming, engaging in new or random skills are recursive. The avatar’s ability to manifest non-biological attributes, uncUSTOMARY to its human-counterpart (the user), furthers the learning experience more readily into a state of enhancement, however virtual. During the engagement of physiological enhancement such as flying or becoming multiple-selves, for example, the user increases brain plasticity. In short, learning new skills and acquiring new behaviours in unfamiliar and/or changing environments motivates brain plasticity. Whether the brain-computer-metaverse vehicle is truly optimal for enhancing plasticity is yet to be determined; however, application of biological principles to the study and design of electronics suggest continuing interest in its gestation and its emerging potential.
During the early years of brain-computer explorations of bionics, parallel computing, neurophysiology, bio-logic, AI, etc., cyberneticist Heinz von Foerster spearheaded the Biological Computer Laboratory (BCL) (1958–1976). The BCL was an independent division within the Department of Electrical Engineering at the University of Illinois. Although seldom mentioned in contemporary research, the BCL was packed with ‘thought leaders’ in cybernetics, including the notable Norbert Wiener and Ross Ashby. It was at the BCL that bionics was further investigated and second-order cybernetics flourished.

Besides systems theory and self-organization, the buzzword “bionics” was primarily responsible for attracting attention to the BCL research group. “Bionics” was a general catchword that covered attempts to analyse biological processes, to formalize them and to implement them on computers. Here the BCL followed the ideas of McCulloch and Pitts, as well as the tradition of the Macy conferences. Symposiums and conferences on bionics were also held, and had an international influence. The term “bionics” also represented an alternative to the idea of “artificial intelligence”, formulated in 1956; although today it is clear that in the long run artificial intelligence has been a more successful concept in scientific research programmes.

(Müller [2001] 2007: 2)

The rise of bionic enhancement and user-generated simulated personas reflects a behavioural similarity between the biological human and the cybernetic asset. Both are generative systems, complex, adaptive, and engaged in dynamic give and take relations with their respective environments. Further, second-order cybernetics applies to this system; since both the user’s and the avatar’s enhancement relies upon the user’s construction of enhancement models of the avatar, the user must be included within the model as a component part, whether the scenario involves the auto-morphosis of brain cells, synthetic matter, or both.

This notion reflects directly back on the valued theory of autopoiesis (self-creation), developed by Humberto Maturana and Francisco Varela in 1972 to explain the nature of living systems, such as a biological cell. A differing characteristic is that auto-morphic enhancement, which is the self-enhancement of living systems and synthetic systems, is a spiralling system and autopoiesis is a self-contained system. It is also worth noting that Maturana was a research biologist and cyberneticist of the BLC.

… [Maturana] worked on, among other things, an important article leading toward his now-famous theory of autopoiesis. Even the earliest formulation of the theory of autopoiesis, as it was later articulated, appeared first as an internal publication of the BCL. Students and co-workers of Maturana also developed ties to the BCL, and centrally important first publications – for example, those of Francisco Varela – were published as BCL reports. The contacts that led to publication in English were made at the BCL.

(Müller [2001] 2007: 3)

Cybernetics has been a key premise and driving force in developing relationships between the observer and what is observable. It is evident that the desire for a more comprehensive, connective bionic interface with computers has
an important history in computer theory and practice. Its future connective artificial general intelligence, however, has not arrived yet, although it is in the works at Novamente by computer researcher Ben Goertzel (Goertzel and Pennachin 2009). Nevertheless, projects that interface mind and machine have been moving forward. In 2007, researchers at the Keio University biomedical engineering laboratory looked at brain-computer interfacing systems for enhancing the user’s thoughts while in the metaverse. In this project, an electrode-equipped prosthetic receives signals from the user’s cortex, which is connected to an EEG machine through which the user’s thought-moving data is sent to the brain-computer interfacing system. ‘When the user just thinks about moving his arm or leg the BCI system correlates the movements to a keyboard emulator, which then controls the action in Second Life®’ (Mascari 2007: 1).

A SPECULATIVE THEORY: SECOND-ORDER ENHANCEMENT CYBERNETICS

Human enhancement is an extremely complex engineering process that aims to overcome cognitive limitation and brain degeneration. Manipulating the neurobiological system through invasive molecular engineering is difficult and risky. Influencing and regenerating nerve centres of the brain through non-invasive experiences within virtual or simulated environments, however, can be uncomplicated and reasonably risk-free. This notion imparts a new heuristic based on the metaverse as an experiential environment for enabling the human user’s cognitive enhancement, otherwise known as neuro-plasticity.

The heuristic can be explained by identifying the metaverse as a non-traditional environment that requires a user to learn new skills. Learning new skills establishes unfamiliar behaviours. Implementing unfamiliar behaviours causes the brain to think differently. Thinking differently arouses neural pathways, resulting in varied levels of brain plasticity. This heuristic suggests that the metaverse is as an experiential environment that is continually changing and this enhances the user’s cognitive properties; in other words, the user is not simply considered as a bodiless agent of process whose role is solely to enable avatars.

Unlike cybernetics’ circularity, this heuristic is not purely circular. It has a spiralling tendency. As the user enhances his/her plasticity, the metaverse is also enhancing its plasticity through the implementation of new simulated environments, new programming protocols, new behavioural abilities, etc. (See figure 3.)

The following four questions further unfold the speculation.

1. How is the relationship recursive?

The recursive relationship between the avatar and its human counterpart is currently inseparable – what enhances the human also enhances the avatar. Perhaps this account appears too simplistic, but it is actually not a complicated matter. Even for those of us who are not the kind of sophisticated avatar builders whose design and programming skills adhere to the seamless elegance of fashionable images, each time a user enters a simulated environment s/he gains a non-historical sense of self by acquiring or taking on new attributes. Moreover, no matter how sophisticated a designer or programmer may be, the nuances of building yet more streamlined entities is a creative undertaking and a problem-solving task, which undoubtedly exercises the brain’s motor activity and linguistic centres.
Yet there is another element to the recursive nature of the relationship between the user and the avatar. As the user becomes more cognitively plastic, s/he is upping the ante on the intelligence level of the metaverse, causing or enabling the metaverse to enhance.

For example, while the initial technology and science of the metaverse date as far back as 1996 (the Canadian Geographic Information System online), it has been further enhanced since the début of Second Life® (SL) in 2003. In 2006, SL had more than 230,000 downloads and by 2006 there was approximately 1.7 million downloads. By 2007, SL extended the level of control of its user/residents. According to the Metaverse Roadmap Overview (Smart, Cascio and Paffendorf 2007), by 2007 the SL experience allowed the world online community to examine and improve upon its software’s capabilities. SL is in a continuous state of enhancement due to the interdependent relationship between its software and the corroborative efforts of its family of users/residents.

2. Why is plasticity an important and necessary element of enhancement?

Brain plasticity is the ability of the brain to reorganize itself and to form new brain cells and connections (Ledoux 2003). Without plasticity, the brain would remain static. Similarly, without plasticity, the metaverse would remain stagnant. The plasticity of simulations of gaming and virtual worlds gives the users/players tremendous freedom to create new ways of performing and behaving, whether intentional or stochastic, which are not reproducible in the real-time world. The metaverse, as an experiential environment, fosters adaptability and novelty for both the human and, in turn, recursively, for his/her non-human counterpart – the avatar.

In the study ‘MRI assessment of cortical thickness and functional activity changes in adolescent girls following three months of practice on a visual-spatial task’ (Haier, Karama and Leyba 2009) published by BMC Research Notes, neuro-imaging reveals plasticity of cortical grey matter before and after cognitive tasks.

The researchers recruited 26 girls, aged 12 to 15. […] Fifteen of the girls were given the task of playing the [Tetris] video game for an average of
90 minutes a week over the course of three months. The others were told to avoid playing video games.

Both groups were monitored for changes in brain function as well as brain structure. Earlier research conducted in Germany (Jones 2004) had shown that juggling practice led to a thickening in areas of the cerebral cortex, so [Richard] Haier and his colleagues were pretty sure they’d find a link between what they saw in the functional MRI (about more efficient brain function) and in the structural MRI (about cortex thickening).

And that’s where the brain puzzle threw them for a new loop.

The researchers analysed the brain changes in the game-playing group compared with the control group, and they found that the Tetris players’ brain function became more efficient in areas linked to critical thinking, reasoning, language and information processing [...] They also discovered that the cortex became thicker – just as the German researchers had discovered. The only problem was [...] they weren’t the same areas.

“We all were surprised when we put the images together and saw that there was no overlap,” Haier said. The cortex became thicker in areas of the brain linked to the planning of complex movements as well as the coordination of sensory information.

(Boyle 2009: 1)

Dissimilar to the results of 2009 cortical thickness study, the findings of the 2010 BBC show ‘Bang Goes the Theory’ revealed that brain games do not necessarily make you smarter.

Researchers recruited participants from viewers of the BBC’s science show Bang Goes the Theory. More than 8,600 people aged 18 to 60 were asked to play online brain games designed by the researchers to improve their memory, reasoning and other skills for at least 10 minutes a day, three times a week.

They were compared to more than 2,700 people who didn’t play any brain games, but spent a similar amount of time surfing the Internet and answering general knowledge questions. All participants were given a sort of IQ test before and after the experiment.

Researchers said the people who did the brain training didn’t do any better on the test after six weeks than people who had simply been on the Internet. On some sections of the test, the people who surfed the net scored higher than those playing the games.

(Cheng 2010: 1)

Brain plasticity and IQ are not synonymous. In fact, IQ may not be the most reliable method for gauging a person’s cognitive wherewithal. When French psychologist Alfred Binet developed the IQ test in 1905, known as the ‘Stanford binet intelligence scale’, he did so to determine if children needed additional assistance in their scholarly pursuits (Roid and Barram 2004). However, studies show that there are several types of intelligence and not everyone has the same methods for learning. Psychologist Howard Gardner identified distinct types of intelligence in his ‘multiple intelligences theory’ (MI theory), which relates to linguistics, logical-mathematical, bodily-kinesthetic, spatial, musical, interpersonal and intrapersonal abilities (Gardner 1993). Here again, one
size does not fit all. The general IQ test may award levels of intelligence to those who enjoy time-based rigorous testing, but not everyone is comfortable, not to mention mentally alert or confident, in this type of environment.

Returning to the issue of auto-morphic praxis of enhancement and introspection of what we are, where we are, our relationship to the environment, and our effect on the environment; we might consider Joseph Ledoux’s thesis: ‘What makes us who we are?’ (Ledoux 2003: 1). From a neuroscientist’s perspective, Ledoux opines that the answer is all about our synapses – the key players in the brain’s communication system. This system contains the hardwired responses that intersect the user/agent’s experiences; in other words, the brain’s nature (hardwiring) meshes with a person’s nurturing (life experiences). Life experiences, in all their varied ways – love, anger, regret, hope, loss, and happiness – are the fuel for brain plasticity. Yet, the pedal that pushes the neuronal pathways into action is the acquisition of new experiences and new skills with which we explore and expend our mental fuel. In brief, it is not the emotions, per se, that fuel brain plasticity but rather how we engage our emotions.

3. What is the relationship between enhancement and second-order enhancement cybernetics?

Enhancement suggests the beneficial adjustment of an entity, whether human or avatar. If the avatar and the human counterpart are aspects of each other, and if the decision to enhance is self-motivated, such enhancement becomes a DIY-generated process of auto-morphic, self-modification and adjustment. One arguably important relationship between the cybernetic avatar and the biological human is a constructivist epistemology. Both are generative systems, complex, adaptive, and engaged in dynamic give-and-take relations with their respective environments. Since DIY enhancement relies upon the observer’s construction of the enhancement model, the observer must be included within the model as a component part, whether the scenario involves brain cells, synthetic matter, or both.

4. Why is second-order enhancement cybernetics important for biological and electronic systems?

The differing systems, one being biological and the other electronic, depend on functioning cells (human) or bytes (avatar) of information to remain in existence. Otherwise, they falter: the electronic cybernetic system will become static and will die without electricity; the biological system will degenerate and will die without neural cells. Both systems need plasticity – the ability to shape and reshape.

The issue of enhancement as being human-centric is a misnomer. The very meaning of human enhancement suggests physiological augmentation, which takes the body/brain beyond its fixed, genomic state. If the human is to become trans-human, and, at a later time, a post-human, an upload, or a whole brain emulation existing in non-biological platforms, then these differing systems have great significance for possible future human life. It is plausible that the metaverse, as a 3D, virtual environment that expands the human persona in the form of an avatar, also has great significance in extending human existence because it is a learning tool – a means to engage what it might be like to exist outside a fixed biology. This in and of itself is one of the
most significant contributions the metaverse has provided its users, especially at the looming cusp of a self-directed species’ transformation.

Each person is an enhancement project as well as an observer of the project. Second-order cybernetics suggests that the observer is a necessary aspect of what is being observed; however, it does not assign a behavioural trait to the observer. The second-order enhancement cybernetics, similar to the directive goals of first-order cybernetics, aims to enhance the human condition. Like cybernetics, there is a feedback system, which provides information to help us adjust and adapt to change. Unlike cybernetics, the loop is a spiralling system rather than a closed circular system. This curve of feedback helps us focus on the zone where desire and feasibility intersect and, further, towards developing long-range plans for possible post-human evolution. The relationship between the project, the observer, feedback, and adaptation is further influenced by a fourth behaviour – what I suggest as DIY enhancement, the observer/participant-based auto-morphic behaviour.

Enhancement attributes are varied and unique, as enhancement is not one-size-fits-all. Each person is individuated by complex behaviours and even though we share biological architecture, personal existence – our own identities and our identifiers – is where each person’s narrative begins. Today, our connective narrative begins at the transitional stage of existence as we are planning potential routes to pilot into the transformative stage.

**PRACTICE IN AN EPOCH OF PLASTICITY**

Practices that design and build simulations ‘have a maximum benefit in stimulating the mind into a growth pattern by developing functional pathways, which manifest as useful heuristics in behaviour’ (Khannea 2010).

It is exhilarating to develop projects through the iteration of trial and error, and those of us whose practices are unrestrained by superfluous rules, dogma or bias have a strong tendency to transform not only our own works, but the experiences of users/viewers. Ergo, freedom promotes creativity. Environments such as SL, and organizations such as the Creative Commons, encourage resourceful investigations through disseminating ideas, and sharing in developing new ideas and building projects. A metaverse free from regulatory restraints, taxes, and governmental or institutionalized control, behaves as a fluid environment and will have the strongest tendency to perpetuate.

How can this principle be applied to practice-based work that engages either the metaverse or human enhancement, or both? Practices engaging the mechanics of human enhancement, such as human-computer-interfaces, wearables, virtual reality; practices engaging narratives of enhancement, such as science fiction and graphic narratives; and practices envisioning human futures, such as drawing from nano-medicine and artificial general intelligence, similarly rely on plasticity – the continuous morphing in shape, material, size, and behaviour while adapting to the environment. While envisioning enhancements for the purposes of altering physiological organization in developing syn-bio bodies and/or radical life extension are currently not feasible; they are yet-to-be engineered or in the process of being developed through NBIC.

Nevertheless, we do exist in an epoch of plasticity. Psychological behaviour and social ecology are mutable, as distinguished from a former biological stasis era of rigidity – a world before the Internet, the metaverse, plastic surgery, stem cell cloning, genetic engineering and neurochemistry. In an epoch
of plasticity, the desire is to perpetuate. The logic is to understand what is and is not feasible to acquire and build, and must include heuristics. Therefore, the design and function of organization, feedback, adjustment, and communication form the basis of human enhancement. The project of enhancement is not necessarily specified as an object – such as a body or shape – but as a behaviour of interrelated parts that work together to manifest life or personal existence, with the purpose and goal of improving upon human biology.

The graphic serious-science narrative, as an area of practice, engages an elastic transition of semi-invasive enhancement and an integration of radical biological and synthetic transformation of computer and silicon. Since existence is an organization of parts (and those parts are currently biological and becoming more artificial) this system could include the following categorical sub-systems: brain (meta-brain prosthetic, cognitive enhancer, and communications enhancers); body (biological enhancers, synthetic-bio templates, and distributed identities); behaviour (consciousness modifiers, and awareness enhancers); and social ecology (networked cognition and hybrid presence) (see figure 4).

**TENSION BETWEEN DESIRE AND FEASIBILITY OF GREATER THAN HUMAN ATTRIBUTES**

An arguable key issue of simulation and enhancement is the tension between desire and feasibility: a desire for greater than human attributes competing with the reality of what is technologically feasible for designing such post-biological attributes.

One possible method to find a balance between desire and feasibility is to build a template for designing an enhanced existence, much like we do when designing an avatar – we select attributes that distinguish one entity from another, or combine attributes for sub-entities and alternative personas. In real time, it is not so easy to increase one’s physiological abilities is socially acceptable in most areas of the world, but the increase is most often limited to cosmetic alterations such as a rhinoplasty, facelifts, liposuction, and skin rejuvenation. Increasing cognitive abilities is most often performed through pharmacology and neurochemistry: through brain enhancers such as Modafinil, a memory-enhancing psycho-stimulant; Buspar (Buspirone), an anti-anxiety psychoactive drug; Celexa (Citalopram) a selective serotonin reuptake inhibitor (SSRI); and hormone replacements such as transdermal Estradiol with Prometrium, which aids memory and filter stress, or testosterone replacement therapy for andropause.

In direct relation to this, the metaverse, as a cognitive enhancer or brain plasticity enabler, might ‘engender as a nootropic, insofar it is created by people with the knowledge, skills and objective of enhancement’ (Khannea 2010).

One cannot blindly bootstrap neurological growth by means of virtual stimuli (so far). This clearly links the idea of nootropic VR stimuli with virtual education, experiential or otherwise. To enhance plasticity, from the perspective of a simulated nootropic, there would have to be a compelling system of failure/rewards, and embed all the critical aspects of a storyline. In more prosaic terms – if one would like to create constructive neurons, and would like to teach management, tweak a version of Eve Online, where success in the game depends on an active grasp of certain management skills, and upon attainment of certain stages in the
game with the participant has shown himself to have acquired functional neurological crosslinks that are associated with the desired knowledge. (Khannea 2010)

CONCLUSION

Cognitive plasticity can be achieved through experience in networked communication of second-order enhancement cybernetics. A fundamental distinction is that this framework is spiralling, rather than circular. The question of how to experience the relationship between the body, brain, behaviour and social ecology within an enhancing system remains unanswered. Nevertheless, what can be explained is how enhancement affects the user/observer, the observable enhancement project, such as an avatar, and the social ecology of both the user and avatar. A key negative assumption is that enhancement behaviours are anthropocentric; nonetheless, a key positive assumption is reciprocity of plasticity. The impact the user/enhancer has on the project (the users’ body-brain system), while in the process of being enhanced, reflects a strong tendency to transform not only the user’s own works, but also the relationship between users, avatars and other assets or vicarious users.

The implication of simulation as an optimal vehicle for brain plasticity is unresolved, yet simulation is an optional vehicle. Its benefit may not be the observable project of enhancement, or our desire to enhance vs. what is technologically feasible; in fact, the foremost benefit may be the finessing of behaviours that assist a larger social ecology of unsullied normalcy.

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SUGGESTED CITATION


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