Beyond the Virtual Sensorium

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Introduction

In the first article of this series (*Research Bulletin* 21-2, Autumn/Winter 2016), I outlined a digital mode of thinking, or "digital gesture," that stands behind virtually every modern technological innovation. I traced the digital gesture from its beginnings in language and mathematics through to the sublime achievement of creating an artificial life form. It was suggested that an awareness of the digital gesture could be the basis for a healthy orientation within a cultural context increasingly dominated by digital technology and as a countermeasure against the threat of digital idolatry.

With the biases implicit in the digital gesture as a background, I will endeavor in this second article to unfold some of the experiences and current thinking surrounding the actual use of digital technology, with particular focus on virtual reality and artificial intelligence, two domains that are currently enjoying a renaissance fueled by Medici-an levels of patronage. Perspectives on the possible ramifications of digitally enhanced experiences for the future development of human beings will be explored in a third (and final) article.

A Bit of Personal History

When I was a teenager, the way I viewed and interacted with the world changed radically after I received an unanticipated gift: a Nintendo Gameboy. Although it was not as technically sophisticated as other portable video game systems of the time, the Gameboy was well-designed, had good battery life, and, most importantly, was bundled with a game familiar to almost anyone of my generation. That game, described on its cover as a "relentless building block video puzzle"—"From Russia with Fun!"—was *Tetris*.

The game's simplicity made it instantly playable. As blocks of different shapes fell from the top of the screen at an ever-increasing pace, the player had to rotate them mid-descent in order to form solid, horizontal rows that would then disappear from the playing area. If an unordered pile of blocks reached the top of the screen, you lost. If, however, you managed to get through all of the levels, you were rewarded with a crude animation of small dancing figures in Russian garb followed immediately by a space shuttle, rocket boosters and all, launching slowly into the digital sky: gravity overcome at last. And, other than the option of choosing a track of simple electronic music to loop endlessly while playing, that was it.

I played this game for an uncountable number of hours. And so did every other person I knew who owned the game. Technically speaking, one could also play with another person, taking turns to see who could reach the highest level, but I tried this on only a handful of occasions. For me, the best part of the game was that I could always begin again if I made a mistake, and, given sufficient time and concentration, that I could master the game completely. There was no ostensible reward, only total immersion in the act of playing.

Today, of course, to play a game of *Tetris* on a tiny monochrome screen capable of rendering only four (!) shades of gray would be a positively archaic act, reserved solely for the purposes of nostalgia.[1] Though I personally have no desire to play again, one memory associated with *Tetris* comes back to me with particular strength: I can vividly recall lying in bed after hours of game playing, closing my eyes, and seeing, not darkness, but clearly defined shapes of light that appeared to fall through my visual field. Over and over, they would appear, move, and disappear of their own accord, seemingly independent of my participation. I had no choice but to wait for the phenomenon to pass before finally being able to fall asleep.

I have had other experiences of similar phenomena in my adult life. I worked for a time as a 3D modeler, a job that entailed long hours of creating objects within a three-dimensional simulation of space generated by computer software. After a work session, I was able to close my eyes and see the contours of the shapes I had been constructing. I could rotate them in my mind's eye, viewing them from any angle. Or, again, after working for some time on an image in a computer-aided design application, I became accustomed to liberal use of the "Control + Z" key combination on my keyboard to "undo" any mistakes or to go quickly backward in time to a previous iteration. I would then find myself inwardly reaching for these keys immediately after making a mistake in the real world. Upon breaking a cup in the sink, for instance, I could quite literally feel an inner movement toward keys that were not there, accompanied by a strong intention to "undo" the event.

Virtual Afterimages

It turns out that I was not alone in having these experiences. Although I was unaware of it at the time, the tendency for developing phantom sense impressions following immersion in a game world had already been given a name by the late 1990s. Without any irony whatsoever, these and similar phenomena came to be known as the "Tetris effect," after an article in *Wired* magazine in which the author described his own encounter with the notoriously addictive game:

> No home was sweet without a Gameboy in 1990. That year, I stayed for a week with a friend in Tokyo, and *Tetris* enslaved my brain. At night, geometric shapes fell in the darkness as I lay on loaned tatami floor space. Days, I sat on a lavender suede sofa and played *Tetris* furiously. During rare jaunts from the house, I visually fit cars and trees and people together. Dubiously hunting a job and a house, I was still there two months later, still jobless, still playing. (Goldsmith 1994)

Such experiences are particularly impressive when one considers that they were precipitated by impressions resulting from a display that was less than four inches square and a game pad with two buttons.

That was then. Most modern games place much higher demands on the gamer's attention. How much higher? An experienced player taking part in a real-time strategy game must track dozens or even hundreds of independent variables, issue a variety of commands in multiple contexts using a full computer keyboard and multi-button mouse, and perform hundreds of actions per minute in order to be competitive with other players.[2] The psychological and sensorial effects of modern video gaming have only recently become the subject of empirical research. Investigators have begun to call the aftermath of gaming on everyday life Game Transfer Phenomena (GTP). One recent paper reports that out of a sample of over two thousand self-reporting gamers, 97% had experienced moments of GTP, which included:

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> ...seeing game tags above peoples' heads, seeing maps in the corner of the eye, hearing music coming from the console when it is turned off, hearing voices in the head or coming from objects associated with the game, perceiving objects as distorted, feeling tactile

sensations of game pads when not playing, confusing memories from the game with those from real life, and saying something from the game without intending to, etc. (Angelica B. Ortiz de Gortari 2016)

To reiterate: these are phenomena experienced in waking consciousness when not in front of a screen. The same study also found that as the time spent "within the game world" increased, so too the frequency of GTP outside it. Moreover, over half of the respondents who experienced the most severe effects reported the phantom sensations as being "pleasant" and more than forty percent specifically hoped that the phenomena would reoccur. Playing with the intention of escaping the real world also had a high correlation with severe GTP. Particularly striking is a similar survey that found that the few gamers who reported having *never* experienced any GTP also *never recalled their dreams.* (Angelica B. Ortiz de Gortari 2015) Put the other way around, only those having an active dream life were susceptible to the hallucinatory effects of their gaming sessions.[3]

Immersion in virtual reality creates immediate bodily sensations that are closely entrained—in real time—to simulated events.

Virtual Reality

Like the internet, virtual reality, or VR, sprang into existence in answer to a problem perceived by the U.S. military. And, like the internet, VR has grown well beyond the problem for which it was originally conceived. So much so, that heads-up displays—designed in the 1960s for multi-million dollar fighter jets—have now arrived at a smartphone near you. Or, at least, something like their great-grandchildren has. In aviation, the heads-up display eliminated the need for cramming a large display screen into a small cockpit by creating a "virtual" screen that appeared to float in front of the pilot's field of vision. When combined in a helmet with sensors capable of tracking head movements, the virtual screen also elegantly solved the problem of aiming ordnance that otherwise had no direct relationship to the pilot's body. The next logical development was to create flight simulators that required no physical relationship to any kind of real equipment at all (aside from the simulator, of course).

Which brings us to the present moment. The most conspicuous accoutrements of VR are relatively well known: head-mounted displays, data gloves or suits that track movement, and handheld input devices with force feedback. Until very recently, these types of hardware were largely consigned to the world of academia due to their high cost, bulkiness, and processing demands. Today they are available on Amazon.

Almost three years ago, Google released a product dubbed "Cardboard" as a proof-of-concept meant to demonstrate the growing capabilities of its smartphones and generate interest in VR. "Cardboard" consists of two inexpensive lenses mounted in a piece of precision-cut cardboard that can be folded into the form of a head-mounted display (HMD). A smartphone fits into the HMD and, using a compatible app, the phone's display is divided into two smaller images that appear as a single three-dimensional image when viewed through the HMD's lenses. Contemporaneously with Google's foray into VR, Facebook spent two billion dollars to buy a small startup company that was poised to release its own HMD. Now a commercial product, the high-resolution "Rift" headset has integrated speakers and movement sensors capable of producing fully immersive VR experiences and costs less than a midrange laptop.

Microsoft, by contrast, is following a somewhat different path when it comes to the future of digital enhancement. Its HMD—called HoloLens—is designed to augment the real world rather than simulate a virtual one.

The HoloLens is a self-contained “holographic computer” that allows the user to see through its semi-transparent screen into the real world where three-dimensional “holograms” appear to be projected onto objects and surfaces. Using the device, an architect can, for instance, have a fully realized model of a building appear on the kitchen table, complete with simulated people, trees, and shadows. Moving around the table in the real world yields the user views of the virtual building consistent with its orientation on the table. Or, because the device can track a user’s hand movements, the model can be rotated by reaching out and “moving” it into a different position on the table. If VR simulates a whole world, augmented reality (AR) creates “real” hallucinations in the ordinary world.[4]

Hierarchy of Simulation

Strictly speaking, even when portrayed in two dimensions, all video games are a kind of virtual reality; they purport to show shapes and movements where there is neither.[5] What is *actually seen* in a game world—if it is to hang together as any kind of world at all—are simulacra of objects and laws that can be found in the “real” world. Look away from two-dimensional simulations, however, and the perspective changes. Within the hierarchy of simulation, proper three-dimensional virtual reality belongs to the upper echelon. In immersive VR, the simulacra take on characteristics beyond those attributes found in phenomena of the outside world. In VR, *the sensation of presence itself* is part of the simulation.

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Maintaining a connection with the real world is relatively easy when looking at a traditional computer screen. Even if the content onscreen is simulating three-dimensional space, one still “knows” that it is “just a simulation.” All one has to do is look behind the screen to see that “there is no there there,” as Gertrude Stein once put it. But, when the movements of the head are integrated with the visual and auditory systems through binocular and binaural simulations, the illusion of being present in a virtual world can be overwhelming. It is nearly impossible to describe the experience of fully immersive VR. It is, quite literally, awesome. People experiencing it for the first time will often react emotionally by crying out, or viscerally by losing their balance (or lunch), or psychologically by losing all sense of time. Unlike “game transfer phenomena” which manifest as aftereffects, immersion in VR creates immediate bodily sensations that are closely entrained—in real time—to simulated events.[6]

Enter Artificial Intelligence

Reserving three billion dollars for “human-machine combat teaming” (a.k.a. “Centaur Warfighting”) doesn’t seem like much of a commitment by the Pentagon’s standards. Nevertheless, it is a clear indicator that the U.S. military is again helping foment a sea of change. If the goal is to maximize efficiency in warfare, the logic of combining artificial intelligence (AI), human beings, and weapon systems is difficult to refute on its own terms: Let the humans do whatever they are good at, and let the digital gesture hold sway when ultra-fast, highly-coordinated precision is called for. Just as it is much less expensive to train pilots on flight simulators, it is also more cost-effective for combat drones to make some of their own decisions without the constant human oversight that they now require.

The moral oblivion of such a scenario is already being normalized in Silicon Valley as companies heavily invested in AI face the possibility of developing “moral algorithms.” Google’s self-driving cars are a case in point. A recent paper in *Science* asserts that “the algorithms that control [autonomous vehicles] will need to embed moral principles guiding their decisions in situations of unavoidable harm.”

(Bonnefon et al. 2016)[7] Engineers who actually work on the technology, however, are often quick to point out that, since AI doesn't think like a human being, the possibility of causing harm in the first place can be mitigated through technical virtuosity. After all, self-driving cars have yet to injure a single person despite having driven hundreds of thousands of miles autonomously.[8]

In addition to a having a stellar driving record, AIs based on "deep learning" techniques have already bested human beings at games of chess, Go, and the game show *Jeopardy!* Although all of the examples mentioned so far have emerged from research done in the U.S., machine intelligence developed through deep learning techniques is not unique to the West. A strategic plan for artificial intelligence released late in the Obama administration identifies China as the leader of new publications in the field.[9]

By discerning the thread spun by the digital gesture, educators who recognize the free, human spirit as alone capable of moral action may confidently lead even digital natives out of the labyrinth.

Education and the iGeneration

Millennials, the original digital natives, are already well into adulthood. The subsequent generation of children—Generation Z or the "iGeneration"—are now, or soon will be, entering school age. While there is, of course, no consensus as to how current and future generations will fare in their encounters with digital technology, there is a growing chorus of influencers who see the digital enhancement of the human being as crucial, not just for the progressive evolution of humankind, but for its very survival. Marc Prensky, a well-known author and speaker on the subject of education and originator of the term "digital native," claims that "the brains of wisdom seekers of the future will be fundamentally different, in organization and in structure, than our brains are today." By becoming enhanced through the use of digital technology, he has predicted that a *"homo sapiens digital"* will evolve and be capable of insights to which "the unaided mind will be blind" (Prensky 2009).[10]

Elon Musk, the billionaire entrepreneur and advisory council member to the Trump administration, shares a similar sentiment. Musk recently told an audience at the World Government Summit in Dubai that he expects to see a "closer merger of biological intelligence and digital intelligence" if the human race is not to become obsolete in a world of artificial intelligences. More provocatively, he has also argued that, given the rapid gains in the last few decades—from *Tetris* to photorealistic 3D games with millions of simultaneous users—it will not be long before games "become indistinguishable from reality." Following the trajectory of his own logic and taking into account the fact that evolution works on exponentially longer timeframes, he ultimately concludes that "the odds that we're in base reality is one in billions." Meaning: We are most likely already living in a simulation created by higher intelligences.

Fortunately, not all thinkers regard human evolution as technologically pre-ordained. In an essay titled "Intellectual Field or Faith-based Religion: Moving on from the Idea of 'Digital Natives'," authors Sue Bennett and Karl Maton rebut popular ideas about children "growing up digital." After challenging Prensky's ideas regarding *homo sapiens digital*, the authors sum up:

> The argument that technology is changing our society is the weakest of truisms on which to rest arguments for radical change to current systems and practices. It may not be as sexy to proclaim evolution rather than revolution, or to highlight diversity rather than paint stark differences, because such notions require

> measured, rational, and sophisticated thinking, and a tolerance for ambiguity and careful consideration rather than sloganeering. Yet this is what the evidence points to, and this is the thinking demanded of us. (Thomas 2011, p.180)

Without an enthusiastic challenge furnished by a true spirit of inquiry, those who, in the name of progress, would yoke human beings to machine intelligence may find their task all too easily accomplished. Foreshadowed by the concepts inherent in "moral algorithms" and simulations "indistinguishable from reality" is a world in which the faculty for moral imagination may matter less than the tireless, unblinking eye of a digital intelligence. By discerning the thread spun by the digital gesture, educators who recognize the free, human spirit as alone capable of moral action may confidently lead even digital natives out of the labyrinth.

ENDNOTES

1. Feeding nostalgia for old 8-bit games has become big business. At the end of 2016, Nintendo released the "NES Classic Edition," a miniature version of its iconic Nintendo Entertainment System originally released in 1985. The new version comes with over two dozen of the most popular games from the late 1980s that play, sound, and look exactly like the original games. A reported 1.5 million units were sold in less than four months, and ongoing demand has led to worldwide product shortages.
2. The current world record for the number of actions per minute (APM) in a real-time strategy game is held by Park Sung-joon, a 30-year-old professional gamer. During a world championship competition he once reached an APM of 818, which is more than 13 actions per second.
3. The 2016 article already mentioned summarizes several other dream recall studies as follows: "In general, incorporation of video game elements in dreams about video games are [sic] often reported by gamers, and gamers that have experienced GTP have reported similar content in their dreams. ... Moreover, absorption and fantasy proneness have been associated with high recall of dreams. These overall findings suggest that it is opportune to investigate sleep disruptions, working memory, attention abilities, and fantasy proneness variables in future studies of GTP." (p. 281)
4. Sometimes the term "Mixed Reality," or MR, is used to describe the use of digital technology to overlay virtual elements onto a view of the real world. A company called Magic Leap is building a mixed reality device that is not yet for sale. In lieu of using a binocular or "holographic" approach, the Magic Leap device creates solid-seeming objects that "intersect" with the real world by projecting digitally controlled patterns of light directly onto the user's retina. By eliminating the visual abnormalities associated with stereoscopic displays, virtual retinal displays do not cause virtual reality sickness, symptoms of which resemble motion sickness. The retinal approach also creates images of a much higher resolution and visual quality. One reviewer of a Magic Leap prototype describes his experience:

   "Intellectually, I know this [object] is an elaborate simulation, but as far as my eyes are concerned it's really there, in that ordinary office. It is a virtual object, but there is no evidence of pixels or digital artifacts in its three-dimensional fullness. If I reposition my head just so, I can get the virtual [object] to line up in front of a bright office lamp and perceive that it is faintly transparent, but that hint does not impede the strong sense of it being present." (Kelly 2016)
5. Does a series of light bulbs lighting up one after the other constitute movement? Like a row of bulbs, the pixels in screen media are fixed and can only brighten or go dim; unlike a reel of film moving through a projector, pixels are unable to move relative to the light they emit.
6. Leveraging the powerful experiences afforded by VR has already proven to be an effective treatment for several medical conditions, particularly pain control management and the treatment of post traumatic stress disorder. One VR engineer successfully created a virtual world that cured his own strabismic amblyopia, a condition which was formerly thought to be incurable in adults. (Blaha & Gupta 2014)
7. The authors of the paper have launched a website called "Moral Machine" (moralmachine.mit.edu) for the purpose of "gathering a human perspective on moral decisions made by machine intelligence."
8. Well, not quite autonomously. There was a human being riding shotgun for nearly all of the miles driven by Google's cars. The company has admitted that its human overseers have had to take over "many thousands of times" for one reason or another.

9. A PDF of the strategic plan can be found at: https://www.nitrd.gov/PUBS/national_ai_rd_strategic_plan.pdf
10. Many believe that VR will play a central role in this evolution. Tom Furness—the man who, in addition to inventing most of the other technologies enabling VR, created the first helmet-mounted displays for the US Air Force—has founded the "Virtual World Society" (virtualworldsociety.org) in an attempt to beat the swords he helped create into plowshares. One of the organization's aims is to "turn the living room into the learning room" by introducing children to VR at an early age. Furness believes that VR is a "transportation system for our senses" that will "unlock intelligence and link minds." Referring to virtual reality's power to create bodily sensations of being "present," he says, "When you put people into a place, you put the place into people." That is, people remember what they learn in the virtual realm because they actually "embody" what they experience there.

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