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From Lab to Living Room: Transhumanist Imaginaries of Consumer Brain Wave Monitors

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Introduction

Advances in small components manufacturing have recently given rise to small industries offering a range of biometric devices to consumers, researchers, and DIY or "do-it-yourself" communities. These devices now include EEG (electroencephalography) or brain wave monitors, marketed as easily accessible, user friendly, affordable equipment, for use by broad markets of users in research, health care delivery, fitness, home system management, gaming, and as DIY tools for artists. Ultimately, these are data collection tools, made for a range of purposes, meant for a range of intended and yet to be discovered practices. Data collection is a key feature enticing consumers to buy. An enormous range of consumer grade biometric monitoring devices invites us to self-surveil our fitness progress, health maladies, physical therapy successes, and mood shifts, and to then collect and disseminate or even repurpose this data. These products, produced largely by North American companies, focus on a western market acclimated to cultural practices of self-tracking via the application of do-it-yourself technologies in efforts to obtain self-improvement.[1]

Popular today are a variety of heart rate and other fitness monitors and more advanced devices like the Nike+ Ipod sensor, that works with your Nike shoe to track your time, distance, and pace. More advanced, the Nike “Fuelband” tracks varied metrics (calories burned, steps taken, jacks jumped, etc.), revealing one’s exercise productivity or comparing it with one’s exercise partner, while also sending the user inspirational messages. In addition to this expansive array of sports equipment, biometric monitors track health metrics and send them directly to medical care providers. New EEG brainwave monitors are both a logical step forward for consumers engaged in personal data collection, and a curious marketing phenomenon revealing a host of odd cultural priorities.

Nike Fuel Band

Nike sensor, placed in Nike shoe

Research trajectories and university and science lab funding trends in the past decade celebrate data collection and processing as a way towards enhanced future societies, while computational theory is noted as the method best able to collect, process and employ data about subjects and communities. Information gained from the body, referred to as bioinformatics, is key to a range of culturally valued biomedical projects. Genome and stem cell projects, gene targeting and drug development, medical diagnostics, and genetic medicine generally are examples of some currently valued biomedical projects.(Thacker, 2003). Biometric devices can be seen as downgraded versions of bioinformatic research projects that bring, to a personal level, the idea that data accounts for the body, and more, that “the body can be generated through data” (Thacker 2003, p 12). Biometric devices promise, for example, an ability to predict and thus enhance or alter the body in the aim of a future where risk, health, and prosperity are managed. In other words, biometric

devices suggest that our personal future progress hinges not only on biotechnological augmentation, but on personal data surveillance and purposing.

In this context, the sale of data collection devices for consumers is an important cultural practice—one that invites consumers to take part in data collection as an always already good and productive practice. The marketing resonates carefully, as will be shown, with common science stories where biotechnology is featured as citizen responsibility through idealized narratives of improved futures. In this context, then, it is unsurprising that tools once relegated to the science laboratory are invited into our living rooms for personal use. This shift suggests changes in how consumers appear to be interested in pulling, viewing, and using data off their bodies. It reveals how we accept associated and highly reductionist, illogical theories of body systems as well as the visual representations produced by these biometric devices as part of their creators' marketing strategies.We seek to understand these shifts by analyzing the varied marketing discourses employed to sell consumer grade brain wave (EEG) monitors to a broad consumer-researcher population. We are interested in this lab-to-living-room shift because it veers away from the usual routing of science instruments to schools and public science festivals. The expansion of EEG monitors into divergent spaces constitutes a significant practice that reflects a host of concurrent cultural technology trends: neoliberalist desires for quick fixes; a growing desire for self-computational wearable and mobile devices; common discourses linking data collection to human progress; and reductionist consumer science discourses that present the body and mind as segmented, coherent, modular systems. These strong currents situate environments in which consumers and hackers come to believe that biometric devices offer biodata that can and should be purposed for other productive ends. In so doing, consumers easily overlook marketing strategies that overdetermine the scant value of the data, and repurpose it for strange ends, creating new science fictions of the personal work that we should undertake toward human progress.

Any study of how media practice intersects with the production of cultural science knowledges requires the melding of Media Studies and STS (Science and Technology Studies)—an approach few scholars have employed. Sara Kember and Joanna Zylinska (2012) argue that we need to move beyond the media object to address the linked technical, social, and biological processes by which we mediate the meaning of new media forms. The work of locating the discursive epistemological crossings from biological and social self to the consuming and augmented self (regularly using smart phone, iPad, Kindle, iPod, or sports grade biometric devices) thus presents a methodological challenge. Kember and Zylinska enjoin media studies scholars to link the creative and the critical, to track and analyze the multiple flows across these mediations.We begin to take up this challenge, asking how marketing strategies for biometric devices present science imaginaries that resonate with distinct cultural discourses and practices of targeted users via creative marketing practices. We focus on textual and visual marketing discourses designed to sell a range of popular brain wave monitors or EEG devices, formerly seconded to science labs and hospitals but now marketed to university labs for cognition research, gamers, early adopting consumers for functional uses such as home entertainment system operation, to education professionals to aid learning, and finally to artists and DIY users in hack labs for experimentation. Our analytical lens places this marketing strategy within normative consumer science culture discourses, the everyday cultural practices of these users, and broader North American cultural ideals, deeply bound to gendered and capitalist values in this post-information, globalization era. We focus on understanding how these marketing techniques tie in with an apparent desire to acquire and employ personal data surveillance devices to visualize our personal data, to obtain information of our body/self, and more importantly, to use this data in novel, productive ways

Data infatuation in liquid times

Given the broad market appealed to by these ads, it is insufficient to examine biometric devices as the most recent technology of self-care that works via biopower. Instead, the marketing strategy pulls upon and reifies a web of interfeeding, normative cultural values. Biopower logically adheres cultural norms together in brain wave monitor discourse and imagery—it binds biometric commodities with DIY cultures of free labor, neoliberalist values, data infatuation, and popular reductionist science fictions. Our cultural practices are (now) deeply implicated with technologies (Haraway 1990). The age of the cyborg is past and we are living in the early days of machine augmentation—mobile and wearable devices collect, store, and communicate our feelings, moods, and biometric data for a range of communication, health, and art purposes. Biometric commodities only make sense within what Bauman terms this "liquid" period of modernity (2007), where globalization has created insecurity, uncertainty, and a personal and collective sense of impotence.[2] Bauman tells us that society is increasingly viewed not as a structure but as a network — a "matrix of random connections and disconnections." Within this network, interhuman bonds become increasingly frail and temporary, and values of division and competition win out. In these constantly changing environments, individuals are encouraged to meet constantly changing conditions with free choice, requiring flexibility and the acceptance of higher levels of risk. Virtue is not consistency but a readiness to change tactics, abandon commitments and exploit opportunities (rather than follow preferences) (Bauman 1990, 3-4).

In this environment, quick fixes become not only virtues, but also responsibilities and requirements for future survival. A range of scholars (Hayles, Rose, Thacker) suggest that new biotechnological tools that service self-responsibility and self-care are increasingly computational. As Turkle has shown, computational devices (e.g. the computer) are but one component in the history of self-care technologies (1984). EEG devices, while clearly computational, are also deeply inscribed in popular science fictions that reduce complexity to manageable, modular systems and resound with imperatives for self care, increasingly presenting computation as a reliable albeit invisible solution that is the link to future, productive success. The following sections seek to unravel the cultural values that undergird these stories, crucially bonding popular fictions to biometric augmentation, to create desires for strange new technologies and their outputs, signified as progress.

A final, crucial component to consider in this story is the role of labor in the research conducted in the DIY community. These workers produce and offer findings to open source sites that industry can exploit; the findings, for example, verify EEGs as reliable devices and point industry to potential new applications (e.g. gaming and early adoption practices) for EEG devices. As Tiziana Terranova (2003) argues, the neocapitialist economy must be viewed as a crucial base from which to understand the development of cultural industries and products. Terranova writes: "Cultural and technical labor are not produced by capitalism in any direct, cause-and-effect fashion; that is …they have developed in relation to the expansion of the cultural industries and are part of a process of economic experimentation with the creation of monetary value out of knowledge/culture/affect" (p 79). While there is a moral imperative to enhance one's brain, at the same time, there is an equally compelling (moral) imperative among biometric hackers and users to offer the fruits of our labor, for free. In (western) culture, free labor is "pleasurably embraced" and "shamelessly exploited." (Terranova, 5). New technological practices align with older practices in relying on public users as productive subjects. However, these technologies produce distinctly new practices and create novel forms of production and ways in which power intersects with knowledge (Terranova 2003). These cultural flows—our consumptive and productive practices—are key to the sale and purchase of EEG devices. Cultural flows are displaced and replaced in accordance with current capitalist-qualified, culturally

fashionable “norms” that include varied distribution sites such as music, fashion, and information (Terranova 2004) To understand this flow, we must identify the threads of western cultural imperatives that typify EEG marketing strategies—to produce data, to labor, to biometrically augment for techno-enhanced futures. The production/consumption flows are key to understanding how the EEG can be sold as a tool for attractive new cultural practices, by resonating with lauded cultural values—neocapitalism, neoliberalist ideals, transhumanist futures, reductive science, and data infatuation. Understanding cultural flow also helps us to analyse the ‘cultural content of the commodity’ (Terranova 2004, 82) produced in the flow—its output: the cultural products of EEG labour and use.

Common cultural science stories and fictions

The cultural context that invites us to capture our own biodata and repurpose it hinges on the increasingly fragmented, reductive stories of biotechnological advancement consumers have been fed, over the past three decades, by health policy and industry product discourse. These cultural narratives intersect directly with global economic practices, the increasingly heightened value of consumption, and neoliberal imperatives for consumer/producers to be hyperproductive and competitive and to undertake innovative, constantly changing forms of self-improvement.

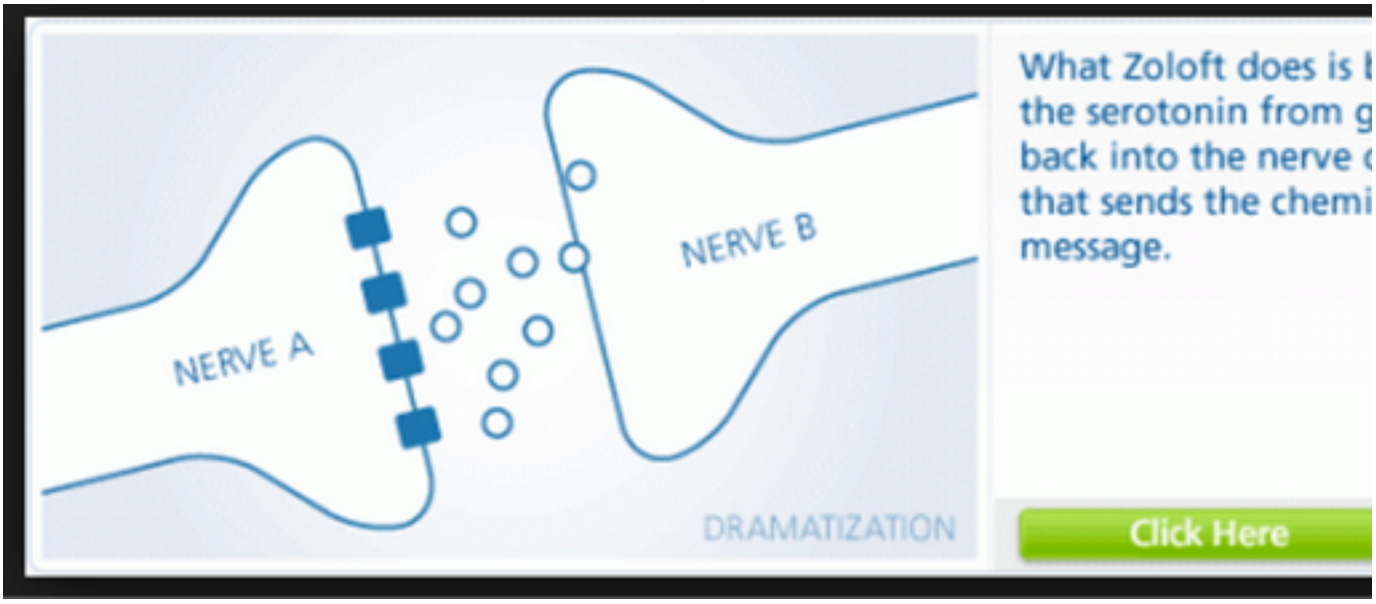
Stories of biotechnological science for consumers tend to be highly reductionist, often aided by visuals that segment body systems from their complex system context. Crucially, such popular science knowledges form the concepts and comparisons that come to *constitute* our collectively held science knowledge (Fleck, 1979). As such, visualized consumer science over the past three decades has inculcated incomplete, inexact, and even illogical tales in our collective science consciousness.

Biotechnology narratives in popular consumer health magazines, newspaper health sections, and mainstream TV and radio programs often represent weak and incomplete data as highly detailed information. This is then used as knowledge that can predict a subject’s health, wellness, and ability. Consumer information routinely substitutes stories of modular body systems for complex system stories (Hayles 2011, McPherson 2011.) These stories ask us to read modularity as complexity, and to overestimate data to mean cause rather than output. Culturally, we are comfortable with consumer science soundbites—easy to digest bits, in keeping with our quick-fix neoliberal culture. [3]

Ubiquitous visuals tend to present “the problem” (e.g. depression) as beholden to a single noxious issue (brain chemicals), declaring that the problem is reducible to a single cause. This single noxious problem is fixed, in this story, by drugs like Prozac that are said to remedy the brain chemical disorder. The other elements of the system that might trigger depression—hormones, genetics, poverty and economic stress, etc.—are eliminated from the narrative.


Depressed


PROZAC


NERVE A
NERVE B
DRAMATIZATION
What Zoloft does is
the serotonin from
back into the nerve
that sends the chemi
message.
Click Here

Popular visual renderings suggest cause and effect where there is no such data—for example, that illness is caused by single elements, repairable by single technologies (Gardner 2007)—or they employ visualisations (e.g. PET scans, which merely demonstrate blood flow in the brain) as proof of cause for "depressed" or "schizophrenic" brains (Dumit 2004).The visuals suggest that symptom is cause, and adeptly frame mind and body data in isolated activity quadrants that fragment body systems. As such, mood is reduced to brain chemical systems, perception to isolated cognitive systems, and cognitive state to brain wave systems. Because they are quickly accessible, such visuals normalize the extrapolation of data from modular systems into tall, overdetermined tales. Scholars have demonstrated the effectiveness of tactics—gendered drug advertising (Metzl 2004), glossed, gendered depression promotion (Gardner 2007), and PET scans (Dumit 2004)—that successfully impress consumers and health professionals with these reductionist logics. This practice teaches a false pedagogy for knowing biological and neurological processes, and works effectively to sell discrete tools to track discrete data (e.g. EEGs and EKGs), and discrete remedies (Prozac / SSRI drugs) to treat alleged single elements effecting modular systems.

Biology, the cutting edge of contemporary technoscience, says Sara Kember, is "*the* hegemonic discourse of the late twentieth and early twenty-first centuries" (2003, 178). Premises underscoring abundant research into neural networks, the human genome, and genetic sequencing all digest the mind and body into computational, biological entities (Galloway 2004, Kember and Zylinska 2012)—and have far-reaching effects.[4] These science tales have become everyday stories, so that consumers understand their bodies as computable, and quick solutions to complex biological problems as the work of good citizens (Rose 2007, Thacker 2004). The stories also impact how scientists conduct research. Lab research dichotomizes materiality to information, rendering the popular belief that information can capture all essential data about an organism (Hayles 2002). Reductionist reasoning is firmly embedded in scientific methods and instruments (Rabinow and Dan-Cohen 2006), and in digital media practice (Fox Keller 1995). The biases cause us to read life as matter (Thacker 2004); as such, biometric data comes to replace identity (Galloway 2004) and subjectivity (Rose 2007).

This reduction of the human to data reflects, importantly, the linked problematic, noted by Lucy Suchman (2007) where humans lack agency in human-computer interfaces. Suchman contends that the human-machine interface obscures the (productive) asymmetries of human and machine, places wisdom with the machine, hails the digital, and valorizes (new) technology. A preferred metaphor for the complexity of human cognition would in fact be the distributed system wherein networked communication links modules that house collections of data. Reductionist cognition, then, like human-computer interfaces, prohibits a complex analysis (of the human or cognition) by failing to address interactivity within the system. Instead, human-machine interfaces (like the EEG) are created and offered to users as forms of systematic communication, where rules are to be followed and wherein humans and cognition are engineered practices rather than complex processes. Hayles (2002) argues that modular systems are key to understanding complex systems, while Suchman (2007) insists we must understand the rules that govern interactive systems in order that humans obtain agency in the human-machine interface. In each of these normative systems (cognition and human-machine interfaces), obscuring interactions (of body-machine and body-mind) creates a science fiction that pushes us from advanced networked analysis of data toward reductive, highly structured readings of data out of context.

Crucially, consumer EEG devices appear to foreground the human and the body, representing them as devices that access rather than obscure cognition. As such, users adopt biometric devices in new personal surveillance practices that Giorgio Agamben terms 'biological tattooing,' which bring us one step closer to

“animalism” (2004, 2). In this exchange between subjective body data and media devices, body data is disconnected from critical context, and public speech itself becomes manipulated and controlled (2). Agamben charges: “Between these two extremes of a body without words and words without a body, the space we once upon a time called politics is ever more scaled-down and tiny” (2004, 2). At stake is our agility in undertaking politically astute interventions as consumers, artists, and scientists with and through biometric devices that capture our personal data, frame it as information, and transform it into knowledge. At stake is whether we critically *mediate* rather than embrace reductionist and transhumanist norms in the creation of knowledge of human subjects.

Normative transhumanism

While reductionism is key to this science fiction, code figures prominently in the tale. Eugene Thacker recognizes a “biotech century” of life sciences and medical research characterizing the intersection of genetic and computer “codes” (2003, 72). Transhumanist premises—that technology will improve the human by improving upon our designs—resonate in information society, linking common cultural practices of computation with stories of science advancement and biotechnological consumer products. Transhumanist claims align computation across spheres of life, science, and consumption, making computation the lowest common denominator uniting these spheres and practices. The reduction of the human body and mind to code is, then, intricately tied to marketing narratives that sell biometric devices, suggesting that data from ourselves can be manipulated in the creation of improved, code-altered, future human subjects.

While length prohibits a full discussion, it is crucial to recognize that science and lab practices reducing bodily systems into subsections and modular systems rely on computational theories of the mind (CTM). The approach springs from the work of Alan Turing, who in 1936 famously produced a computing machine that linked syntax to cause and could, as such, duplicate human computing processes. A major problem, however, arose in analyzing the mental state of “attitude.” Philosophers group “attitudes” into two states: occurrent (evident in the object) and dispositional (traits in elements that are not so evident). The latter are more problematic for computational theories of the mind, as they are difficult to categorize as *recurring* states or phenomena. Turing himself saw this problem and, as such, separated modular from global thinking, to avoid extrapolation or misinterpretation of the theory. Respected CTM author Jerry Fodor decries the overblown commitment to CTM reflected in the sharp shift from global to modular brain processing study across the sciences, Fodor writes: it “hadn’t occurred to [him] that anyone could think that is a very large part of the truth; still less that it’s within miles of being the whole story of how the mind works” (in Fodor 2000, 1).

This now common bastardization of CMT and framing of cognition in modular segments grounds our popular understandings, our infatuation with data, and our assumption that data retrieved from modular systems can create reasonable, even predictive information of cognition. Transhumanist discourses exploit this*computational* reduction of brain process, making it a new reasonable imaginary for those of us seeking to improve health, cognition, mood, and other practices related to brain/mind process. Tara McPherson (2011) recognizes modular thought as a kind of “lenticular common sense”—a practice bridging cultural thinking, from the UNIX system to racist culture. She contrasts modular thinking to stereoscopic melding of two disparate images to create 3d perspective; the former (lenticular) image “partitions and divides, privileging fragmentation. A lenticular logic is a logic of the fragment or the chunk, a way of seeing the world as discrete modules or nodes, a mode that suppresses relation and context. As such, the lenticular also manages and controls complexity.” (25)

Modular logics make sense within transhumanist imaginaries that seek to improve upon human design. Advanced technologies from nanotechnology to neural computing claim to enhance, augment, and advance the human into a posthuman future.[5] A cogent metaphor from these intersecting disciplines is "uploading"—a practice likening neural pattern brain activity with advanced neural network computing, suggesting that humans' minds can be upgraded, in time, to more durable hardware systems (Moravec 1988, 109-10). Here the mind is component. Potent science fiction films have duplicated the idea that the brain is essentially data:*2001: A Space Odyssey* (1968)*, Johnny Mnemonic* (1995), and *Lawnmower Man* (1992), among others, extrapolate on current abilities of technology to enhance or manipulate cognition.[6] TV documentaries such as PBS's *The Secret Life of the Brain* represent cognition and perception as biological, universal, and, in essence, data-driven. The series also examines visualization technologies, such as PET and CAT Scan machines, in technical terms, failing to interrogate fundamental misperceptions—e.g. that these visualizations can show cause of cognitive impairment or actions of cognition, when they instead visualize small actions in modular systems. A still image available to viewers as a screensaver (see image below), illustrates our cultural fascination with the synapse as the formidable space where data moves across the brain to (factually) create thought. Interestingly, this image is colored in sepia tones, suggesting perhaps new knowledges, but in keeping with historic with scientific commitments to empirical methods that produce facts. As the series suggests, brain data obtained by new technologies is presented to consumers as always-desirable output, and yet, its interpretation is best left to experts.

Screensaver of synaptic activity, colored in warm and sepia tones, made available to viewers, from the PBS series The Secret Life of the Brain (2002).

This is the story that Hans Moravec pegs as the hope for a transhumanist future where "we will soon be able to upload our consciousness into computers and leave our bodies behind" (in Hayles 2011, 1). Code, or data, of course, is the ubiquitous output of the upload metaphor. Katherine Hayles deems Moravec's improbable scenario as "dependent on a decontextualized and disembodied construction of information" (2011, 1). This imaginary grants excessive power to capture (or imagine) brain data; it is referenced in consumer EEG marketing suggesting that the act of *tracking* modular brain wave data (as patterns), and visualizing it, holds unforetold future applications for enhanced cognition. Our brain data is alterable and in

turn we can alter our brains. In Foucauldian terms, docility and alterability are required assumptions that enable us to envision our bodies and minds in technologically mediated, positivist, transhumanist human evolutionary process.

Transhumanism decontextualizes the human and oversimplifies our relationship with technology, mitigating against cyborgian critiques of the biotechnical subject as framed by normative science practice. Where Hayles worries that transhumanism suggests corporeal limitations are *transcended* by technological augmentation, Thacker claims that technology positions itself to move us *into* the transhuman future. For Hayles, this dangerous claim also offers the possibility for critical questioning of the relations between matter, machine, and manipulation. Brain wave sensors, then, reside in a critical terrain where we can either reify or push back against modular, computational theories of the mind that reduce human reasoning, mood, personality and subjectivity to data without context and in turn represent that data as the right stuff for remaking humans.

Lab to elsewhere: from perception and synthesis to reduction and hacking

Historically, the development of consumer grade EEG monitors sits in an ancillary position to technologies that have moved from the lab to the home and to spaces elsewhere. Photographic technology, for example, moved from lab to home use; the impact of adapting this scientific documentation tool for everyday self-documentation is addressed by many including Roland Barthes, Susan Sontag and others. Scientific devices developed for consumer researchers, however, have distinctively different epistemological and use-value assumptions, and differently impact how consumers learn, and expect to learn, about science. Nineteenth-century photography was widely used as a science tool to document medical “deviants,” but the camera lost some of its science documentation import in becoming a casual tool to ‘kodak’ one’s family history archive. Different are the tools of science that move from lab to institutional and home spaces for the purpose of conducting or learning science. Jonathan Crary (1992) argues the importance of nineteenth-century optical research devices such as the oscilloscope and stereoscope, which moved from labs to public events, positioning the subject, all at once, as spectator/subject/and element in the machine. Play with devices in public forums ushered in an epistemological shift in our popular understandings of perception as something subjective (temporal) and autonomous to the subject, but also largely quantitative—showing a perception as a universal biological process (Crary 1992). Empirical experimentation transformed science observers into participants, using the machine to read the (objective) data and to create “truthful” interpretations of perception. This reified an objectivist understanding of cognitive processes where the user weeded out subjective experience from the (objective) data offered by the machine.

Charles Acland (2007) cites a later twentieth century trend of movement from lab to classroom, employing a psychology testing tool, the Tachistoscope, that measured rapid visual perception by temporarily projecting text on a screen and then removing it. Acland asks about the “cultural logistics” of this transition—the ideas, impulses and metaphors attached to the experience of this device transposed as a tool in the classroom to teach speedy perception to children (363). Where nineteenth-century science devices in public spaces worked to *reduce* our understanding of perception to an objectivist account, the Tachistoscope created new ways to explore the *liminal* zones of consciousness, or perception. As such, the brain “may work to coordinate the incoming information into composite portraits, but the point of access, and hence of quantitative measurement, is the pick up device (e.g. the eye, the ear, the skin, the tongue, the nose)” (Acland 2007, 365). The Tachistoscope *both* fragmented perception data and then synthesized it into

broader knowledges of perception, teaching users this as a new, critical way to deal with body data capture and processing.

This public scientific technology trend—which fragmented the body into data modules—is an essential epistemological precursor to this modular logic era. Differently, however, EEG data is not synthesized in a contextual, complex understanding of cognition. The relocation of EEG machines from science labs to living rooms and hack labs entails the capture of data from body sections, to read, present, and interpret it as reputable data of the whole. As we will show, EEG data is explained as an electromagnetic frequency (EMF) output from the modular brain wave system that is represented as *the* data of cognition. The frequency of the brain wave (alpha, beta, gamma, theta, etc.) is correlated to a particular state of cognition—attentiveness, meditation, concentration, etc. Where the Tachistoscope invited users to do the mental work to link the data to an epistemological outcome, the consumer-grade EEG *obscures* the work of capture, and processing, and prohibits synthesis beyond the narrow brain wave theory of cognition. In addition, packaging literature explaining the EEG devices unproblematically correlates brain waves to cognition, which is presented simply as the *effect* of the brain waves. Any broader understanding of cognition as articulated to a larger system (that might include brain chemicals or hormones or environment) is abstracted from the textual and visual explanations of the data. Differently from the Tachistoscope, adopted from science for *pedagogical* purposes, consumer-grade biometric devices obfuscate the practices by which data is captured, processed, and transformed (albeit, not synthesized) into knowledge. Where the Tachistoscope synthesized data of perception into a theory, biometric monitors *reduce* the idea of cognition to one explainable by data drawn from EEG monitors gauging EMF data alone. Where consumer EEG monitors have different levels of ability to extract comprehensive or reliable EMF data, they all present similar epistemological claims that fetishize the practice of capturing from (but not peering too closely into) the brain: overvaluing the data captured and obliquely offering brain wave theory as an uncontentious way to understand cognitive ability and possibility.

EEGs past to present: consumer grade bachelor machines

EEGs are used by a range of researchers, including in neuroscience and cognitive science, as agile technologies to monitor brain wave frequencies, to better understand cognitive ailments such as seizures, coma, brain death, and delirium, as well as conditions such as sleep disorders. Researchers tend to use them for short periods of 20-40 minutes to monitor electrical activity in the brain; this makes these tools useful to diagnose brain states, but not useful for understanding activity, for example, in quandrants of the brain. Brain wave monitors became available to consumers over ten years ago when consumers were offered the service of “BMM” (brain-mind interfaces) by novel small industries, as a quick route to understanding one’s behavioral responses (such as aggression) or to learn to meditate. Joe Dumit (2003) found that users tried to achieve yogic levels of meditation output from the machines as evidence of self-improvement—that their ‘brain machine’ reflected the BMM machine. The *machine output*, rather than one’s state of mind, became the goal, reflecting a military goal of automation as opposed to a Taylorist industrial sentiment of enhanced efficiency. Consumers, Dumit argues, sought self-improvement via machines, which ‘did it to them’ in an autoerotic, as opposed to interactive, fashion. Over ten years later, the design of these products for broad expert-consumer use demands we examine how marketing situates machine as interactive or ‘doing it to us,’ as theorized through Deleuze and Guattari’s bachelor machine.[7] In the context of understanding how we view the data coming from EEG monitors, we must ask: do today’s EEG bachelor machines produce subjects as ‘residue’ that, like older BMM machines, reunite the fragmented body—

bonding desire to the 'body without organs'—via machine? Is our predominant desire that the machine does it to us, or is there an instruction for doing it to ourselves?

It is important, with consumer EEGs, that though they still 'do it to us,' we as users are, tasked, albeit minimally, with taking part in the data collection activity—we pull off our brain wave data, read the visualized data (as proof of relaxation, focus, mediation, etc.) and sometimes direct the data to effect—moving a game avatar or turning off the TV set. This latter activity—the analysis of the data and the purposing of it to other effect—suggests, we argue, a transhumanist type of participation in improving upon the current use of our brain data for other functions, however novel or unimpressive.

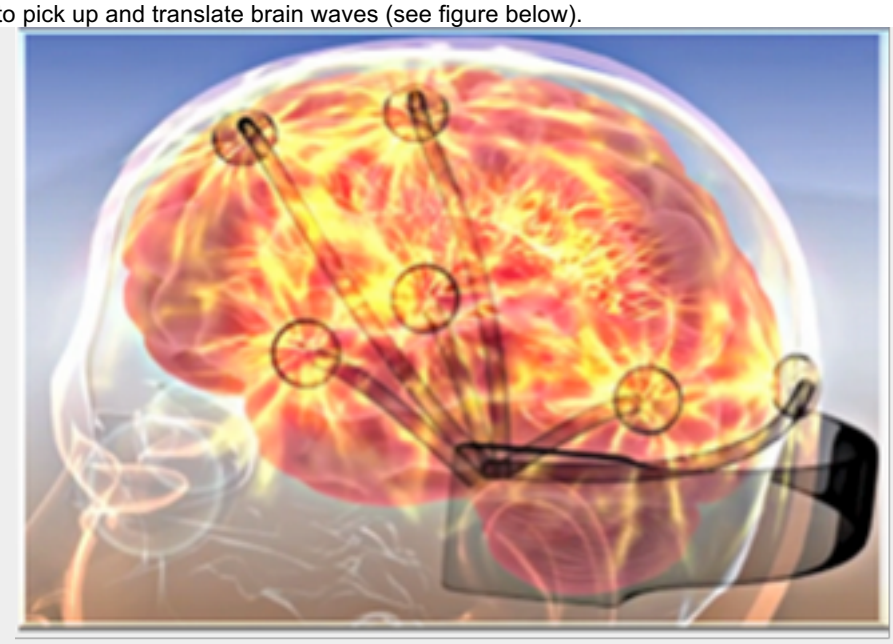
A variety of EEG devices are available on the consumer market, including the Neurosky Mindwave, EPOC Emotiv, and NIA mobile and wearable brainwave sensors. These and the other models range in price from $150-$400.[8] EEG marketing visuals, alone and accompanied by textual stories, strongly lead consumers to interpret brain process reductively.

The textual and visual rhetoric of brain wave sensors relies on but rarely articulates CTM-type reasoning, suggesting that cognitive practices are largely computational. The science on the box simply presents the brain wave system—electromagnetic processes—as able to produce reliable data that can access and visually represent a user's state of cognition, rest, meditation, and so forth.

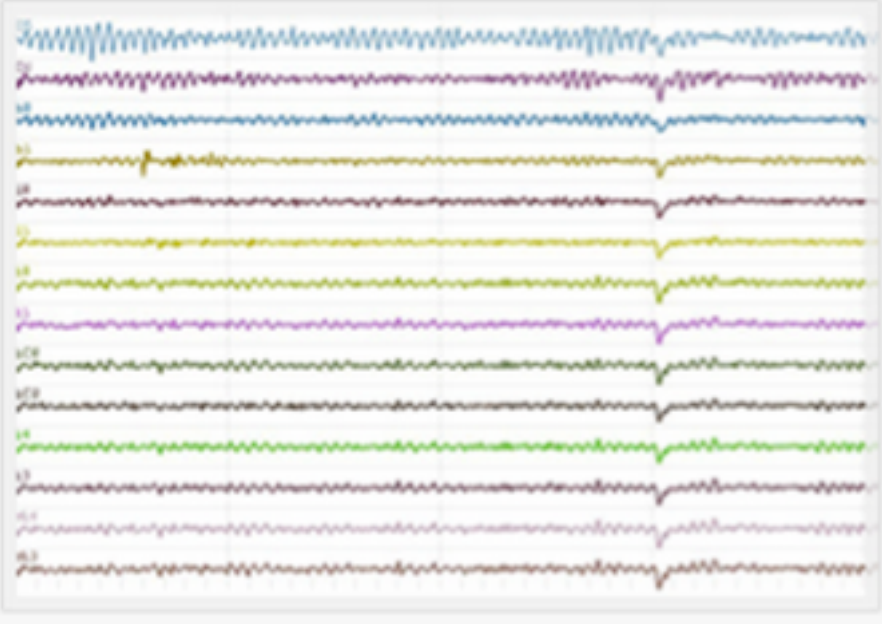
As we have argued, brainwaves are most sensible in a complex system of interconnected neural activity, but EEG monitor descriptions suggest that the waves are coherent pieces of *singular* data. Much critical thinking regarding the nature of cognition is possible if users are presented with basic brainwave theory. Brainwaves work in the following manner, according to standard neuroscience research, as explained to us by Neuroscientist Dr. Sean Montgomery (2010). A brain cell (neuron) receives a signal via a neurotransmitter from a neighboring neuron, and responds by releasing ions into the space on the outside of the cellular membrane. As such it moves from being a negatively to positively charged neuron. The change in charge causes an electrical rush in these ions, exciting them. When sufficiently excited, the neuron sends the signal forward, and spits out a neurotransmitter to a post-synaptic neuron. This action potential of the "excitatory" neuron is demonstrated in its firing. The EEG device, which conducts electric charges, picks up excitatory energy—which is, in effect, the communication *impact* of complex internal interneural processing. The electron activity is measured by the EEG device, which picks up its electric signal on the outside of the skull. Notably, the processing involves *both* excited and unexcited neurons, but the EEG registers only the activity of *excited*neurons. The playground or context of the unexcited electrons offers, says Montgomery, is an interesting unexplored territory that is important to a more complete, deeper understanding of cognition.

The EEG device, then, tracks the frequency or patterns of (excited) neural activity—average peaks, across time, or the relative amplitude of each wave frequency. Relative amplitude, ironically, is defined in cognitive neuroscience as 'convergence': the exciting of a single sensory neuron by incoming impulses from multiple other neurons. This modular way of framing frequency is a highly restrained theory of cognition, situated in a paradigm that seeks *repetition* across only *similar* space distributions of neurons. This 'convergence' ignores the larger and mysterious pattern of activity across nonexcitatory and excitatory neurons. Because excited neurons are trackable (that is, computable data), these patterns of computed frequency, amplitude and phasebecome defined as 'normal' patterns of brain waves. This critical reading of brain wave theory is instructive, because it demonstrates that theoretical factness is often constructed out of data collection situations that make do and that science models and tools (especially those measuring cognition) are optimally read by what they are *unable* to track.

In short, this framing of brain activity demonstrates a modular and computational way of approaching the complexity of neural processing. The (collectable) data are deemed meaningful as stand alone data. Crucially, their authenticity is reified by the visualization of the data, transforming it into information (of cognitive state), suggesting it is a scientifically validated illustration of cognitive process. The absent data and that absent story—the activity of (all) neural activity across synapses—are not made visible. Instead, the visuals on the websites largely demonstrate the design of the EEG, rather than how it functions technically to pick up and translate brain waves (see figure below).



Images from online advertising for the Emotiv's Epoch EEG device, to represent how brain waves work.



Images from online advertising for the Emotiv's Epoch EEG device, to represent how brain waves work.

The marketing text and visuals roundly fail to provide information regarding how EEG data is transformed into information via brain wave theory. It simply presents EEG data as evidence of cognitive state. The EEG

devices offer applications that demonstrate your mind state, and games and applications that issue effects in response to a particular brainwave frequency. Alpha waves, said to reflect states of relaxation, calm, and meditation, register in at 9-14 Hz; Theta waves, registering 4-8 Hz, are said to reflect states of *deep* meditation or problem solving; and finally Beta waves, reflecting alertness and consciousness, register at 15-20 Hz. Yogis have been shown to have highly developed Theta; meditation is said to be a mix of Alpha and Theta. EEG devices invite us to trigger any of these waves to produce a desired effect. Aside from the absence of brain wave information, the devices, because they have few pick up leads, often fail to collect reliable EMF ("activator data"), and fail to correlate frequency consistently to the same cognitive state.

As well, using the EEG to activate particular brain states is difficult. Games, for example, call upon users to trigger a certain brain state in order to move a ball over a goal line or to keep a yogi suspended in meditation. Commonly, gamers achieve the desired game effect by hacking the machine—either deep breathing or repeating a mantra to produce an Alpha frequency and counting backwards to alert the Beta frequency. In so doing, users can be seen as hacking their bodies to produce symptoms or feedback (e.g. Alpha frequency). They are not generating relaxation by relaxing or thought by thinking, but engaging in practices that produce the desired effect. Counting backwards to obtain Theta frequency is like slapping one's face to obtain a positive galvanic skin response on a lie detector. The point is that one is not learning to manage one's cognitive process (learning to think hard, to lie or to hide one's lying), but, rather, one is affecting the brain to generate the desired EMF frequency. Hacking one's brain process is a way to hack the device; in both cases, users are trying to produce the desired data, not to understand cognition with complexity.

Because we get visualized output and effects from brain wave monitors, they provide the allure of peering inside the ever-elusive mind, suggesting, despite our hacking, the possibility to see one's self *controlling* one's mind. The founder of Emotive, maker of the Epoch headset, Tan Lee, whose public talks are widely available online, sees the EEG device as sharing key internet ideals of openness, connectivity and democratization. She discusses neural processing in complex ways—consisting of "100 billion nerve cells and many more support cells" (Lee 2013). Nonetheless, Lee routinely references our common cultural fascination with the mysterious brain and the "magic" of peering in with the EEG, participating in our cultural EEG story that dances from extremes of mindless fantasy to mindful complexity. Entreaties to take part in the magic of (seeming to) peer into our brains, constrained science visualizations, and the fact that EEG data output (cognitive state visuals, playing a simple game, turning off the light) is rarely fantastic, complete EEG marketing campaigns that rely heavily on our cultural collective science fictions. The campaigns lazily use logical glossings to suggest that the machines possess novel and extreme abilities to capture and transform potent brain data into powerful results. Marketing pulls on our desires—to believe the science, to peer into and harness our own brains, to engage in expert-like data collection, to submit to the thing doing it to us. Together, these enticements pull us into a desire to allow the device to use us.

Reifying modular logic, capturing mundane data

Brain wave monitors often collect inexact or faulty data. As we have argued, the visualization of brain waves in games and other exercises with the EEG ask users to simply accept the data, rather than address it critically as an element in cognitive process. EEG games and biofeedback exercises (that teach relaxation for health benefits) often ask users to trigger Alpha waves, desirable because they signify calm. Yet Alpha waves, Dr. Sean Montgomery advises, reside more deeply in the back bottom of the skull, while many

consumer grade monitors use leads that attach to the forehead. The EEG “leads” (or data collection points) problematically detect brow furrows, sneezes, and other activities that record as brain waves, muddying the data. As such, the data coming from these monitors is often unreliable. As well, the monitors output the data in standard linear representations of frequency highs and lows across time, entreating users to understand the data only within the paradigm of the brain wave story of cognition. Altogether, the marketing story for brain wave monitors constrains consumers from “synthesizing” data—as Acland finds possible via the Tachistoscope. Instead, the monitor packing information and advertising presses the reductionist framing of waves as cognition at every stage: graphic and textual explanation, visual description, and even at the level of use, where users have to hack to succeed quickly in game play..

Beyond the bar graphs that represent the data coming off these devices, the marketing employs textual and visual discourses in the pretense of scientific accuracy—to scientize the brain wave data as useful to consumers. Where the “NIA” (Neural Impulse Actuator) device distinctly presents itself as a science tool, the Neurosky and EPOC Emotiv devices exploit the authority of scientists using their tools for research and shroud the tools in CTM theory, to suggest that modular data is appropriate for predicting cognitive states. These assumptions are found in suggestions that the EEGs are useful for an astounding range of everyday tasks—cognitive assessment, cognitive play, gaming, hacking, and utilitarian home tasks. The enormous ontological leap from EEG capture for scientific inquiry to gaming or home entertainment use relies on collective fictions that this “science” data is useful, reliable, and re-computable. The marketing obscures rather than relays this process; we come to know our cognitive state (attention, meditation), and view our brains, newly, as effect generators, promising greater future results.

The NIA (Neural Impulse Actuator) by OCZ Technology.

The most effective brain wave monitors have more electromagnetic sensors or “leads” that are able to pick up more brain wave signals from diverse areas of the skull. Such devices make better contact with the skull, are user friendly, and don’t require gels to be applied to heads to activate sensors. Referred to as “space age technology,” the NIA device used a host of muscle, skin and nerve data to track “biopotentials” rather than neural signals alone. While this might seem a more comprehensive technique for assuaging cognitive process, the NIA’s (carbon nanofibre) sensors, worn in a band across the forehead, produced poor data, and it was removed from market in 2011. The NIA marketing literature presented the device as a “computer controllable” gaming tool—a futurist way to use biopotential data from facial expressions, eye movements, and concentrated brainwave activity. Unique among its competitors, the NIA admits that its data is muddied

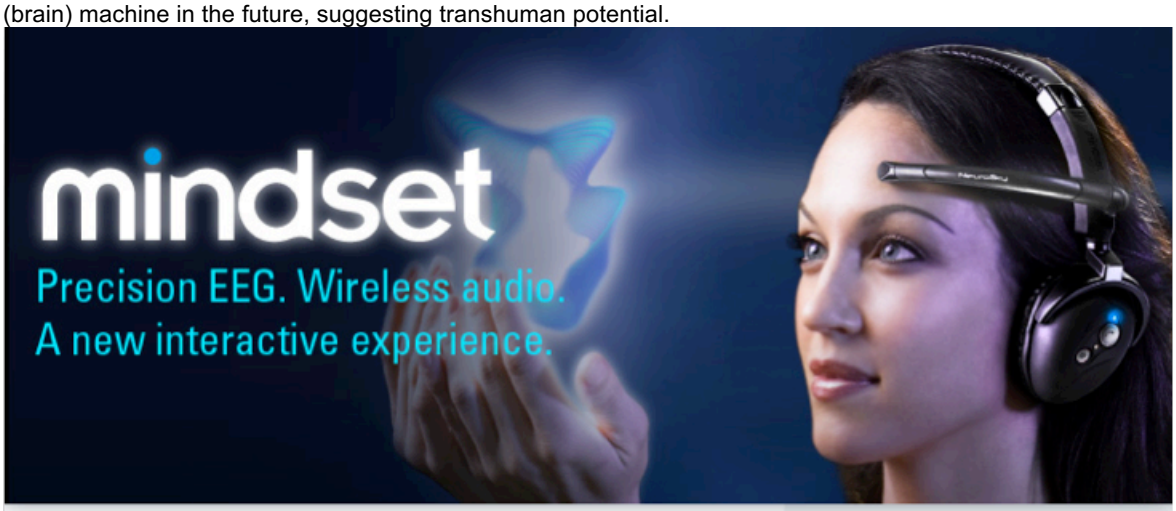
by forehead response. With its simple online marketing strategy, the NIA device presents itself as a research tool, presumably banking on creating a community loyal to a tool that merely serves as a cheap gaming input. This modest approach and its weak data pick-up design strongly contrasts this tool to the Neurosky and EPOC Emotive brainwave monitors, which reach for bigger market segments and thus work on more potent imaginaries.

The Neurosky Mindwave and new (wireless) Mindwave Mobile have only one single sensor lead, which sits on the forehead—not an ideal site to capture desirable relaxation-signifying Alpha waves. The marketing consistently references the brainwave's role in future cognitive enhancement and transhumanist advancement.

With its single lead, the Neurosky is not the favoured device among research scientists. They tend to use the EPOC Emotiv device, which contains 14 sensor leads that more accurately pick up EMF. To compensate for its weak data production, Neurosky's marketing plan presents the devices as accessible, familiar, and friendly to the open source community. It seeks to naturalise the device with visual references to common cultural activities—kids using the Neurosky to game and users gazing at screens to operate home entertainment devices. This marketing strategy references, as explained, a reductionist and under-argued suggestion that potent data in our brains can be accessed by these 'good enough' devices, to help kids to improve their brains (Dumit 2000). The text provides a weak link between monitoring students'

attention levels (via the devices) and their improved thinking and achievement. Instead, these tasks and outcomes are persuasively linked by extra-discursive discourses—vague transhumanist texts from industry, science, and media, and potent North American educational policy directives linking assessment to improvement, and labeling inattention as a mental disorder (ADHD) in need of technological mediation. Deeply resonant in many EEG marketing images are mainstream science fiction media (film and TV particularly) that inform our popular imagination, creating formative cultural myths regarding the crucial role of technology in human progress. While space prohibits a full analysis of science fiction narratives resonant in EEG marketing, the strongly stereotypically feminized images employed in ads are key to understanding the monitors as representations of techno-power: a dual sexualized fantasy of sublimating self to both technophilic desire and to technology itself, as has been explained by a range of feminist scholars (Balsamo, 1996; Kember 2003). Femininity in these ads is not offered exactly as a thing controllable by technology, but instead as a set of fetishized exchanges of power-data referencing femininity as potent, desirable, and available—a willing and interested site. Biotechnical marketing works successfully when it glosses illogical suggestions and makes invisible the complex context of a problem, replacing it with potent, culturally resonant discourses, including visuals (Gardner 2006). In Foucauldian terms, this is a discursive rupture—the subtle insertion of a new logic into an old, accepted logic. It works to successfully withhold "the rich uncertainty of disorder" that lies behind the "visible facade of the system" (Foucault 1969, 76).

Like the history of marketing pharmaceutical drugs to consumers, attractive female subjects are deployed as the first line of entry, offered up as a welcoming entry to the curious device. Below, a beautiful woman conjures a holographic image, beholding it with serene composure, linking a presently unachievable dream—future progress—with technology, via sexual allure. Reflecting a new kind of binding of the gendered body to social body imaginaries (Balsamo 1996), this body (or face) is represented as a subject (as opposed to the more traditional female silhouette or body fragment), transgressing the habits of marketing via female bodies. She is a subject whose mind conjures magic in and through the brain wave monitor; she is not exactly *constrained,*but rather, she is enjoined in the rapture of technopromise. And yet, this is not a subject in a comprehensible story—she is a subject only as an interface with the EEG device. Her (disembodied) mind alone is the thing mediating the viewers' relationship to the odd device. In this loose story of technofascination, the mind/female might enable (but not exactly create) magical output via the EEG (brain) machine in the future, suggesting transhuman potential.



The female is not mere body, but mere brain. In that sense, she still serves the social body—as medium for transhumanist fantasies. The image can be seen as conjuring up dominant images of femininity we have

learned collectively from the long-running TV and film narratives of *Star Trek,* often (though not always) representing the female via essentialist characteristics, and alien female leaders as failed versions of the feminine (Roberts 1999).[9] This marketing reflects cultural expectations cultivated by common representational practices that bind technology with femininity "played out through cooperation and an undifferentiated self" (Roberts 1999, 65). In other TV dramas, such as *CSI* and spin off crime dramas, which are popular across youth and adult age groups, femininity is linked to science work (albeit crime scene investigation), via tropes of beauty, geeky music scores and explicit heterosexual content, that fall well within normative framings of femininity.[10] Normative femininity is a knee-jerk semiotic device here, suggesting this strange new EEG machine as potent, desirable, accessible, alluring—an inviting technological innovation that keeps intact other knowledges (e.g. gender, science fictions) that we can rely on in uncertain times and with uncertain devices.The device does not promise to open up new opportunities for knowing, but rather for obtaining brain data, with perhaps little understanding. It does not in that sense challenge reductive science narratives, gendered technology paradigms, or gender's place in normative social structures. This female subject obtains no new power, but rather harkens to the power of femininity as conduit. She seduces us to desire this new technology, while embracing paradigmatic sameness; in using the EEG we are asked to attribute the power of even poor science practice to progress, and to follow this obfuscated technology to its (seemingly preordained) logical conclusions.

Brainwave sensors for every body

Neurosky advertising suggests that the device can accurately measure mental states (such as meditation and attention), which it concedes are different than actual thoughts, but can be framed as conscious and unconscious states. It suggests that users can pull off data to demonstrate thinking or feeling, overdetermining its ability to detect cognition. The Neurosky capitulates: "Seeing that a user is in a state of calm is different from sensing that the user likes the color blue. " Nevertheless, the marketing blurs the ability of the device to "detect" either state, focusing instead on output: "these mental states have powerful capabilities when integrated into video games, education, sports coaching, meditation, etc." (Neurosky 2013). After all, its marketing slogan is "Brain Wave Sensors for Every Body." This discursive framing asks consumers to accept that the machine can detect EMF data to interpret conscious and/or unconscious state, in order to engage in this fantasy—the transformation of brain signals to new information, and the promise of expanded consciousness or cognitive abilities. Users are asked to ignore the process of data collection and to be impressed by the graphic output from the monitors. In fact, subjective experience can equally work to interpret this brain activity (thinking hard, meditating), that is, the monitors' output tells us little more than our experience already tells us. The visuals, and the referenced cultural contexts, seek to supplement our mere subjective knowledge with the knowledge provided by machine-produced "data." EEG monitors dress brainwave data as science in action, valorizing the factness of data, reducing our mind practices to data, and focusing us on other, more interesting stories, and hopes—repurposing our personal data in novel ways. The enormous glossing made here concerns how measured levels of mental states, like meditation or attention, prove instrumental in discourses of use—how to become a better gamer, learner, teacher, or athlete. In this case, the device safely assumes that cultural training around quick fixes and easy hacks, and the allure of personal data will create a market of complacent consumers who don't care to know how devices capture, process or output brain waves. The presentation of the Neurosky as a "mind reading" device takes a giant step toward locating us as computationally and data-duped consumers, who have consumed in its entirety reductionist research regarding "the Brain" and "the Mind" celebrated across North America and Europe over the past two decades. The Neurosky is smugly certain we will buy its story—that

any data, particularly brain data, is good and useful, and can be employed to manipulate consumers via highly overdetermined neoliberal, transhumanist discourses.

In this marketing discourse, the realm of neuroscience is both mystified and presented as a coherent field of inquiry producing incontrovertible views of conscious and unconscious processing. By referencing research affiliations with major institutions like Stanford, MIT, Carnegie Mellon, and Trinity College, and showing visuals of workers dressed in medical uniforms, readers are asked to trust that the brain wave science is advanced, that the brain's modules (e.g. electromagnetic frequency emanating from brain wave activity) can be reasonably studied in isolation, and that the effect—small or enormous effects— moving gaming avatars, turning on the TV, or driving cars—reflects the integrity and power of the data.

The Neurosky marketing pulls directly on transhumanist claims to justify it as a healthcare device. Starting from a rhetoric of responsibility, its website claims: "It is our duty to preserve brainwaves so that we may continue to thrive as humans." With the positivist linkage of human evolution to technology, the Neurosky frames itself as a home tool for self-improvement. In line with neoliberal, transhumanist discourses binding individual responsibility for self-improvement, consumers are encouraged to dutifully step up to the plate, taking on strange new data capture technologies to supplement docile brains—brains that are by definition imperfect and in need of improvement. The EEG offers us an individualistic technology for powerful self-enhancement, to administer upon our imperfect brains. The online consumer audience is told:

Technologies from Neurosky will be instrumental in the effort to harness, maintain and heal this most vital of human organs ... healthy brains are vital to our family, our patients, our students, our planet and ourselves. Early detection. Frequent exercise. Periodic relaxation. Indulgent entertainment. Swift healing ... That's why at Neurosky, we make Brainwave Sensors for Every Body.

This inclusive marketing approach, threaded with the promise of health care, impossibly presents this awkward brain wave capture device as a tool for *every body*, via a familiar health discourse of "responsibilisation" (Rose 2006)—that consumers should pre-detect risk, find early solutions, to enhance their productivity. With this chameleonesque tool, Neurosky taps into markets ranging from gamers to yogis to hypochondriacs, gliding over the glossed rationales of its messy data, suggesting overdetermined data impact, with the overarching clause that brains matter and should be technologically embraced and modified, if not precisely understood.

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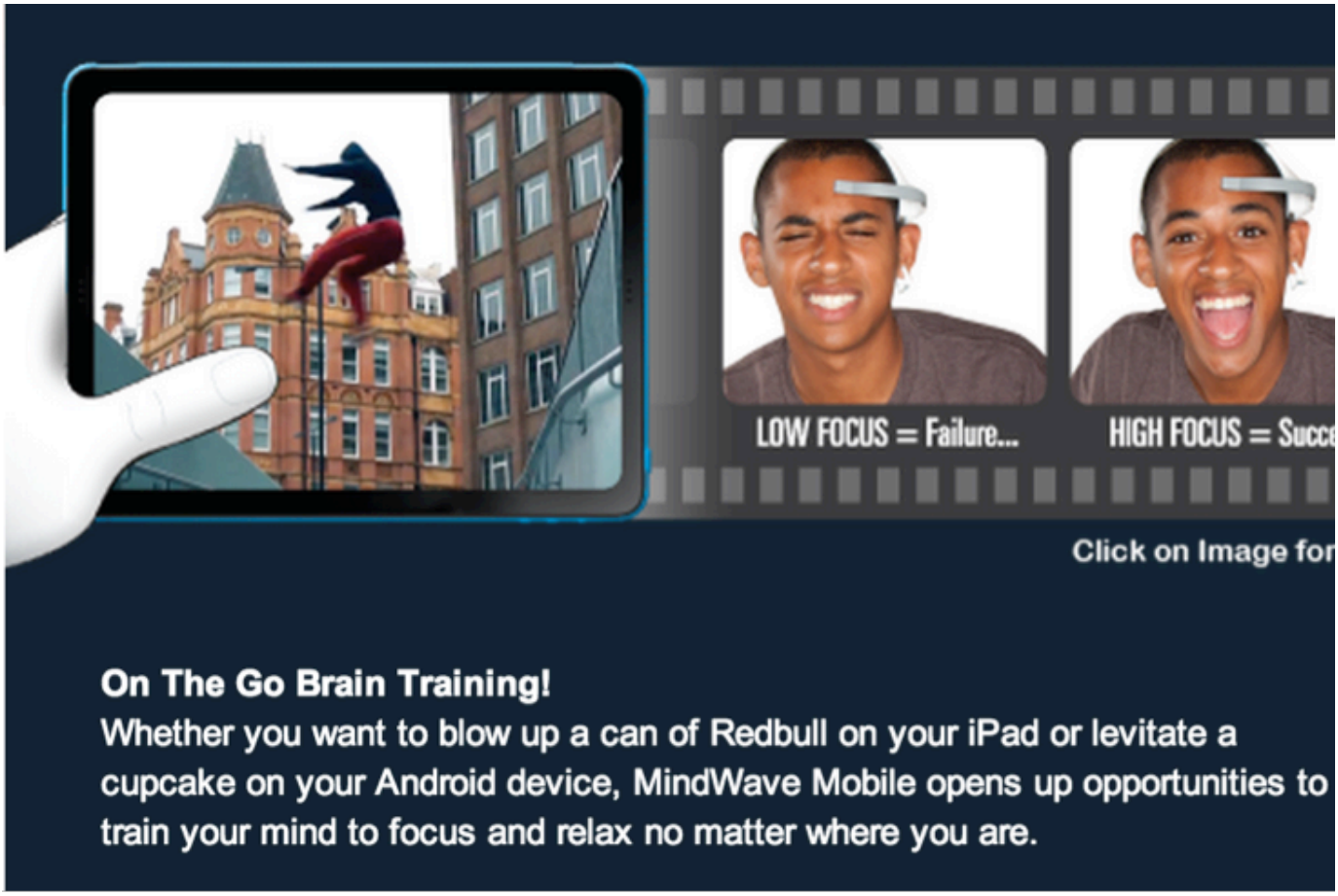
This Neurosky project combines the Neurosky brain wave sensor and Think Gear chip with the Haier Cloud Smart TV, allowing users to interact with their smart TV using their brain waves. In this image, the human brain and machine are suggested to fit together like a hand in a glove.

The relationship between the brain and technology as belonging to one another gets further reified in how the Neurosky sells itself as a television controller. In the image above, we see that the brain inside the human head is dualistically separated from the technology intended to hold it. Their enframing within the television set, side by side, signifies that they belong together, fitting neatly like pieces of a virtual life puzzle. Playing on the idea that technological augmentation generates human evolution, the image suggests that something is lacking when pieces don’t fit together—something is lost if the dialogic opposite is not present––the brain needs a tool.

These visual references allow this new, radical suggestion —that brain waves themselves can be effective domestic devices—to become a new discursive truth. As a rupture of discourse, seeming to fit the usual logic of personal data capture, the brainwave effect story slips into our ways of framing everyday behaviors (like watching television or monitoring our daily run), inserting playful, fictionally familiar tools. Brainwave monitors thus enter our imaginaries and our living rooms as new gaming devices, fitting neatly alongside the Wii wand, Kinect sensor, and Nike sensor. In this quiet discursive slip, which looks merely like an innocent and perhaps predictable addition to our data collection tools, the EEG uses mythologies to load consumers with stories that gloss its weak data collection and overestimate its ability to know cognition. As such, EEG monitors are successfully transformed for purposes of play, home use, and research as mind improvement and even ‘preservation’ tools. EEG monitors, like other biotechnical tools, reinforce the peculiar character of advanced liberal democracies: “a complex of marketization, autonomization and responsibilization” (Rose 2006, 4). We are hailed by extracultural discourses to purchase this commodity to manage uncertainty by laboring to improve our futures at the site of the brain.

New geek markets, new applications

New Neurosky applications such as the Visualizer allow users to listen to music through their device and watch on-screen melodies that apparently affect one's mood and thoughts. Other games promise dramatic video effects or even brain training to users conducting in fact little work on our brains. Notably, many of these games are produced by third parties, evidencing the new flow of productivity made possible by open sourced products that articulate to (biocomputational) cultural trends.



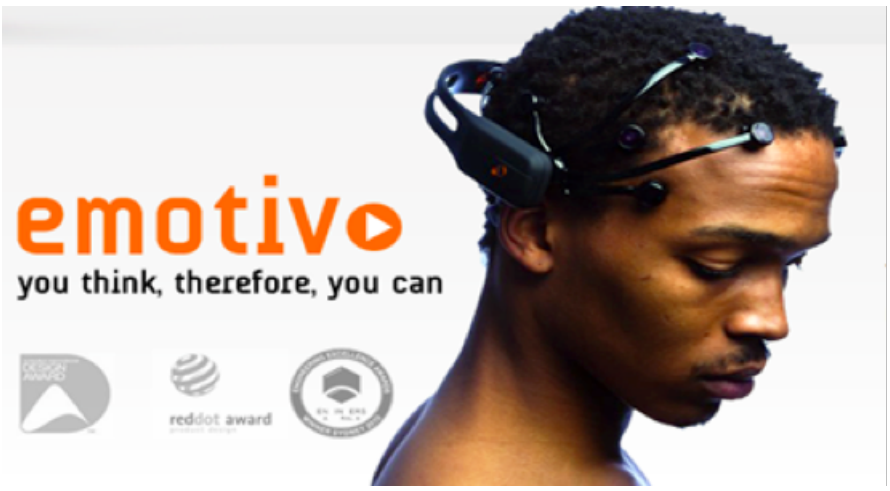
On The Go Brain Training!

Whether you want to blow up a can of Redbull on your iPad or levitate a cupcake on your Android device, MindWave Mobile opens up opportunities to train your mind to focus and relax no matter where you are.

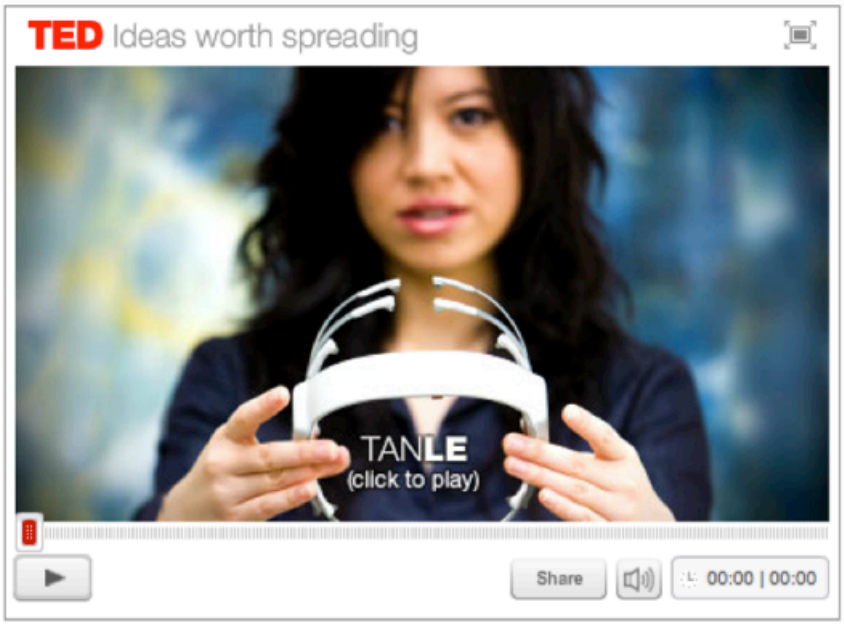
Among available games, the NeuroBoy application tells young gamers it will grant them the feeling of having super-powers as it allows them to “push” and “burn” virtual objects with their interpreted mental states. Mindwave apps reduce mind to body, enticing prospective buyers to use the devices to exercise our minds like “other body elements”. The video game application (above) suggests great impact (controlling an action figure in a video game) via “focus;” users can trigger this brain wave effect, easily, as we have argued, by counting backwards. Finally, the Neocomimi is the Neurosky’s new aesthetic accompaniment: it interprets sensed brain waves as moods and expresses them using cat ears for a public display of what’s on users’ minds. The ears relax when highly relaxed, move vertical when focused, extend extremely vertically and close together in quick succession when intensely focusing on something, and wiggle back and forth when the wearer finds something interesting.

The marketing video for the Neocomimi features a woman wearing the ears who gets intrigued by a male passerby. We watch her ears go from relaxed to focused, highly focused, and highly interested as the man strolls past; flirting is no longer a subtle affair. Clearly seeking to appeal to youth gamers, kids, and subcultures such as cosplayer (costume play) communities, the transhumanist marketing strategies are transposed onto these dress up monitors in playful, recognizable, and normative gender play scenarios presented by the visuals. Neurosky articulates a familiar gender/technology nexus, promising to constrain technology to the desires of the social body. The bunny ear figure maintains this reductionist role of the body, infusing it with childish (culturally recognizable) play where technology is promoted for non-productive play among certain subjects—namely the girls wearing the bunny ears.

Finally, the Neurosky embraces an open-source ethos of sharing in giving away developer tools free of charge and sell chipsets in volumes as low as ten. Their website states that "[t]hough EEG has been around for over 100 years, we are still in the nascent phase of the movement. Do-it-yourselfers have shown tremendous creativity with NeuroSky technology. Our open philosophy embraces community, hacking, and sharing." Not only is the device marketed to *every body* across a variety of different social categories and professional pursuits, it is marketed specifically to a burgeoning community of DIY creatives who provide free marketing and new applications that can in turn be sold by Neurosky. By encouraging the DIY movement to use and extend the applications offered by its technology, the developers benefit from the creative projects of outsiders that add value to their technology, for the low price of access. As Terranova (2003) tells us, this decentralization discourse from EEG producers disingenuously heralds information sharing, while taking full advantage of the generosity (and neoliberalist) inclinations of DIY workers. As critical scholars, we are aware that while one cultural product from this flow is the exploitation of inexpensive labor, other critical production is possible here. Research creation in our lab, for example, has spirited this critique of EEG monitors, and much productive work is possible across DIY communities, which can, for example, employ the devices as critical art projects, reflecting on reductive science and data valorization, as well as biofeedback tools to teach mindfulness practice.[11]



EPOC's Emotiv device is used routinely by universities and research centres and its data withstands the peer-review process of some science journals. Yet, all the same, the device uses discourse purporting that it is a revolutionary, personal Human Computer Interaction device that one in fact *needs*. The website poorly links brain wave science, largely unexplained, with this still consumer grade HCI technology. As such, it provides a sell different from that of the Neurosky—suggesting that cutting edge and diverse individuals on the forefront of knowledge, who recognize the words of René Descartes when they see them, can use, and may *need*, a personal interface with their brain.While the Neurosky's marketing literature explains that it can read mental states, such as relaxation and meditation, but not *thoughts*, the EPOC Emotiv website claims it "uses a set of sensors to tune into electric signals produced by the brain to detect player thoughts, feelings and expressions" (EPOC 2013). Using technology very similar to the Neurosky, which reads the faint electrical potentials generated by neurons placed near the device nodes on the scalp's surface, the Emotiv also suggests that it is able to achieve extreme information (even feelings) from our brain data. The sexually provocative photographs of EPOC models, matched with its romantic claims, presumably constitute a marketing gamble: that a consumer's desire for this gendered, technological imaginary will overshadow the slippery logic suggesting that the device can read feelings. Like the Neurosky, the gendered half-naked body (in this case, a black man) is articulated to familiar western of science experiments, where historically marginal subjects become the first to submit to the promises of science fictions, and perhaps, titillatingly, offering greater insights into subject's desires for empowerment.Like the Neurosky, the EPOC Emotiv draws upon recognizable technology like apps to demonstrate its role as a tool for everyday use. Promising early users exclusive access to the Emotiv App Store and its "one-of-a-kind neurotechnology platform," customers are invited to use their apps for artistic and creative expression where they can employ their "thoughts, feeling, and emotion to dynamically create color, music, and art" (EPOC 2013). Their marketing literature promises life-changing applications for disabled patients, such as controlling an electric wheelchair with one's thoughts. It suggests that the device can link to PC games, enabling the fantasy of controlling one's favourite game with the mind. Lastly, it capitalizes on applications for market research and advertising, suggesting that the Emotiv will deliver true insight about how people respond to and feel about products presented to them. The gaps between the needs of disabled populations, innovative gaming culture, and market foresighting are vast, while scientific explanations of the Emotiv's functioning are completely absent. Again, these marketing stories deliver transhumanist discourse that lauds technogenesis and brings the subject ever closer to technological emancipation from human limitations.



This closeness closes in on the home, indeed, the living room—suggesting the brain monitor as intervening tool for daily use, in the casual self-monitoring and self-surveilling of discrete biometric data. The device implies that we are less evolved without the knowledge and freedom gained through such devices, and that casual living room surveillance of brain data is both everyday and has enormous effects and potentials.

Conclusion

This paper makes the case that consumer discourse associated with brain wave monitors glosses brain wave science in a manner not entirely different from the ways in which CTM makes glossed assumptions about how we can know the brain. The marketing raises important questions, but provides consumers no information by which they can answer them. Is cognitive process or perhaps reason something we can know from computing brain data such as waves and electromagnetic frequency or energy? Can one demonstrate intention by cognitively "pushing" or "relaxing" their "mind"? If one can push or hack the device, does this show a decision-making ability reducible to synaptic electric activity—is the subject the sum total of modular, collected, computed, and mapped data? In the science fiction of brain wave monitors, is "intentional" pushing or relaxing sufficient to suggest we are controlling our "brain" activity?

The poor data, collected and transformed into overdetermined effect, suggests that cheap devices, reductionist science, and minimal effort can have enormous, transformative, even transhumanist results for everyday consumers and expert researchers alike. Across the marketing discourses, the social body politic is mapped to the gendered body, thus linking sexual power dynamics to the promised power housed in our ever mysterious and seductive brains. The marketing logic captures the neoliberalist ease of computational theories that bind simple reductionist theories of bodies or minds to productive ends—notably, suggesting neoliberalist ethics, seeking simple solutions for brain data capture, for repair or improvement. As such, the consumer subject needs only buy the device and accept some apps to acquire the quick and easy result. Happily and magically, the science brain wave fiction is easily realized—hacking the device to get effect is fair play, and the results that seem science fictionally enticing are also familiar, constrained—flashy but nontransgressive by gender, social and consumer science norms. The absence of complex scientific discourse or reasoning, replaced by familiar gendered technoscience narratives and data infatuation, makes the entire consumption process user friendly.

This fiction, or rather sales scenario, is an apt metaphor, we'd suggest, for the consumerization of neuroscience information, and of CTM theories. They gloss over contentions among cognition philosophers and brain researchers in a similar manner. In the absence of a coherent narrative about how the mind creates thoughts, each of us scientists, science reporters, media makers and product advertisers, and consumers—is forced to embrace some other kind of logic to promote or embrace the brain wave monitor. This normally means linking the device to some other kind of authority or some level of cultural practice that seems recognizable, fits a recognizable flow—like gaming, or narrativized science research, or cosplay, or monitoring your kids—while creating new highly productive and diverse flows or outputs.

We've begun to outline a method here, linking critical approaches to technoscience and human computer interaction, with an analysis of the epistemological and cultural practice trajectories that bind biotechnical and neuroscience studies with biotechnical device (specifically EEG) marketing and consumption. In this paper, we have applied our critical biotechnical computational lens to the work of marketing EEG devices. From this work, we begin to respond to Hayles' plea that we track how transhumanism embeds its ideas in "deep, rich, and challenging contextualizations that re-introduce the complexities it strips away… in these encounters, transhumanism serves as the catalyst—or better, the irritant—that stimulates a more considered and responsible view of the future than it itself can generate" (2011, 217). In future work, we will explicate more fully this methodological approach and its value toward manifesting broader new media studies, desired by Kember and Zylinska, that target technologies and cultural practices to understand more deeply how we mediate and how consumers use these devices.

Optimistically, we find a rich terrain of controversial and contradictory claims that gloss the value of modular brain waves and make it tenable to launch our critique of EEG devices and, in time, a range of other reductionist technologies—both discourses and devices. We take seriously Thacker's concerns (2003) that the reduction of humans to data is made possible by "the equivalency, the back-and-forth mobility, the accountability, and the generativity of code in relation to the body," thereby regulating the bio-logic of the biomolecular body (13). Ongoing cultural and media analysis, bonded to STS approaches, is crucial to exposing the ongoing lauding and normativisation of biologic. With Terranova (2003), we find that the stakes are high; she sees new cultural flows, articulated in such products as consumer biotechnologies, as a "flattening out of social, cultural, and political connections" resulting in "the loss of transcendence, of external principles which organize the social world from the outside…a loss of strategies for dealing with power" (p 27). Terranova insists that it doesn't necessarily have to end in nihilism, but rather, we must engage in what Levy termed collective intelligence –the "mutual recognition and enrichment of individuals rather than the cult of fetishized or hypostatized communities" (14).

As practicing artists ourselves, we are currently exploiting these glossed, reduced, overdetermined, and contradictory claims through our own aesthetic engagements. Gardner's research creation projects invite to query and challenge reductionist, computational claims of biometric devices, via aesthetic interpretations of biodata (Biomapping project) and movement interventions with biofeedback (Body Editing) both referenced at mobilelab.ca. Wray is re-imagining tactical practices of crafting biotechnical stories of genomes, through material participatory practices and through audio critique. Much resistive brain monitor art practice is afoot internationally, challenging reductionist and transhumanist imaginaries attached to the devices. [12]

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