Interactivity, Wearability, and the Rhetoric of Proposed Brain-Machine Interfaces

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On July 20, 2009, the *New York Times* ran an article by Richard MacManus headlined, "The Wearable Internet Will Blow Mobile Phones Away." For a moment, the headline conjures the comical idea of each of us wearing the entire contents of the internet: *Let me put on the Internet today and go out for a walk.* While people are already constantly connected with wireless devices—texting, tweeting, using GPS—the idea of *wearing the Internet* suggests a different sort of ambient interactivity. Taken to an extreme, it implies that, by wearing the Internet, we *become* the Internet. Pessimistically, however, it also suggests that the Internet is wearing *us*. We become tracked, traceable, presupposed entities not only whenever we access the Internet but all of the time; because, presumably, we will wear it *all of the time*. Moreover, this particular headline makes a boastful prediction, namely, that one medium will render another obsolete: mobile phones are on their way out; they're dead in the water. What is certain, however, is that this headline reveals a compelling new media transformation toward *wearability* (i.e., *Why hold a device if you can wear it?*) coupled with a self-satisfied tone of goading *imminence* (i.e., it *will* happen, *most certainly*)—two concepts that seem to be driving the discourse concerning interactivity.

Indeed, new technological advancements drive toward a future that will augment human-computer interactivity with spontaneous feedback. According to inventor Alex Pentland, ID badges equipped with a "sociometer" will enable one to read whether another person is being honest or not in a social situation by sensing subtle body language. A sociometer implies augmented social interaction, but it also seems like a personal surveillance device that enables wearers to police friends

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and relatives. Cocktail party banter will never be the same (e.g., *Did he really run a marathon yesterday after having that root canal?*). Generally, this kind of interactivity is achieved with sensors, which "have the ability to collect information that is, implicitly or explicitly, produced by humans" with the goal of pairing it with "human actions, states, intentions, and, eventually, needs" (Grammenos 46). Another example of augmented interactivity is the "Skinput" interface, which resembles a tattoo and turns the body into a touch-screen device. Researchers of Skinput at Microsoft and Carnegie Mellon University claim that tapping on a visual, virtual keyboard on skin flesh is possible (Kelly) (see Figure 7). Ironically, our flesh and bones will act as conduits for our virtual interactions.

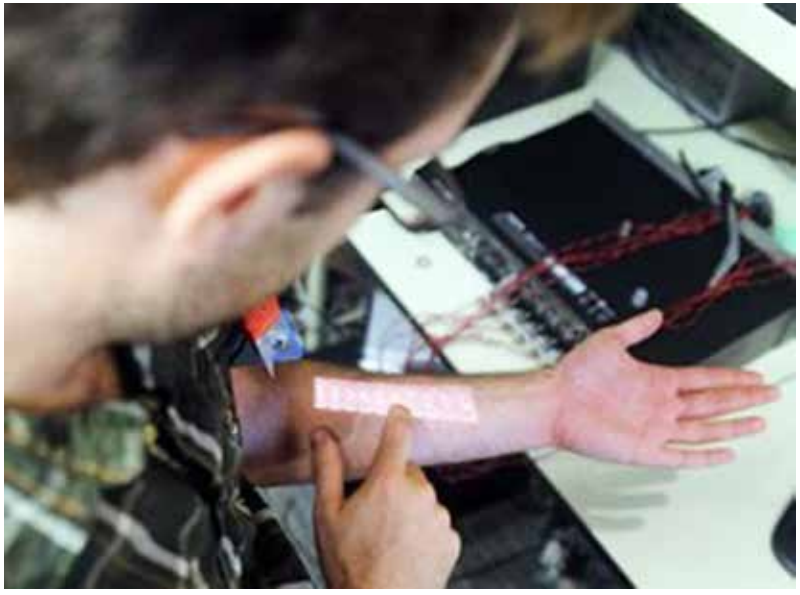

Figure 7. Skinput interface. Chris Harrison, Microsoft Research and Carnegie Mellon Photo Credit: Chris Harrison.

Computer interactivity is a slippery, polysemous concept, which can point to meaningful exchanges between computer devices, people using computer devices, an individual and a device, or many others things. They all imply liaisons. To liaise is to intercede, mediate, negotiate, manipulate, or meet to fulfill a functional goal, or form what might be a transient social exchange. In *How Images Think*, when writing of interactivity, Ron Burnett notes, "humans and their technologies

have become not only interdependent, but also profoundly interwoven" (168). In this chapter, I examine rationalizations for new styles of interactivity that involve wearable technology and reality-shifting media. My discussion concentrates on how inventions, justified by journalists and inventors, act rhetorically upon the public before they emerge, and how we then use language to enact self-goading tactics upon ourselves to fulfill the expectations that we created. The momentum builds toward an investigation of the language used to herald new brain-related technologies that promise a future of spontaneous interactivity with the material world. I argue that neurorhetoric manipulates the emergence of certain technologies by embedding them within dehumanizing claims that can potentially become subsumed into the latter practices they will fulfill. As a counterpoint, in the latter half of the chapter, I look at the notion of spontaneous interactivity by focusing on tactical artists that use pain to interrogate social practices and ideology through their (painful) wearable pieces.

SixthSense

News about inventions not only travels fast, it constantly drives news. The article that follows the *New York Times* headline "The Wearable Internet Will Blow Mobile Phones Away" describes "SixthSense" technology, which was introduced to the public through a popular TED talk. So, as far as the public is concerned, SixthSense is a research idea, a media product, that can only be consumed through these news outlets. The article recounts how small, body-worn wearable sensors and projectors will let us do many things that include phoning people using our fingers and the palm of our hand (as keypad), rather than with a cell phone. The *New York Times* writer coos with enthusiasm:

> The video shows the system's main developer, Pranav Mistry, taking photographs with his hand, summoning up Amazon review data onto the cover of a physical book, displaying information about a person he's just met on their tee-shirt, and calling someone by inputting a phone number onto the palm of his hand.
>
> Look out mobile phones, because in a decade's time wearable systems may be the primary means of accessing the Web! (MacManus)

The TED talk itself is also wildly optimistic. With SixthSense, information can be projected anywhere—onto a book, body part, wall, etc.—appearing anywhere you need it. To a degree, SixthSense promises to make screens and monitors obsolete. Natural hand gestures drive the activities. To take a photograph, for example, you fashion your hands into a rectangle around your subject, as if you were sizing up the shot; this is the "take a picture" gesture (Maes).

This technology emerges from the MIT Media Lab's Fluid Interfaces Group under the watch of the director, Dr. Patti Maes. SixthSense entails relatively cheap, accessible components (that cost around $340), suggesting a radical change in the area of interactivity (Maes). The system uses tiny wearable devices—e.g., a camera, a projector, a processor, markers on the finger tips, etc.—but it does not cover the eyes or ears. The subtly-placed camera, mounted on a hat or hung around the neck like a pendant, watches the user's hand gestures and recognizes the meaning of each action (Mistry, Maes, and Chang 4113). Its intent is to augment everyday life rather than detract from it. This kind of subtlety is a trait the wearable computing movement has promoted for two decades under the influence of inventors like Steve Mann and Thad Starner (both alumni of the MIT Media Lab). However, a device like SixthSense seems much more achievable for the public now because its components are so small, weightless, and cheap. Wearables do resemble clothes rather than devices. While the clunky bits and pieces of the first wearables in the 1990s were off-putting, these components seem natural. As described on their website, the inventors' vision is to alter human-machine interaction radically and to create systems that "become true 'accessories' for expanding our minds" (Fluid Interfaces Group), capable of spur-of-the-moment interaction with people, objects, and places.

Mind expansion is an ambitious as well as a vaguely dehumanizing claim. Do our minds need expansion, which, in this case, simultaneously implies further territorialization by the Internet? Many have dealt with how people are increasingly vulnerable to so-called digital interactivity and media experiences. Andrejevic provides a rich definition for it using the trope of the "*digital enclosure*—the creation of an interactive realm wherein every action and transaction generates information about itself" (*iSpy* 2). *Enclosure* suggests not only the encroachment and dominance over our digital activities but also submission to the "condition of surveillance" (2). Andrejevic means that, as we inter-

act (e.g., buy things online, use Google Maps on handhelds, consume advertising alongside our email clients, etc.), we agree to be monitored as a condition of use. Our transactions, the feedback we provide the companies who surveil us, become "cybernetic commodit[ies]" (3) sold to third parties. For Andrejevic, privacy is wholly asymmetrical, "individuals are becoming increasingly transparent to both public and private monitoring agencies, even as the actions of these agencies remain stubbornly opaque" (7). Consumers are forced to *share* information, as companies and governments hoard it. The SixthSense configuration, which seems so deceptively personal and ambient, might cause wearers to become increasingly oblivious to the asymmetrical information exchange that is ongoing. Wearable components used to access bank accounts and credit card information transform the process of consumption further. If we obfuscate our access to social security information or our health plans, for instance, with devices that do not make it utterly clear who or what is also accessing this information with us, we might enable further degrees of blind participation in the digital enclosure. While these examples hyperbolize the situation to an extent, I seek to foreground the fact that the new wearable components make these conditions of surveillance and exchange even more opaque.

What is also interesting is how people are lured to new technology. When Maes explains the future potential behind SixthSense during the TED talk, she reveals some interesting motives:

> But other than letting some of you live out your fantasy of looking as cool as Tom Cruise in *Minority Report*, the reason why we're really excited about this device is that it really can act as one of these sixth sense devices that gives you relevant information about whatever is in front of you [. . .]
>
> If [Pranav Mistry] picks up a book in the bookstore, he can get an Amazon rating. It gets projected right on the cover of the book. This is Juan's book, our previous speaker, which gets a great rating, by the way, at Amazon. And so, Pranav turns the page of the book and can then see additional information about the book—reader comments, maybe sort of [sic] information by his favorite critic, et cetera. [. . .] Reading the newspaper—it never has to be outdated.

By widening the rhetorical circumference surrounding Maes's words, one can identify different motives than just the immediate benefits dangled before the TED audience. Clearly inspired (or leveraged!) by Steven Spielberg's 2002 film *Minority Report*, SixthSense is alluring because it is so physically subtle. Likewise, Tom Cruise's character in *Minority Report*, Chief John Anderton, confidently opens, manipulates, and wipes away files across a massive transparent glass screen using his hands. With machismo, he forgoes usage of a mouse and other user-interface paraphernalia to interact directly with digital content. He certainly does not fumble around for his Blackberry! Similarly, James Cameron's 2009 film *Avatar* features transparent 3D screens that curve around characters operating them. They allude to the "cool" seamlessness that *Minority Report*'s fictional interfaces promote.

SixthSense strives for the same level of refinement and socializes potential users toward these manners. To engage in these kinds of digital liaisons means to bait people with the suggestion of a new sophistication. If one sees a book, one must know how millions of others "rate" it on Amazon. More sophisticated still is to consult with one's favorite book critic. In this case, a *sixth sense* implies that one's knowledge is always predetermined by everything ever said on a topic. However, the bait is the "on-the-spot" relevance made possible with wearable components. To be looking "cool" is to dole out utterly up-to-date knowledge in social situations and use it spontaneously with the help of small, subtle, wearable technologies. At the end of the TED talk, Maes says: "[A]nd who knows, maybe in another ten years we'll be here with the ultimate sixth sense brain implant." She dangles a further degree of sophistication—no wearable device at all and direct brain manipulation—the ultimate in subtlety. She also allays latent fears that we will have even more immediate access to previous knowledge, and we will be able to use it spontaneously and seamlessly.

SixthSense entices by offering a new strategy of human-computer interaction, "brain implants." To go a step further, one could say that Maes's comments engage in the process of *premediating* brain-machine interfaces. Grusin revises *remediation* (Bolter and Grusin) with the logic of *premediation*, which entails imagining "future media technologies as remediations of current ones" (Grusin, "Premediation" 18):

> Where remediation entailed the refashioning of prior media forms and technologies, premediation entails the desire to remediate future media forms and technologies. In addition, [

> . . .] premediation entails the desire to remediate the future before it happens, the desire that catastrophic events like those of 9/11 never catch us unawares. [. . .] Finally, this desire to premediate the future before it happens is accompanied by the desire to colonize the future by extending our networks of media technologies not only spatially across the globe and beyond, but also temporally into the future; in this sense, premediation seeks to make sure that the future is so fully mediated by new media forms that it is unable to emerge into the present without having already been remediated in the past. (36)

Premediation, then, collapses the future into the past. While remediation involves the refashioning of prior media in the process of new emergence (e.g., television remediates cinema), premeditation is driven by societal "desire" to "pre-know" things, events, and messages before they happen. To a further extent, this desire is born of fear; premediation allays the panic surrounding the future's *newness*. Grusin adds that this "desire to colonize the future" functions by extending media globally as well as temporally. He writes that "premediation is part of a heterogeneous media regime whose fundamental purpose is to preclude that no matter what tomorrow might bring, it will always already have been premediated" (29). SixthSense, framed in the language of its annunciation, operates rhetorically by suggesting that a trajectory already exists from wearable components to brain implants. It offers the opportunity to participate in premediation to an even greater degree by asking for an early buy-in to the wearable version.

I use Grusin's *premediation* in conjunction with my own term *imminence* in order to emphasize subtleties in the discourse. Premediation operates as a goading hierarchy or ruse. It reflects how society is goaded through desire and sometimes fear to want to presuppose and participate with the future *before* it happens. Hierarchical goading of this sort provokes us to always strive to "keep up," lacing premeditative discourses with ordering vocabulary. Premediation also implies a degree of guilt if one does not keep up. In the context of this book, I use the concept of imminence to explain a deep-seated rhetoric that I see operating across the discourses surrounding reality-shifting media. Imminence reflects the certainty that technological changes are inevitable and that subjects have little or no agency in that process. The term imminence implies that something is going to happen. *It is im-*

minent. While premediation suggests some kind of forethought by another party (e.g., government or a commercial entity), imminence simply implies that an occurrence seems utterly inevitable. This seemingly total devotion to technological changes operates as an ultimate, indisputable order in the discourse surrounding reality-shifting media.

SixthSense is a research project, yet it operates intertextually with a reticent commercial discourse that perpetuates a vocabulary rooted in neurorhetoric. On November 20, 2009, a *Popular Science* headline declared that "Intel Wants Brain Implants in Its Customers' Heads by 2020." Emitting similar rhetoric, the article claims that "scientists anticipate that consumers will adapt quickly to the idea, and indeed crave the freedom of not requiring a keyboard, mouse, or remote control for surfing the Web or changing channels" (Hsu). The headline unabashedly points to the digital enclosure. Ease of use (i.e., no input device) and promises of spontaneous interactivity will be the ruse. Ethos-laden Intel is, of course, no-fly-by night operation. If Intel wants to get in our brains, Intel probably will; but, framing the sentence with the verb "want" rather than a "will" makes it much more alluring. This *desire* leaves open the door of possibility. Still, the sense of inevitability remains. The cost is a further condition of surveillance and it will be weighty and asymmetrical. By physically attaching gadgets to brains, we reinforce a sort of co-ownership of privacy between the consumer and the corporation.

Neurorhetoric and Technology

Wearables strive to assimilate new processes in the course of daily life. They endeavor for what Jay David Bolter and Richard Grusin call "immediacy," whereby the style of visual representation corresponds with the goal to make the viewer forget the presence of the medium (22). They bring the body into an ecological relationship with the technology. Another example of this trend toward immediacy and augmented interactivity is brain-control software. Brain-computer interaction (BCI) is an emerging medium of communication. Using wireless headsets and electroencephalography (EEG), users can forego input methods like game controllers, keyboards, pointing devices, mice, and tablets and move virtual objects directly with the brain. BCI also works with affective responses, meaning that these interfaces can track human emotions, to an extent. *Thinking* and *feeling* become the

key to interactive experiences. Discourses surrounding BCI promise the power of levitation, mind control, and amazingly subtle, ambient interface devices in the future. Their emergence on the market parallels (or contributes to) the growing tendency to use *neurorhetoric* to sway consumers to buy and participate in this culture. The EPOC device by Emotiv Systems enables a person to use brainwaves to move virtual objects on a screen with one of these headset devices. What is interesting about the EPOC is the assumption that it will become an aspect of everyday life in future. In an interview, one Emotiv Systems executive says: "We see it becoming a totally ubiquitous device, allowing you to interact in a seamless way with everything else in the world" (Freedman, "Reality Bites"). It promises a future of constant, spontaneous, and direct brain-machine liaisons with the virtual objects that surround us.

As *liaisons*, these interactivities between humans and machines are so constant and commonplace that one might not notice how they are often situated between a dialectic of spontaneity and predetermination. In Burke's configuration, dialectics juxtapose opposing ideas, which cause tension that never really resolves. Following Timothy Crusius, Marika A. Seigel writes that "the purpose of Burke's dialectic, then, is not to reveal Truth, but contingent, mutable, and multiple truths (Crusius 193, 183). [. . .] Clearly, ecological thinking is compatible with Burke's 'dialectical dialogic' (Crusius 179)" (400). Dialectics operate in discourses, drawing from and contributing to constantly morphing ecologies. Dialectics do, however, instigate instantiation of higher or more fundamental principles that transcend the dialectic. While voices compete in discourses, more substantial language reorders motive. I argue that an ongoing conversation, a *neurorhetoric*, shapes a competing dialectic when it comes to the idea of interactivity and brain interfaces at the nascent stages of emergence. On the one hand, if we want to interact with others, we need to allow our actions to be monitored and, ultimately, predetermined by computers. At an utterly basic level, you have to share your email address if you want someone to write to you electronically. Indeed, the notion of ambient intelligence suggests that a wide range of hardware devices and software modules, embedded in the environment and worn by humans, will constantly presuppose the needs of humans (Grammenos 46–50). The discourse goads us with this sort of ambitious promise that computers can *know what you want before you do*. On the other hand, a

countering thread emerges in the discourse. In order to have meaningful reality-shifting experiences, people must be afforded a degree of freedom or participation in unknowable spontaneous activities. Or, they must feel *as if* they are participating in this manner. Whether "real" or not, spontaneous experiences made possible with wearable components seem to steer the discourse toward promises of dynamic interactivity, which seems to imply a more humanizing stance. This side of a dialectic promises and goads us with the concept of privacy, which warns us that we need to constantly protect ourselves from computers that seek to *know* us. Through the friction of the two sides, the dialectic undergoes transcendence to another hierarchy, an ultimate order instantiated in the language, which prods the public toward *keeping up* with a future that appears imminent.

Brains are used rhetorically. Recently, Jeff Pruchnic's "Neurorhetorics: Cybernetics, Psychotropics, and the Materiality of Persuasion" "maps notable moments in, and intersections between, mid-twentieth-century scientific investigations into cybernetics and psychotropics [. . .] the two disciplines that led the mid-century 'rediscovery' of the human nervous system and its impact on identity and behavior" (167–69). He states that his attempt will be to interrogate "the potential of what we might call a neurorhetoric, an investigation into the interaction between the force fields of persuasion and neurological matter" (172). Jordynn Jack and L. Gregory Appelbaum's "This is Your Brain on Rhetoric: Research Directions for Neurohetorics" argues that interdisciplinary research from both rhetorical studies and neuroscience must be combined in order to treat the topic with the fullest attention. Guest editor to a special issue of *Rhetoric Society Quarterly*, Jack writes in her piece "What are Neurorhetorics?" how the prefix "neuro" now occurs in discourse with "startling frequency" (405). Jack and Appelbaum identify two relevant research directions when dealing with neurorhetoric:

> In rhetorical studies, there seem to be two main approaches to studying this bourgeoning attention to all things *neuro-*. One area of study under the rubric of neurorhetorics might be the *rhetoric of neuroscience*—inquiry into the modes, effects, and implications of scientific discourses about the brain [. . .] A second approach might be the *neuroscience of rhetoric*, drawing new insights into language, persuasion, and communication from neuroscience research. Findings such as this study

> of noncommunicative patients can prompt us to broaden our very definitions of rhetoric to include those with impaired communication (such as autism, aphasia, or "locked-in" syndrome). (412)

The first approach, rhetoric of neuroscience, concentrates on rhetoric constructed through "discourses *about* the brain" (emphasis mine). The second approach, neuroscience of rhetoric, concentrates on how our new knowledge about the brain (findings in neuroscience) "can prompt us to broaden our very definitions of rhetoric." For example, Jack and Appelbaum question whether "neuroscience findings might also add new insights to longstanding rhetorical issues, such as the relationship between pathos and logos, or emotion and logic, or other cognitive dimensions of rhetoric" (412). They also warn that there is a danger with trying to chart pathos, for example, by reading brainwaves because it might lead to a neuro essentialism.

In the passages that follow, I explore how rhetorics of neuroscience operate not only to justify new brain-related technologies but also justify the need for much more simultaneous, immediate responses from devices—a pathway that normalizes dehumanizing tropes.

Brain-Computer Interfaces

While we are glued to our handheld devices, tapping away awkwardly at our Blackberrys and iPhones during every spare moment, inventors promise us more seamless, increasingly immediate interaction with computers. They are developing the so-called real brain-machine interfaces, which involve "a literal realization of the human computer interaction paradigm by physically connecting man and machine" (Minnery and Fine 75). These noninvasive devices fall under the vast field of neuroscience. Referred to as either brain-machine interfaces (BMI) or brain-computer interfaces (BCI), they are being offered to the public with the promise of augmenting several aspects of everyday life.

One biotech firm, Cyberkinetics, has invented BrainGate technology, which uses electrodes implanted in the body to interpret neural signals that enable people with severe paralysis to control devices with their thoughts. (This is known as neural-sensing technology.) However, several new devices currently promise to provide brain-computer interactivity for everyday use with lightweight wearable headsets and

electroencephalography (EEG); thinking is the input method rather than typing, clicking, mousing, or touch-screening. There is a recent movement to adapt this technology for consumer video game play. EEG provides a form of noninvasive neural feedback. It measures the brain's electrical function or "brainwaves" using electrodes worn on the scalp and it records that information as a code of brainwaves (Tatum, et al.). Laced in the discourse about these video games, however, is the suggestion that people ought to use this technology as a mainstream style of computer interactivity. I am interested in this thread in the discourse that normalizes us to this idea. As these wearable devices are currently offered as games, they serve as a playground for the future.

As a rough breakdown, game-based mind-control interfaces seem to fall into two categories. One promotes interaction between brain wave readings and material objects. For example, Mattel is shipping the MINDFLEX game, which is described on Amazon.com:

> You'll feel like a character in a science fiction movie as you strap on the headset, connect the clips to your ear lobes, and align the metal forehead sensor just above your left eyebrow. But even this strange accessory won't prepare you for the sight of a foam ball quivering five inches above the game console! ("Mindflex Game")

MINDFLEX presents itself as a breakthrough, a freakish novelty. The game rests on playing at telekinesis, rather than achieving any typical game-based goal. It promotes activities that are tantalizingly spontaneous (e.g., if you think of lifting the ball, it rises into the air).

The second category of game-based mind-control interfaces promotes interaction between brains and virtual components on a computer screen; this is sometimes referred to as BCI gaming (Nijholt, Reuderink, and Bos). This category yields a rich surrounding discourse of YouTube videos, website marketing materials, and news stories geared more toward a future of brain-controlled technology. The exemplar for this group of innovations is a company called Emotiv, which has created the EPOC device that lets users manipulate different styles of thinking in order to cause different computer outcomes. Emotiv makes ambitious claims. When describing one of the proposed games, the website draws gamers with claims insinuating that, by playing, they will be able to "wield amazing supernatural powers just by thinking of them" (emotiv.com). However, deeper in the website, one

finds the company vision, which is "to introduce the immediacy of thought to the human-machine dialogue." So, while it has emerged in the form of several games, it is more interesting, within the context of this book, to explore the way the EPOC device uses utopian language and imagery to promote a new level of immediacy with computers.

Long before Emotiv began to ship the EPOC in the winter of 2009, it generated a media response that heralded its emergence. It first hit the news in 2006 when Emotiv, a partner in the Centre of the Mind project run by the Australian National University and the University of Sydney, won a large federal grant (Shanahan). The news begins in Australia, but by March 2007, it becomes American news when this research group sets up shop as a gaming company in San Francisco (Holmes). Seemingly attracting both investors and gaming enthusiasts, Emotiv spent years announcing the arrival of the headset device. One interesting thing about Emotiv and its EPOC is this transformation in news reports and, ultimately, transformation in rhetorical *motive* as Emotiv changes from being from an academic research entity to a business.

The EPOC device itself dominates much of the marketing strategy that accompanies this idea (see Figure 8). A single photograph of the headset fills the entire front page of the Emotiv website. YouTube videos, and one in particular that features the artificial intelligence guru Marvin Minsky trying out the EPOC, underscores the noninvasive nature of the headset (Le and ForaTV). The reductive depiction of this complex device in positive terminology is somewhat spellbinding. The visual rhetoric evokes charming, disarming thoughts: *It seems so safe, much like a pair of audio headphones.* It sells us on this idea of materializing that which is immaterial, like our thoughts, emotions, and fancies. Of course, it is a commonsense presumption that people would be far more comfortable playing around with a brain interface that you can take off like a winter hat rather than one implanted inside your head. Anyone who has seen the film *Johnny Mnemonic* suspects that brain implantables are a risky (and potentially fatal) business! However, as we trot out our devices on this trajectory from being worn to implanted, their wearable existence is key to their emergence because it serves to normalize the seemingly incomprehensible. Depictions of the headset itself, the key artifact, provide the catalyst to the concept of spontaneity that lies in the discourse surrounding this innovation and which betrays dialectic in the language.

Figure 8. Emotiv's Epoc headset. Photo Credit: Jeremy Littler.

The Economist wistfully mentions the EPOC and its future ambitions in a 2007 article focusing on how "[p]eople will then be able to tell a computer what they want it to do just by thinking about it. Tedious fiddling about with mice and joysticks will become irritants of the past" ("Mind Games"). The article emphasizes how people believe they have had to toil over the go-between language that we use to tell computers what we want to accomplish. It assumes that spontaneity—*think and it will happen*—is an ideal goal. A *USA Today* article echoes the sentiment: "Emotiv's elegant, lightweight EPOC headset is a piece of cutting-edge technology that grants Yoda-like telepathic powers, allowing players of computer games to move items on screen with merely their thoughts" (della Cava). The phrase "cutting-edge" takes a jab at the clunky, seemingly blunt edge of our current interfaces, while the EPOC headset seems to offer a hop, skip, and jump to godlike abilities. The news repeatedly constructs an ideal of spontaneous interactivity surrounding the forthcoming EPOC.

Much less salient is a reticent, countering thread that challenges the idea of brain interfaces. One *Washington Times* writer seems to express the questions that the discourse rarely, if ever, explores:

> The downside? Here I'm speculating because I don't know how well it will be possible to tell what people are thinking. It is one thing to detect a desire to move a finger, another to detect emotional states or truthfulness, and quite another to detect the thought, "I think I'll strangle the boss." Detailed thoughts may never be readable. However, there is something unnerving in the thought of no longer enjoying privacy in one's own mind. Already I've seen research on security gates that would attempt to read brain waves of airline passengers to determine which were under stress. We have all heard of thought police. They may be coming. (Reed)

The writer fantasizes over the situation in dystopian terms, worrying over the price tag of "thought police" and the asymmetrical relationship that might emerge between the subject and the state. Using the word "determine," he offers a potential scenario whereby "stress" might be considered a "security" issue when he imagines passengers as potential threats. When surveillance technologies *read* human emotional states, they subjugate emotion to a rhetoric of potential weaponry (i.e., Is the passenger carrying a gun? Or, Is he thinking of carrying a gun?). The writer is "unnerved" and fears the dehumanizing outcome that could arise, like "no longer enjoying privacy in one's own mind." Most interesting is the way he questions the complexity of human thought and the ability of a machine to distinguish so many unique ways of thinking: "It is one thing to detect a desire to move a finger, another to detect emotional states or truthfulness." While the EEG devices certainly chart different categories of thought, do they, as this writer points out, consider "desire," "truth" (with its counterpoint in lie), and ways that people engage in fictional yearning such as "I think I'll strangle the boss"? On the whole, however, this thread is taciturn; few pieces really question this technology on any grounds.

Language surrounding the emergence of these brain interfaces betrays the desire for telepathy (i.e., spontaneity) and the much more reticent fear of predetermination. It also structures other hierarchies that seem more insidious or hegemonically ordering—namely, the belief that brain interfaces will emerge whether we like it or not. In

many news articles about Emotiv, the future is treated as a phenomenal agent:

> "[S]cientists believe that we're moving towards a speechless, thought-driven future—a time when you can switch on your computer with a blink of an eye and words flash up inside your mind" (Ahmed 39).
>
> "When the barrier between game and gamer disintegrates, the concept of virtual play will irrevocably mutate" (Stuart 3).
>
> "[O]ur current 'awkward mechanical dance' with computers will be replaced by an intuitive approach" (Rawsthorn 14).
>
> "'This is the tip of the iceberg for what is possible,' said Tan Le, another of Emotiv's co-founders, during a recent press demonstration. 'There will be a convergence of gesture-based technology and the brain as a new interface—the Holy Grail is the mind'" (Ayres 20).
>
> "Nan Do, chief executive of the San Francisco-based creators, Emotiv Systems, said: 'The future is brain-based technology. The next major wave of technology innovation will change the way humans interact with computers'" (Bale 36).

Used as a concept rather than only a timeframe, "the future" functions as the reasonable justification (or excuse) behind brain interfaces. In some cases, passive grammatical constructions (like "computers will be replaced by") allows *the future* to stand in as an agent by default. Or *the future* as a concept operates scenically, suggesting that, because *it* is happening, we (i.e., readers, users, etc.) are along for the ride. When you cut through melodramatic characterizations of what the technology can or will do, you find yourself on a train ride toward a future that is never really questioned nor fully explained.

IBM has expressed an interest in Emotiv so that it can "explore how to make these environments more personal, intuitive, immersive and ultimately more lifelike" (Emotiv Systems). The mere mention of IBM delivers the EPOC from sounding like the pastime of a basement-bound geek. IBM itself gains ethos because it sounds future-friendly

or sage-like. Newspaper depictions describing the relationship give IBM this sort of role:

> The IBM experts are keen to point out that these systems [e.g. the Emotiv headset] are not being created so that the bone idle can switch the kitchen lights on. This sort of technology could transform the lives of people with degenerative illnesses, such as "locked-in syndrome," where a healthy mind is left trapped inside a failing body. (Ahmed 38)

Here IBM governs a dialectic driven by a value system between mundane laziness (e.g., technology that aids couch-dwelling lay-abouts) and vaulting utility (e.g., technology that cures), creating a wonderful double-profit; people crave technology that predetermines everyday needs (even so-called lazy ones) and they crave technology that is transformative and heroic. IBM makes Emotiv technology serious, alluring, and imminent.

To talk, write, and imagine a wearable brain interface, like the EPOC, slaps another set of values upon us. Virilio so often warns of the political economy of speed. He writes, "Speed is carrying us along, but we have yet to master it. An accident is bound to happen" (*Crepuscular* 66). For him, our dedication to the so-called race of technological progress will ultimately cause our downfall. To use a brain interface in the everyday dealings of life would probably not alter life very much, but it would alter how we conceive of the brain and our imagined social and personal responsibilities. Talking about life with brain interfaces inculcates us in the ruse of spontaneity on many levels. It suggests that our brains and bodies need to react as quickly as computers and that the speed of thought is more important than thought itself, and lastly, that these inventions will occur without much intervention from the people who will use them.

Pain, Empathy, Interactivity and Art

A quote often attributed to McLuhan is "I think of art, at its most significant, as a DEW line, a Distant Early Warning system that can always be relied on to tell the old culture what is beginning to happen to it" (Coupland 192). Artists are reacting to society's desire for simultaneous, immediate responses from technology by creating personal artifacts with ideological purpose. The popular discourse that

discusses our current mediated lives—our smartphones, social media experiences, MP3 players—generally neglects to address basic existential concepts, gearing the talk to discussions of "easing life." However, operating simultaneously is an artistic, countercultural response to this gap. Within these artifacts and the experiences they instigate, lies a rich interpretation of the conceptual implications of highly personal reality-shifting media. Artists are responding to issues that are being neglected in inventors' discourses.

Matthew Kenyon and Doug Easterly, artist collaborators, created the Improvised Empathetic Device (I.E.D.) in 2005 and continue to develop it today (see Figure 9). It is a wearable computing device worn on the arm to make the wearer feel a painful response when people die in war-related deaths in the Middle East. The I.E.D. uses an electric current on an armband:

> When new deaths are detected the data is extracted and sent wirelessly to custom hardware installed on the I.E.D. armband. The LCD readout displays the soldiers' name, rank, cause of death and location and then triggers an electric solenoid to drive a needle into the wearers arm, drawing blood and immediate attention to the reality that someone has just died in the Iraq war that is raging far away.

The purpose of the I.E.D. project is to make salient the deaths (both military and civilian) occurring in the Iraqi War. A play on IEDs, or *improvised explosive devices*, the Improvised Empathetic Device focuses the wearer to mediate positive signs created by the body—blood, a wound, a painful sensation—in dialectical terms by forcing a person situated in a nonviolent location to reflect on a violent war zone through signs that signify death. The body, the skin, and the brain, in conjunction with the interface, become the site for these extremes.

Pain functions at the core of this message. The notion of pain, the experience of it, its descriptions and justifications, alter so much of the living of lives. *Being* in pain alters one's worldview. Fear of pain drives actions in so many life spheres. Thinking etymologically, to be in pain is to be guilty. *Pain* comes from the Latin *poena*, meaning *penalty*. *Poena* comes from the Ancient Greek *poinē*, meaning ransom or a payment that acts as punishment (i.e., blood money). Pain is never a do-gooder; it is viewed as an agent bringing penance for a fault. *Healing*, on the other hand, which may very well involve pain, implies mak-

ing the body whole again. Healing is restorative. While not opposites (*pain* finds its opposite in *pleasure*), healing and pain are often bound up in the same process, but their metaphorical realizations seem to imply quite different value systems. Pain is retributive; healing participates in holism. The I.E.D. also asks the wearer and art spectator to empathize, which is the act of vicariously feeling (or imagining that one feels) the experience and thoughts of another person without actually feeling them. On the whole, I.E.D. constructs an ultimate order based on a terminology of guilt (through the experience of pain and empathy) that acts as an ideological varnish over the whole experience. We are invited to participate in an installation that punishes the wearer for his/her ambivalence to a violent situation that is occurring at a remove.

As art, the I.E.D., a modern day hair shirt, demands empathy and guilt from the scopophilic viewer (the one not wearing the device), a person who is ultimately embedded in a privileged world where art enthusiasm (rather than war) is possible. The spectator reflects on the pain of the wearer, but cannot feel it. The message is morally ameliorative, slightly shocking, and reality-shifting for both the wearer and the spectator.

Pain inducement works ironically in other artifacts. Designer and artist Lauren McCarthy created a series of reality-shifting devices under the umbrella "Tools for Improved Social Interacting," which essentially promotes value systems that privilege social over solo interactivity:

> The Happiness Hat trains the wearer to smile more. An enclosed bend sensor attaches to the cheek and measures smile size, affecting an attached servo with metal spike. The smaller the smile of the wearer, the further a spike is driven into the back of their neck. The Body Contact Training Suit requires the wearer to maintain frequent body contact with another person in order to hear normally; if he or she stops touching someone for too long, static noise begins to play through headphones sewn into the hood. (400)

Figure 9. Improvised Empathetic Device (I.E.D.). Photo credit: Matthew Kenyon and Doug Easterly.

We can look at "Tools for Improved Social Interacting" as sardonic, even though it also appears whimsical. The concept of measuring wearer's smiles is a comical and light-hearted call to overturn social practices that are alienating, but the idea of a device driving a spike "into the back of their neck" is ironic and provocative. Likewise, that we need *tools* and *training* for improving basic social behaviors is a jab at us and how society is goaded by the personal media always at our fingertips with little or no forethought into what it really means. McCarthy writes that she "is interested in the invisible influences of

technology that can result in perceptible changes and shifts. As technologies that can manipulate our brains continue to be developed, it is essential that we explore the possibilities while considering the effects" (401). The experience of using these devices is mortifying; discomfort shifts reality to the point that we are called upon to dwell upon basic life experiences (and our silent acquiescence to alienation) with irony rather than complacence.

Iraqi-American artist Wafaa Bilal enlists painful experiences across many of his reality-shifting projects. In 2007, he conceived and participated in a painful, interactive, anti-war exhibit in a Chicago gallery called *Domestic Tension*. For hours a day, he allowed himself to be paintballed by anyone who logged on to a website in order to fire at him as he was viewed on a webcam (see Figure 10).

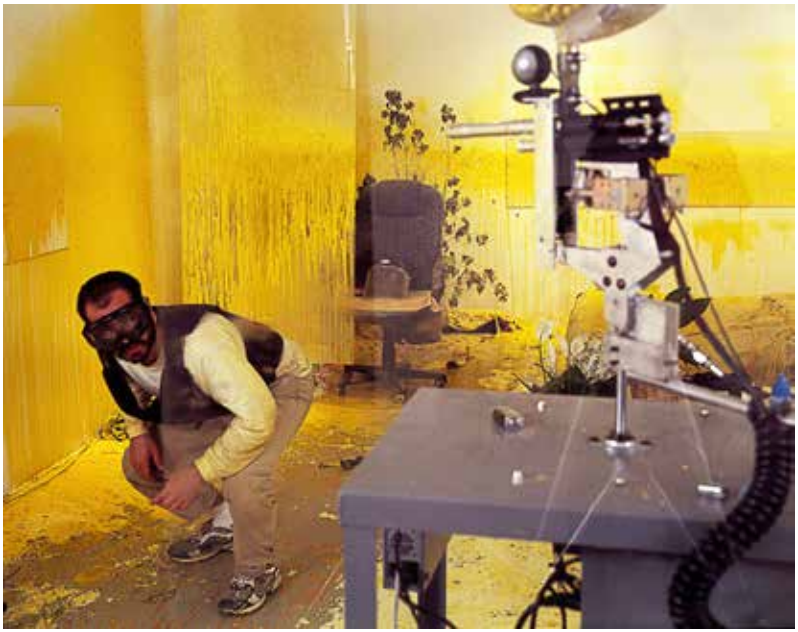

Figure 10. Artist Wafaa Bilal, "Domestic Tension" installation. Photo credit: Wafaa Bilal.

The installation ran for thirty days and pondered concepts such as the entertainment of war, technology, killing, memory, and pain. His more recent *3rdi* project explores spontaneity, storytelling, photography, and ideology. In the winter of 2010, Bilal surgically implanted a

small digital camera and USB connection to the back of his head that worked with a laptop and Internet connection, which he carried on his body (see Figure 11).

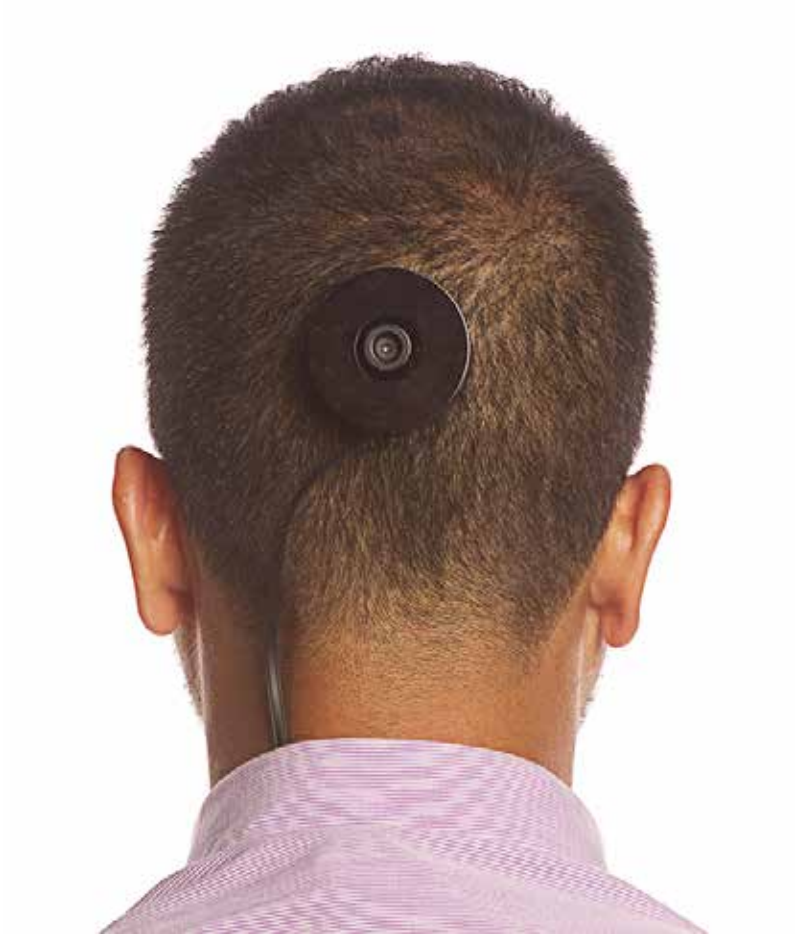

Figure 11. Artist Wafaa Bilal, "3rdi." Photo credit: Wafaa Bilal.

Viewers could watch the stream of time-stamped photos on a website as Bilal moved through spaces and places and collected digital images. The project also involved an installation that opened on December 15, 2010 in Doha, Qatar as part of the Told/Untold/Retold exhibition inaugurating the new Arab Museum of Modern Art. Bilal explains the design intent behind his work:

> I am nothing if not a storyteller. My work to date has been concerned with the communication of public and private information to an audience so that it may be retold, distributed. The stories I tell are political dramas, which unfold through my past experience and into the present where they interact with the currency of media as the dialectic of aesthetic pleasure and pain. Through various layers of distribution and interpretation, pictures are drawn using interactive models established through the stories' (technological) framework where they are revealed and shared. With an audience locked in participation, my story may be retold.
>
> The 3rdi is just such a platform for the telling and retelling of another story. A camera temporarily implanted on the back of my head, it spontaneously and objectively captures the images—one per minute—that make up my daily life, and transmits them to a website for public consumption. (3rdi)

The implanted camera sets up a dichotomy between subjectivity and objectivity in multiple ways. Bilal's body (in combination with the device) operates objectively by automatically gathering and then distributing images (stories) for the viewer to consume and actively engage, without editorializing or overt framing. Yet, Bilal still travelled to locations of his choice in order to go about his everyday life, thereby exercising his subjectivity, his subjective (and reversed) point of view.

By February 2011, *3rdi* became too painful and Bilal had to remove the implant. Although not explicit about these kinds of claims, *3rdi* interrogates interactivity amid dehumanizing machinic orders. Bilal's performance requires taking a carryable device, a commonplace digital camera, and painfully stitching it onto his head, turning it into what is essentially an implanted device. He *endures* his project rather than stages it, as he points out in an interview that questions why he would do such a thing (Parry). Pain, and the slow onset of the body's rejection of the device, dictated the temporal span of the project. The spectatorship involves not only viewing the images that come out of *3rdi* but also acknowledgement of Bilal's ongoing pain, that of having a consumer device nailed to the body. Bilal's transformation into an automatic camera requires reaction from a squeamish audience in order to be wholly meaningful. We are all nailed to our devices.

Improvised Empathetic Device, "Tools for Improved Social Interacting," and *3rdi* all use pain as a rhetorical device to reveal dehu-

manizing ideologies. In each case, the aesthetic yokes the wearer's real pain and bodily sensations with the spectator's discomfort, empathy, and ultimately, guilt, over the spectacle. Spontaneity also plays a role in each. Improvised Empathetic Device creates a spontaneous physical reaction to the mounting dead in a war zone in order to instigate an emotional response, a reaction that is so easy to postpone or even ignore in an era when facts, figures, and information clouds the reality of people dying. "Tools for Improved Social Interacting" reminds the body about social alienation simultaneously in the moment that it occurs. However, this message is flippant, the artifact uses pain to create an instant response reminding us that technology itself is alienating. *3rdi* spontaneously collects images that record Bilal's life narratives, but it also constantly reminds the spectator of Bilal's discomfort. Wearing these pieces, or watching others wear them, is an act of penance. It shakes the subject from complacency with mobile devices and personal technology in general.

Projects using brainwaves as an apparatus for ideological examination are not wholly novel. Mann has produced art installations using thought-controlled interfaces for over a decade. In 2003, he began a series called *Telematic Tubs Against Terror*. Inviting the audience to join in a bath, he used biofeedback, brainwaves, and heart monitors to create a communal and bodily response to ideologies that seemed to drive suspicion and terror. He wrote of the piece: "This symbolized the seemingly arbitrary nature of suspicion. Additionally, through biofeedback, attendees were invited to suppress the odd harmonics of their brainwaves" ("Telematic" 373). The aesthetic also involved "brainwave therapy to cure Obedience Deficit Disorder (ODD). Those who were not ODD were rewarded in various ways" ('Telematic" 373). The performance/participation often involved similar acts of ironic debunking with the goal of demystifying fear.

Staging these events only two years after 9/11 and in the midst of Toronto's SARS[5] outbreak, anxiety informed the context. *Telematic Tubs Against Terror*, installed in Toronto's downtown core, instigated a rhetorical response within a very specific cultural circumference during a time when fear over one's physical well-being was tacit. It was stated that "between February and September 2003 Health Canada reported 438 probable or suspect cases of severe acute respiratory syndrome (SARS) resulting in 43 deaths primarily in the Greater Toronto Area (GTA)" (Borgundvaag, et al. 1342). Although downplayed, "air-

borne transmission" was noted as a cause and "several 'super-spreading' events, instances when a few individuals were responsible for infecting a large number of others" were mentioned, making things worse (Borgundvaag, et al. 1342). The idea of a potentially fatal disease travelling mysteriously through the air fuelled the collective apprehension at the time and became part of the art piece:

> Thus, with Telematic Tubs, the public bath, a concept that already challenges the notion of physical privacy of the body, now takes on the role of challenging the privacy of the mind. Telematic Tubs stripped attendees of their prosthetic shells and probed both the mind and the body. The tub events turned the clothed (concealed) individual into an exposed element of a collective (de)consciousness, assimilated into its immersive medium of water and brainwaves. ("Telematic" 373)

Telematic Tubs Against Terror used brainwaves to counter the dread of pain, which is different than the Improvised Empathetic Device that involves pain inducement. *Telematic Tubs Against Terror* essentially *wired* its audience members together in a performance resembling a cleansing ritual in order to stage a communal act challenging a hegemony of privacy. During this time of paranoia in 2003, SARS temperature sensors were used in public places to root out offenders who might be 'suffering' with a fever, one of the only signs of the disease. People were physically barred from buildings and events in an attempt to discourage crowds. Visitors and tourists avoided the city[6]. *Telematic Tubs Against Terror* used technology to work contra to these conditions. It serves as a key example of how brainwave art or thought-controlled media can be used to subvert dominant ideologies and offer a backlash position.

Conclusion

Reality-shifting media promises significant change over the ways we will use personal computers to interact or liaise with the multiple facets of life. In this configuration, brains are used rhetorically to convince us that we have been left lacking, that we need spontaneous interactions with computers in order *to keep up*. Neurorhetoric surrounding new brain-related technologies drives toward a future that demands spontaneous interactivity with aspects of life. Yet, close analysis of

neurorhetoric uncovers the lingering fear that brain-computer interfaces will also signal a diminished privacy for humans whose thoughts will be interpreted by machines in a new way. Despite this groundbreaking technological advancement, neurorhetoric manipulates the emergence of certain technologies with dehumanizing claims that never get resolved, but simply become absorbed into the way we speak about advancement.

Neurorhetoric, and its manipulative quality, is also problematic when it comes to the emergence of consumer digital devices and games. I have argued that one impetus for new reality-shifting media devices is the rhetorical trajectory from carryable to wearable to implantable devices. This process seems to be advancing at an incredible rate when it comes to brain-related entertainment (e.g., gaming). Handheld or carryable gaming has infiltrated the fabric of society. The inclusion of wearable "brain" headsets, sitting on the grounds of gaming, which is an already ensconced mundane cultural practice, is not a great persuasive stretch, but the fact that one can use a wireless headset and seemingly telepathically communicate with a computer is also alluring and fantastical. The idea of the implanted brain device lingers in the popular science discourses (e.g., TED talks, magazines, pop science TV, films), and is normalized before appropriate attention is paid to it. The implanted brain device as a popular phenomenon rides the coattails of medical brain implants and legitimate practices that are clearly contributing to the lives of individuals and the betterment of society.

Artists and their aesthetic examinations counter many of the implications of this type of media invention by creating new (painful) liaisons with wearable technology of their own conceptualization. Experience with these art pieces is not only a challenge to this neurorhetoric but also a challenge to processes of dehumanization that operate so reticently as this kind of technology emerges. Pain, empathy, and irony are woven into the aesthetic and interactive experience with these devices to make salient society's complacency with personal technology.

Works Cited

"AH 2012 Call for Papers." *Augmented Human International Conference*. Web. 3 May 2012.

Ahmed, Murad. "I Can Move Things with my Mind." *The Times* 4 February 2010: 38–39. Print.

Amft, Oliver, and Paul Lukowicz. "From Backpacks to Smartphones: Past, Present, and Future of Wearable Computers." *IEEE Pervasive Computing* 8.3 (2009): 8–13. Print.

Anderson, Fiona. "iphone woes." *The Vancouver Sun* 14 July 2007: D1. Print.

Andrejevic, Mark. *Reality TV: The Work of Being Watched*. Lanham, MD: Rowman & Littlefield, 2004. Print.

—. *iSpy: Surveillance and Power in the Interactive Era*. Lawrence: U of Kansas P, 2007. Print.

Anthes, Gary. "Skin-Like Electronic Patch Unveiled." *Communications of the ACM* 54.10 (2011): 14. Print.

Anthony, Sebastian. "Harvard Cracks DNA Storage, crams 700 terabytes of Data into a single gram." *ExtremeTech*. 17 August 2012. Web. 18 August 2012.

Antonelli, Paola. "Design and the Elastic Mind." *Design and the Elastic Mind*. Ed. Antonelli, Paola. New York: Museum of Modern Art & Distributed Art Publishers, 2008. 14–27. Print.

—. "Of Good Clothes and Good Design." *Yeohlee: Work*. Ed. John S. Major and Yeohlee Teng. Mulgrave: Images Publishing Group, (2003): 31-72. Print.

Apple Computer, Inc. "*100 million iPods sold*." 9 April 2007. Web. 7 August 2007.

—. "Apple Introduces New iPod touch and iPod nano" 12 September 2012. Web. 3 October 2012.

—. "Apple Introduces the U2 iPod." 26 October 2004. Web. 29 June 2010.

—. *Calamari*. *YouTube*. Web. 19 September 2012.

—. "H2O Audio Interval Waterproof Headphone System for iPod Shuffle (3rd gen.)." *Apple Store*. Web. 15 January 2010.

—. "iLife '06." *Apple Canada*. Web. 30 January 2007.

—. *Never been an iPod*. *YouTube*. Web. 9 September 2008.

Associated Press. "Japan Optical Camouflage." 2 May 2003. Photo.

Arnheim, Rudolf. *The Power of the Center: A Study of Composition in the Visual Arts*. Berkeley: U of California Press, 1988. Print.

Art Threat. "Art Threat: Exploring the World of Art and Politics." 2008. Web. 22 August 2008.

Ayres, Chris. "From Joystick to Helmet: The Next Leap Forward is All in the Mind." *The Times* 18 July 2008: 20. Print.

Azuma, Ronald. "A Survey of Augmented Reality." *Presence* 6.4 (1997): 355–85. Print.

Azuma, R., et al. "Recent Advances in Augmented Reality." *Computers & Graphics* 21. 6 (2001): 1–15. Web. 25 July 2010.

Bale, Karen. "Mind Games for Skulled Players." *Daily Record* 10 March 2007: 36. Print.

Barron, Cheryl. "Digital Diary." *San Francisco Chronicle* 28 January 2007: E1. Web. 7 March 2007.

Bass, Thomas A. "Dress Code." *Wired Magazine* 6.4 (1998): 1–10. Print.

Basu, Saikat. "The First Invisibility Cloak Could be Practical in Six Months." *Digital Journal*. 4 April 2009. Web. 8 September 2012.

Barthes, Roland. *Image, Music, Text*. Trans. Stephen Heath. New York: Hill & Wang, 1978.

—. *Mythologies*. Trans. Annette Lavers. New York: Hill & Wang, 1972.

Bell, Gordon, and Jim Gemmell. "A Digital Life." *Scientific American* 296.3 (2007): 58–65. Print.

—. "About the Book." Total Recall *Book Website*. Web. 14 July 2009.

—. *Total Recall: How the E-Memory Revolution Will Change Everything*. New York: Dutton, 2009. Print.

—. *Your Life Uploaded*. New York: Plume, 2010. Print.

Bendle, Marvin F. "Teleportation, Cyborgs and the Posthuman Ideology." *Social Semiotics* 12.1 (2002): 45–62. Print.

Benedictus, Leo. "How I Remember: The LifeLogger." *The Guardian* 14 January 2012. Web. 13 April 2012.

Berkeley Lab. "Blurring Lines between Magic and Science: Berkeley Researchers Create an Invisibility Cloak." U.S. Department of Energy. 1 May 2009. Web. 8 September 2012.

—. "Testing Relativity, Black Holes, Strange Attractors in Laboratory." U.S. Department of Energy. 20 July 2009. Web. 8 September 2012.

Berzowska, Joanna. "Electronic Textiles: Wearable Computers, Reactive Fashion, and Soft Computation." *Textile* 3.1 (2005): 2–19. Print.

Berman, Jessica. "'Electronic' Skin Monitors Heart, Brain Function." *VOA News*. 15 August 2011. Web. 15 March 2012.

Bilal, Wafaa. *Domestic Tension*. Art installation. 2007. Web. 19 September 2012.

—. *3rdi*. Art installation. 2010. Web. 19 September 2012.

Bilton, Nick. "G.M. Tinkers with Augmented Reality System for Cars" *Bits New York Times Blog* 17 March 2010. Web. 22 September 2012.

Bittiner, Julian. "Exhibition Review: Design and the Elastic Mind, the Museum of Modern Art, New York, 24 February to 12 May 2008." *Visual Communication* 7.4 (2008): 503–08. Print.

BlackBerry. "BlackBerry® Loves U2." TV and web advertisement. *BlackBerry.com*. 5 July 2010.

Blakesley, David. *The Terministic Screen: Rhetorical Perspectives on Film*. Carbondale: Southern Illinois UP, 2007.

BlogTO (Toronto). *Flickr*. 2008. Web. 22 August 2008.

Bolter, Jay David, and Richard Grusin. *Remediation: Understanding New Media*. Cambridge: MIT P, 1999. Print.

Borgundvaag, Bjug, Howard Ovens, Brian Goldman, Michael Schull, Tim Rutledge, Kathy Boutis, Sharon Walmsley, Allison McGeer, Anita Rachlis, and Carolyn Farquarson. "SARS outbreak in the Greater Toronto Area: the emergency department experience." *Canadian Medical Association Journal* 171.11 (2004): 1342–344. Print.

Bourdieu, Pierre. *Language and Symbolic Power*. Cambridge, MA: Harvard UP, 1991. Print.

Boyle, Rebecca. "Epidermal Electronics' Paste Peelable Circuitry On Your Skin, Just Like A Temporary Tattoo." *Popular Science* 12 August 2011. Web. 21 March 2012.

Bridges, Andrew. "Scientists Aim to Duplicate Harry Potter's Invisibility Cloak." *Live Science*. 25 May 2006. Web. 13 July 2009.

—. "Scientists Ponder Invisibility Cloak." *Associated Press Online*. Web. May 26 2006.

Brinkley, Leslie. "For sale? Spot in line for coveted iPhone." *ABC News*. 28 June 2007. Web. 29 May 2008.

Buckler, Ernest. *Ox Bells and Fireflies*. Toronto: McClelland and Stewart, 1968. Print.

buddesign. *Nokia Morph Concept (long). YouTube*. 25 February 2008. Web. 7 July 2010.

Burke, Kenneth. *A Grammar of Motives*. Berkeley: U of California P, 1945. Print.

—. *A Rhetoric of Motives*. 2nd edition. Berkeley: U of California P, 1969. Print.

—. *Language as Symbolic Action: Essays on Life, Literature, and Method*. Los Angeles: U of California P, 1966. Print.

—. "Poem." *The Legacy of Kenneth Burke*. Ed. Herbert W. Simons and Trevor Melia. Madison: U of Wisconsin P, 1989. Print.

Burnett, Ron. *How Images Think*. Cambridge: MIT P, 2005. Print.

Bygrave, Stephen. *Kenneth Burke: Rhetoric and Ideology*. London: Routledge, 1993. Print.

Carducci, Vince. "Culture Jamming: A Sociological Perspective." *Journal of Consumer Culture* 6.1 (2006): 116–38.
Caron, Andre H., and Letizia Caronia. *Moving Cultures: Mobile Communication in Everyday Life*. Montréal: McGill-Queen's University Press, 2007.
Chengappa, Aditi. "From invisibility cloaks to magic carpets." *Digital Journal*. 2 May 2009. Web. 27 July 2010.
Chu, Ronald Jin. "Smartphone App Measures User's Brainwaves." *Japan Trends*. 13 July 2011. Web. 11 April 2012.
Cogdell, Christina. "Design and the Elastic Mind, Museum of Modern Art (Spring 2008)." *Design Issues* 25.3 (2009): 92–101. Print.
Communications of the ACM. *ACM.org*. 2005 Web. 7 May 2007.
Cordery, Walter. "iPhones won't be here until '08." *Harbour City Star* 30 June 2007: A4. Print.
Coupland, Douglas. *Extraordinary Canadians Marshal McLuhan*. Toronto: Penguin, 2010. Print.
Coxworth, Ben. "Film-maker's Eye is Up and Shooting" *Gixmag.com* 29 August 2011. Web. 22 September 2012.
CNN. "iPhone sales said to hit half-million." *CNNMoney.com*. 2 July 2007. Web. 29 May 2008.
Crawford, Diane. "Editorial Pointers." *Communications of the ACM* 49.1 (2006): 5–7. Print.
Cronian Labs. "Skin Scan—Your Pocket Scan Technology for Skin Cancer Prevention." 11 April 2012. Web. 7 September 2012.
Cross, Alan. "Secret Boston Gig and Interview with U2 Bono." *Explore Music* 13 Mar 2009. Web. 15 June 2010.
Crusius, Timothy. *Kenneth Burke and the Conversation After Philosophy*. Carbondale: Southern Illinois UP, 1999. Print.
Cyberman. Dir. Peter Lynch. Canadian Broadcasting Corporation (CBC), 2001. Film.
Czerwinski, Mary, et al. "Digital Memories in an Era of Ubiquitous Computing and Abundant Storage." *Communications of the ACM* 49.1 (2006): 45–50. Print.
Danigelis, Alyssa. "Electronic Tattoo Grafts Gadgets to Skin." *Discovery News* 11 August 2011. Web. 20 September 2012.
DARPA. "DARPA Mission." DARPA About. *Defense Advanced Research Projects Agency (DARPA)*. Web. 19 April 2012.
—. "DARPA Mission." DARPA Home. *Defense Advanced Research Projects Agency (DARPA)*. Web. 9 October 2003.
—. "Lifelog Mission." *Defense Advanced Research Projects Agency (DARPA)*. 2003. Web. 26 June 2003.
—. "PIP for Lifelog (Baa# 03–30)." *Defense Advanced Research Projects Agency (DARPA)*. 7 May 2003. Web. 26 June 2003.

Davis, Joanna. "Invisibility Cloak Closer to Reality." *The Press* 1 June 2006: 3. Print.

de Grey, Aubrey. "Why We Age and How We Can Avoid It" *TED Talks* July 2005. Web. 3 October 2012.

della Cava, Marco R. "Let Video Games Read Your Mind." *USA Today* 5 August 2008: D3. Print.

Design and the Elastic Mind. Online exhibition, *The Museum of Modern Art*. Spring 2008. Web. 7 July 2010.

Didymus, JohnThomas. "Texas scientists create 'invisibility cloak' for 3-D objects." *Digital Journal* 26 January 2012. Web. 24 April 2012.

Dillow, Clay. "Amid Privacy fears, police across the nation will role out face-recognizing iPhone tech this year." *PopSci* 14 July 2011. Web. 11 April 2012.

Dixon, Sara. "Magic cloak makes GBP 100,000 vanish." *Express* 21 August 2009: 15. Print.

dreamyear. "Time Machine Patent !!!!" 1 June 2008. Web. 8 September 2012.

Drummond, Katie. "Invisibility's Next Frontier: Scientists Cloak 3D Objects." *Wired Magazine* 25 January 2012. Web. 24 April 2012.

du Gay, Paul, Stuart Hall, Linda Janes, Hugh Mackay, and Keith Negus. *Doing Cultural Studies: The Story of the Sony Walkman*. London: Sage Publications, 1997.

Elliot, Stuart. "Academy Awards ads routed Super Bowl's." *International Herald Tribune* 27 February 2007. Web. 31 July 2008.

Elmer-DeWitt, Philip. "30,000 Canadians Petition for iPhone Rate Relief." *CNNMoney* 29 June 2008. Web. 3 October 2012.

Elmer, Greg, and Andy Opel. *Preempting Dissent: The Politics of an Inevitable Future*. Winnipeg: Arbeiter Ring Publishing, 2008. Print.

Emotiv. *Emotiv.com* Web. 18 October 2010.

Emotiv Systems. "Emotiv Unveils World's First Brain-Controlled Video Gaming Headset." *Business Wire* 20 February 2008. Web. 7 June 2010.

Ermolov, V., et al. "Significance of Nanotechnology for Future Wireless Devices and Communications." *18th Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC'07), 3–7 September 2007*. Los Alamitos, CA: IEEE Publishing, 2007. 1–5. Print.

Fahnestock, Jeanne. "Accommodating Science: The Rhetorical Life of Scientific Facts." *Written Communication* 3.3 (1986): 275–96. Print.

Final Cut, The. Dir. Omar Naim. Lions Gate Home Entertainment, 2004. Film.

Fluid Interfaces Group. "Our Vision." *MIT Media Lab*. 2010. Web. 14 June 2010.

Frazier, Mya. "When a Brand Buster Becomes a Brand." *Advertising Age 78*.47 (2007): 1–29. Print.

Freedman, David. "Future Tech: Looking Forward to the Post-Screen Era." *Discover Magazine* March 2011. Web. 15 March 2012.
Freedman, D.H. "Reality Bites." *Inc.* 1 December 2008. Web. 12 May 2009.
Fukuyama, Francis. "Transhumanism." *Foreign Policy* 144 (September-October 2004): 42-43. Print.
Gage, Douglas. "Lifelog Objective." *Defense Advanced Research Projects Agency (DARPA)*. Web. 31 July 2003.
Gallagher, James. "Electronic tattoo 'could revolutionise patient monitoring.'" *BBC News* 12 August 2011. Web. 15 March 2012.
Ganapati, Priya. "Eye Spy: Filmmaker Plans to Install Camera in His Eye Socket." *Wired Blog: GadgetLab* 4 December 2008. Web. 8 July 2009.
Gartner Inc. "Gartner Says Sales of Mobile Devices Grew 5.6 Percent in Third Quarter of 2011; Smartphone Sales Increased 42 Percent." *Gartner Newsroom* 15 November 2011. Web. 23 March 2012.
Gemmell, Jim, Gordon Bell, and Roger Lueder. "MyLifeBits: Personal Database for Everything." *Communications of the ACM* 49.1 (2006): 89–95. Print.
Gershenfeld, Neil. *When Things Start to Think*. New York: Henry Holt, 1999.
Goldman, Robert, and Stephen Papson. *Nike Culture: The Sign of the Swoosh*. London: Sage, 1998. Print.
Google. "Project Glass." 29 June 2012. Web. 26 July 2012.
—. "Project Glass: One Day…" *YouTube.* 4 April 2012. Web. 22 September 2012.
Gow, Gordon A., and Richard K. Smith. *Mobile and Wireless Communications: An Introduction*. New York: Open UP, 2006. Print.
Grammenos, Dimitris. "The Ambient Mirror: Creating a Digital Self-Image through Pervasive Technologies." *interactions* 16.2 (2009): 46–50. Print.
Gray, Fiona. "Invisibility Cloak You'll Never See." *Scotland on Sunday* 23 November 2008: 10. Print.
Gronnvoll, Marita, and Jamie Landau. "From Viruses to Russian Roulette to Dance: A Rhetorical Critique and Creation of Genetic Metaphors." *Rhetoric Society Quarterly* 40.1 (2010): 46–70. Print.
Grossman, Lisa. "Illusion Device Could Make One Object Look Like Another; A Modified Invisibility Cloak Could Make Military Planes Look Like Civilian Ones, Says Scientists." *New Scientist* 4 July 2009: 20. Print.
Grusin, Richard. "Premediation." *Criticism* 46.1 (2004): 17–39. Print.
—. "Premediation and the Mediaphilia of Anticipation." Rogers Communication Centre, Ryerson University, Toronto. 29 January 2009. Lecture.
Gusfield, Joseph R. "Introduction." *On Symbols and Society*. Ed. Joseph R. Gusfield. Chicago: U of Chicago P, 1989. 1–52. Print.
Hallen, James. *Open Letter to Steve Jobs about the situation.* 15 August 2008. Web. 20 September 2012.

Hansen, Mark B. N. *Bodies in Code: Interfaces with Digital Media*. New York: Routledge, 2006. Print.

Harmon, Katherine. "Skinlike Electronic Patch Takes Pulse, Promises New Human-Machine Integration." *Scientific American* 11 August 2011. Web. 20 September 2012.

Hartman, Kate. "The Art of Wearable Communication." *TED*. March 2011. Web. 7 May 2012.

Hawk, Byron. *A Counter-History of Composition: Toward Methodologies of Complexity*. Pittsburg, PA: U of Pittsburgh P, 2007. Print.

Hawk, Byron, David M. Rieder, and Ollie Oviedo. *Small Tech: The Culture of Digital Tools*. Minneapolis: U of Minnesota P, 2008. Print.

Hayles, N. Katherine. "Commentary: The Search for the Human." *New Literary History* 36.2 (2005): 327–33. Print.

—. "Connecting the Quantum Dots: Nanotechscience and Culture." *Nanoculture: Implications of the New Technoscience*. Portland: Intellect Books, 2004. 11–26. Print.

—. *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*. Chicago: U of Chicago P, 1999. Print.

—. "Wrestling with Transhumanism: Is Finitude a Necessary Human Condition?" Transhumanism and the Meanings of Progress workshop, ASU, Tempe, AZ, April 24–25, 2008. Web. 22 September 2012.

—. *How We Think: Digital Media and Contemporary Technogenesis*. Chicago: U of Chicago P, 2012. Print.

—. *Writing Machines*. Cambridge: MIT P, 2002. Print.

Heap, Imogen. "Want to accompany me on the red carpet today?" 31 January 2010. Web. 1 February 2010.

The Heavy Projects. "G George." Los Angeles: Lab Art. June 2011. Art installation.

Hecht, Jeff. "Magic carpets can hide objects in plain sight." *New Scientist* 13 June 2009: 20. Print.

Hinchey, Xanthe. "Harvesting energy: body heat to warm buildings." *BBC News* 11 January 2011. Web. 21 March 2012.

Hirst, Nicholas. "No Apple iPhone? You must be Canadian." *Winnipeg Free Press* 2 August 2007: A11. Print.

Holmes, Sam. "Introducing the Next Joy Stick—Your Mind." *The Advertiser* 13 March 2007: 19. Print.

Hurst, Lynda. "Keep Your Eyes On the Submarine; It Was a Banner Year for Research in Invisibility. The U.S. Army Could Have a Device Within a Decade." *Toronto Star* 25 October 2008: ID03. Print.

Hurtado, Joseph. *Toronto—iPod City*. *Flickr*. 9 September 2008. Web. 20 September 2012.

Hutcheon, Linda. "Postmodern Afterthoughts." *Wascana Review of Contemporary Poetry and Fiction 37*(1) (2002): 5–12. Print.

Hsu, Jeremy. "Intel Wants Brain Implants in Its Customers' Heads by 2020." *Popular Science* 20 November 2009. Web. 20 September 2012.

Inami, Masahiko, Naoki Kawakami, and Susumu Tachi. "Optical Camouflage Using Retro-Reflective Projection Technology." *Proceedings of the Second IEEE and ACM International Symposium on Mixed and Augmented Reality (ISMAR '03), 7–10 October, 2003*. Los Alamitos, CA: IEEE Publishing, 2003. 348–49. Print.

"Introducing New Scientist." *New Scientist*. Web. 8 September 2012.

"Invisibility Cloaks: Items of the Future?" *Irish News* 12 August 2008: 22. Print.

"Invisible Man Close to Reality." *Daily Telegraph* 22 August 2009: 4. Print.

iphonenoflash. *iPhone Parody No Flash. YouTube*. 2007. Web. 22 August 2008.

Jones, Dylan. *iPod, Therefore I Am: Thinking Inside the White Box*. New York: Bloomsbury, 2005. Print.

Jack, Jordynn. "What are Neurorhetorics?" *Rhetoric Society Quarterly* 40.5 (2010): 405–10. Print.

Jack, Jordynn, and L. Gregory Appelbaum. "This is Your Brain on Rhetoric: Research Directions for NeuroRhetorics." *Rhetoric Society Quarterly* 40.5 (2010): 411–37. Print.

Jenkins, Henry. *Convergence Culture: Where Old and New Media Collide*. New York: New York UP, 2006. Print.

—. *Fans, Bloggers, and Gamers: Media Consumers in a Digital Age*. New York: New York UP, 2006. Print.

—. *Textual Poachers: Television Fans and Participatory Culture*. New York: Routledge, 1992. Print.

Kahney, Leander. *The Cult of iPod*. San Francisco, CA: No Starch Press, 2005. Print.

Kelly, Cathal. "Newest Computer Touch Screen May be Your Own Body." *Toronto Star* 6 March 2010. Web. 4 May 2010.

Kenyon, Matthew, and Doug Easterly. *Improvised Empathetic Device (I.E.D.) S.W.A.M.P. YouTube*. 28 April 2011. Web. 20 September 2012.

Kittler, Friedrich. *Gramophone, Film, Typewriter*. Trans. Geoffrey Winthrop-Young and Michael Wutz. Palo Alto, CA: Stanford UP, 1999. Print.

Kress, Gunther R., and Leo van Leeuwen. *Reading Images: The Grammar of Visual Design*. 2nd ed. New York: Routledge, 2006. Print.

Lanier, Jaron. *You Are Not A Gadget: A Manifesto*. New York: Vintage, 2011. Print.

Lasn, Kalle. *Culture Jam: How to Reverse America's Suicidal Consumer Binge—and Why We Must*. New York: Harper, 2000. Print.

Le, Tan, and ForaTV. "Mind Control Device Demonstration—Tan Le." *YouTube*. 31 December 2008. Web. 8 July 2010.

Lee, Ellen. "The iLine begins." *SFGate.com* 27 June 2007. Web. 29 May 2008.

Lehman, Stan. "Locator chips keep track of students in Brazil." *The Guardian* 22 March 2012. Web. 12 September 2012.

Leo Burnett Moscow. *Death Revealer*. Computer software. *Apple App Store*. 11 August 2011.

Lepht Anonym. "About Me" *Sapiens Anonym*. 7 May 2011. Web. 6 June 2011.

Levinson, Paul. *Digital McLuhan*. London: Routledge, 1999. Print.

Lions Gate Home Entertainment. *The Final Cut:* Movie Trailer #2. *IMDB.com*. 2004. Web. 30 January 2007.

Ma, Zhenqiang. "An Electronic Second Skin." *Science* 12 August 2011: 830–31. Print.

MacManus, Richard. "The Wearable Internet Will Blow Mobile Phones Away." *New York Times* 20 July 2009. Web. 26 July 2010.

Maes, Pattie. "Pattie Maes and Pranav Mistry Demo SixthSense." *TED*. February 2009. Web. 7 January 2010.

Main. Douglas.. "Electronic Sensors That Stick to Your Skin Like Temporary Tattoos." *Popular Mechanics* 12 August 2011. Web. 20 September 2012.

Mann, Steve. "Mediated Reality." *Linux J* 59 (1999): 5. Print.

—. "Telematic Tubs against Terror: Bathing in the Immersive Interactive Media of the Post-Cyborg Age." *Leonardo* 37.5 (2004): 372–73. Print.

Mann, Steve, with Hall Niedzviecki. *Cyborg: Digital Destiny and Human Possibility in the Age of the Wearable Computer*. Toronto: DoubleDay, 2001. Print.

Marck, Paul. "Canadians await launch of much-hyped iPhone." *Winnipeg Free Press* 23 June 2007: B9. Print.

—. "July likely arrival date of iPhone in Canada." *Calgary Herald* 23 June 2007: C9.

—."iPhone puts Canada on hold." *Edmonton Journal* 22 June 2007: E1. Print.

—. "Sellers expect the iPhone to hit Canada this summer." *The Vancouver Sun* 23 June 2007: F4. Print.

McCarthy, Lauren. "Tools for Social Interacting." *Leonardo* 43.4 (2010): 400–01. Print.

McCarthy, Will. "Being Invisible." *Wired Magazine* 11.8 (2003). Web. 20 September 2012.

McKenna, Barrie. "Will iPhone change everything—or fall flat?" *The Globe and Mail* 26 June 2007: B18. Print.

McLuhan, Marshall. "The Hot and Cold Interview with Gerald Emanuel Stearn." In McLuhan: *Hot and Cool: A Critical Symposium*, Ed. Gerald Stearn. New York: Dial 1967.

—. *Media Research: Technology, Art, Communications (Critical Voices)*. Ed. Michel Moos. Amsterdam: G+B Arts International, 1997. 45–78. Print.

Melzer, James E., and Kirk Moffitt. *Head Mounted Displays: Designing for the User*. Ed. Robert E. Fischer and Warren J. Smith. New York: McGraw Hill, 1997. Print.

MicroVision. "Company History." 2009. Web. 5 July 2010.

—. "Wearable Displays: Military Displays." 2009. Web. 5 July 2010.

—. "Wearable Displays: Mobile Device Eyewear." 2009. Web. 5 July 2010.

Milburn, Colin. *Nanovision: Engineering the Future*. Durham, NC: Duke UP, 2008.

—. "Nanotechnology in the Age of Posthuman Engineering: Science Fiction as Science." *Nanoculture: Implications of the New Technoscience*. Ed. N. Katherine Hayles. Portland, OR: Intellect Books, 2004. 109–29. Print.

—. "Nanotechnology in the Age of Posthuman Engineering: Science Fiction as Science." *Configurations* 10.2 (2002): 261–95. Print.

Miller, Carolyn R. "Opportunity, Opportunism, and Progress: *Kairos* in the Rhetoric of Technology." *Argumentation* 8 (1994): 81–96. Print.

"MindFlex Game." *Amazon.com*. Web. 11 June 2010.

"Mind Games." *The Economist* 17 March 2007 vol 382:8520.ST. 4. Print.

Minnery, B. S., and M.S. Fine, M. S. "Neuroscience and the future of human-computer interaction." *interactions* 16.2 (2009): 70–75. Print.

Minority Report. Dir. Steven Spielberg. Twentieth Century-Fox Film Corporation, 2002. Film.

Mistry, P., Pattie Maes, and L. Chang. "WUW—Wear Ur World: A Wearable Gestural Interface." *Proceedings and Extended Abstracts of the 27th Annual CHI Conference on Human Factors in Computing Systems: Digital Life, New World, April 4–9, 2009: Spotlight on Work in Progress Session 1, New York*. Assoc. for Computing Machinery, 2009. 4111–116. Print.

Morales, Alex. "Harry Potter's Invisibility Cloak is Conceivable, Scientists Say." *Deseret Morning News* 28 May 2006 Web. 3 October 2012.

Mosco, Vincent. *Digital Sublime: Myth, Power, and Cyberspace*. Cambridge: MIT P, 2004. Print.

Musgrove, Mike. "Apple Seeks To Muscle Into Telecom With iPod Phone." *The Washington Post* 10 January 2007: D1. Print.

MyLifeBits Project. Microsoft BARC Media Presence Group. 2010. Web. 12 July 2010.

Narumi, Takuji, et al. "Meta cookie." *International Conference and Exhibition on Computer Graphics and Interactive Technologies (SIGGRAPH), Los Angeles, July 25–29, 2010*. Exhibit.

Nijholt, Anton, Boris Reuderink, and Danny Oude Bos. "Turning Shortcomings into Challenges: Brain-Compuer Interfaces for Games." *Intelligent Technologies for Interactive Entertainment: Third International Conference, INTETAIN 2009, Amsterdam, The Netherlands, June 22–24, 2009*. Berlin: Springer, 2009. 153–68. Print.

"No iPhones for Canadians." *Times & Transcript* (Moncton, NB) 30 June 2007: D2. Print.

"Nokia Morph concept" *www.nokia.com*. Web. 7 July 2010.

"Now We See Myth of Invisibility Come True." *Courier Mail* 12 August 2008: 17. Print.

NEC Corporation. *NEC Offers World's First Ubiquitous Business Support System Using Retinal Imaging Displays and Wearable Computers*. 26 October 2009. Web. 12 January 2010.

Nokia Research Center. *Nokia Mixed Reality—Nokia Worlds*. *YouTube*. 30 October 2009. Web. 26 July 2010.

O'Brien, Terrence. "Eyeborg filmmaker fires up eye-cam to document cutting edge prosthetics (video)." *Engadget.com*. 28 august 2011. Web. 17 October 2012.

O'Gorman, Marcel. *Necromedia*. 2005. Web. 13 July 2009.

Orr, J. S. "Engage Cloaking Device; Scientists in Hot Pursuit of the Ultimate Vanishing Act." *Post-Standard* 28 May 2007: A10. Print.

Ovid. *Metamorphoses*. Trans. Michael Simpson. Baltimore: U of Maryland P, 2001. Print.

Palmer, Jason. "'Cloaking' A 3-D Objects from all angles demonstrated." *BBC News* 25 January 2012. Web. 24 April 2012.

Paul, Ian. "Apple's iPhone 4 Hired as Tricorder for Space Station." *PCWorld* 13 June 2011. Web. 14 March 2012.

Parry, Marc. "Health Problems Force Professor to Pull Camera From Back of Head." *The Chronicle of Higher Education* 7 February 2011. Web. 9 September 2012.

Parviz, Babak A. "Augmented Reality in a Contact Lens." *IEEE Spectrum* September 2009. Web. 14 January 2010.

Pedersen, Isabel. "A Semiotics of Human Actions for Wearable Augmented Reality Interfaces." *Semiotica* 155.1/4 (2005): 183–200. Print.

—. "Dehumanization, Rhetoric, and the Design of Wearable Augmented Reality Interfaces." *Small Tech: The Culture of Digital Tools*. Ed. Byron Hawk, David Rieder, and Ollie Oviedo. Minneapolis: U of Minnesota P, 2008. Print.

—. "Mobility, Human-centricity, and the Design of Wearable Augmented Reality Interfaces." *International Journal of the Humanities* 3.1 (2006): 143–54. Print.

—. "MyLifeBits, augmented memory, and a rhetoric of need." *Continuum: Journal of Media and Cultural Studies* 22.3 (2008): 375–84. Print.

Pentland, Alex. *Honest Signals: How They Shape Our World*. Cambridge: MIT P, 2008. Print.

Pfanner, Eric. "Cameron Exploring Crackdown on Social Media After Riots." *The New York Times* 11 August 2011. Web. 14 March 2012.

Pilieci, Vito. "Apple's iPhone launch leaves Canadians i-envious." *The Vancouver Sun* 28 June 2007: F5. Print.
—. "Canada's iWait will continue." *Ottawa Citizen* 28 June 2007: D1. Print.
—. "Canadians left out of rush for iPhone." *Calgary Herald* 30 June 2007: D7. Print.
Plato. *The Republic of Plato: Second Edition*. Ed. Alan Bloom. New York: Basic Books, 1991. Print.
Pruchnic, Jeff. "Neurorhetorics: Cybernetics, Psychotropics, and the Materiality of Persuasion." *Configurations* 16.2 (2008): 167–97. Print.
Qualcomm Tricorder X Prize. "X PRIZE Foundation and Qualcomm Foundation Set to Revolutionize Healthcare with Launch of $10 Million Qualcomm Tricorder X PRIZE." *www.qualcommtricorderxprize.org*. 10 January 2012. Web. 14 March 2012.
Quinn, Michelle. "While Canadians wait for iPhone, Americans try to break the code." *The Gazette* 14 July 2007: I2. Print.
Rainwater, D., A. Kerkhoff, K. Melin, J.C. Soric, J. Moreno, and A. Alu. "Experimental verification of three-dimensional plasmonic cloaking in free-space" *New Journal of Physics* 14 (2012) 13pp. Print.
Rankin, Mike. "St Andrews Physicist 'Turning Science Fiction into Reality.'" *Fife Today*. 27 August 2009. Web. 20 September 2012.
Rawsthorn, Alice. "The Demise of 'Form Follows Function'; the Way Digital Products Look Often Bears No Relation to What They Do." *International Herald Tribune* 1 June 2009: 14. Print.
Redshaw, Kerry. "Claude Shannon (1916–2001)." 1996. Web. 2 July 2009.
Reed, Fred. "Thought Police May Be Coming" *Washington Times* 14 April 2007: C08. Print.
Regan, Tom, and Jim Bencivenga. "Post Digital Big Brother." *The Christian Science Monitor* 2 June 2003. Web. 31 July 2003.
Reuters. "Cloaking Device Begins to See Light of Day. "*Pittsburgh Tribune Review* 11 August 2008. Web. 20 September 2012.
Reynolds, James. "Scientific Wizards Find Real Cloak of Invisibility." *The Scotsman* 1 March 2005: 20. Print.
Rheingold, Howard. *Smart Mobs: The Next Social Revolution*. New York: Basic Books, 2002. Print.
Rhodes, Bradley. "A Brief History of Wearable Computing." *MIT*. 10 September 2003. Web. 20 September 2012.
Rocha, Roberto. "In Canada, iPhone is still a paperweight." *The Gazette* 11 August 2007: C2. Print.
Ryan, Susan Elizabeth. "Re-Visioning the Interface: Technological Fashion as Critical Media." *Leonardo* 42.4 (2009): 307–13.
Saltzman, Marc. "Why the iPhone is on hold in Canada." *The Gazette* 23 June 2007: I1. Print.

Sample, Ian. "The Brain Scan That Can Read People's Intentions" *Guardian News and Media* 9 February 2007. Web. 20 January 2009.

Saramago, José de Sousa. *Blindness*. London: Harvill P, 1997. Print.

Sargent, Ted. *The Dance of Molecules: How Nanotechnology Is Changing Our Lives*. Toronto: Viking Canada, 2005. Print.

Schiele, Bernt, Thad Starner, Brad Rhodes, Brian Clarkson, and Alex Pentland. "Situation Aware Computing with Wearable Computers." *Fundamentals of Wearable Computers and Augmented Reality*. Ed. Woodrow Barfield and Thomas Caudell. New Jersey: Lawrence Erlbaum Associates, 2001. 511–37.

Scheeres, Julia. "Saving Your Bits for Posterity." *Wired News* 6 Dec ember 2002. Web. 30 May 2007.

Schwerdtfeger, Björn, and Gudrun Klinker. "Supporting Order Picking with Augmented Reality." *Proceedings of the 7th IEEE/ACM International Symposium on Mixed and Augmented Reality, September 15–18, 2008, Cambridge (UK)*. Los Alamitos, CA: IEEE Publishing, 2008. 91–94. Print.

Seigneur, Jean-Marc. "The Emotional Economy for the Augmented Human." *Augmented Human International Conference, March 12–14, 2011, Tokyo*.

Seigel, Marika A. "'One Little Fellow Named Ecology': Ecological Rhetoric in Kenneth Burke's *Attitudes Toward History*." *Rhetoric Review* 23.4 (2004): 388–403. Print.

Sloane, Neil. "Biography of Claude Elwood Shannon." *AT&T Shannon Lab*. 2003. Web. 2 July 2009.

Shachtman, Noah. "Pentagon Kills LifeLog Project." *Wired.com*. *2* April 2004. Web. 8 July 2009.

Shanahan, Leo. "The Latest Computer Plug-in: Your Brain." *The Age* 25 April 2006: 3. Print.

Sinnreich, Aram. "Come Together, Right Now: We Know Something's Happening, But We Don't Know What It Is." *International Journal of Communication* 1 (2007): 44–47. Print.

Soar, Michael. "The First Things First Manifesto and the Politics of Culture Jamming: Towards a Cultural Economy of Graphic Designs and Advertising." *Cultural Studies* 16.4 (2002): 570–92.

some_guy_said. "Post a Comment." *ExtremeTech* 17 August 2012. Web. 18 August 2012.

Sorensen, Chris. "Apple sets out to sell iPhone by its rules." *The Toronto Star* 28 June 2007: B1. Print.

Spence, Rob. "About Me" *Eyeborg.blogspot* 29 January 2009. Web. 17 October 2012.

—. *Deus Ex: The Eyeborg Documentary*. *Eyeborg Blog*. 2011. Web. 20 August 2012.

—. "Team Eyeborg Goes on the Daily Planet." 2009. Web. 8 July 2009.

—. "The Daily Planet: One Eyed Toronto Film Maker Turns Bionic with a Web Cam Eye." 9 April 2009. Web. 8 July 2009.
—. "The Eyeborg Project." 2009. Web. 8 July 2009.
St. Clair, John Quincy. "Full Body Teleportation System." U.S. Patent Application Number: 10/953,212. Filled 29 September 2004.
Stallabrass, Julian. *Gargantua: Manufactured Mass Culture*. London: Verso, 1996. Print.
Starner, Thad, Steven Mann, Bradley Rhodes, Jeffrey Levine, Jennifer Healey, Dana Kirsch, Rosalind W. Picard, and Alex Pentland. "Augmented Reality through Wearable Computing." *Presence* 6.4 (1997): 386–98. Print.
Sterling, Bruce. "Interview with Bruce Sterling: Augmented Reality and Transitioning out of the Old-Fashioned 'Legacy Internet.'" *Augmented Reality Event 2011*. 6 May 2011. Web. 23 March 2012.
Stillar, Glenn. *Analyzing Everyday Texts: Discourse, Rhetoric and Social Perspectives*. Thousand Oaks, CA: Sage, 1998. Print.
Strange Days. Dir. Kathryn Bigelow. Twentieth Century Fox Home Entertainment, 1995. Film.
Stross, Randall. "Tracking Vital Signs, Without the Wires." *New York Times* 3 September 2011: BU3. Print.
Stuart, Keith. "Technology: Game Theory: When Games Get Physical, Guilt Comes into Play." *Guardian* 27 August 2009: 3. Print.
SwingDrama. *Lifelogger*. Computer software. *Apple App Store*. 13 December 2011 Web. 13 April 2012.
Tatum, William O., A. Husain, S. Benbadis, and P. Kaplan. *Handbook of EEG Interpretation*. New York: Demos Medical Publishing, 2008. Print.
Thorp, Edward O. *Beat the Dealer: A Winning Strategy for the Game of Twenty-One*. New York: Random House, 1962.
—. "The Invention of the First Wearable Computer." *The Second International Symposium on Wearable Computers, October 19–20, 1998, Pittsburgh, PA*. 4–8. Print.
Tolkien, J.R.R. *The Lord of the Rings*. New York: Ballantine Books, 1973. Print.
Toronto 2007. *Flickr*. Web. 25 August 2008.
"Toronto Rocked." *CBC News*. 30 July 2003. Web. 12 September 2012.
United States Patent and Trademark Office. "What Are Patents, Trademarks, Servicemarks, and Copyrights?" 12 May 2004. Web. 5 July 2010.
Usher, Oliver. "The Memory Machine." *Varsity* 2 March 2006. Web. 30 June 2007.
Virilio, Paul. *The Information Bomb*. Trans. Chris Turner. New York: Verso, 2000. Print.
—. *Ground Zero*. Trans. Chris Turner. New York: Verso, 2003. Print.

—. *Crepuscular Dawn*. Trans. Sylvère Lotringer. Cambridge: MIT P, 2002. Print.

Vuksanovich, Kalan. "Interview with Dr. Steve Mann: InteraXon's very own Research Advisor." 9 August 2011. Web. 5 May 2012.

Weiss, Rick. "Their Deepest, Darkest Discovery: Scientists Create a Black That Erases Virtually All Light." *Washington Post* 20 February 2008. Web. 15 Aug. 2010.

Weiser, Mark. "The Computer for the 21st Century." *Scientific American* September 1991: 94–104. Print.

Wells, H.G. *The Invisible Man*. London: C. Arthur Pearson, 1897.

World Intellectual Property Organization (WIPO). "What Role do Patents Play in Everyday Life?" Web. 5 July 2010.

X PRIZE Foundation. "Who We Are." *www.xprize.org*. 2012. Web. 14 March 2012.

Yong, Ed. "'Electronic skin' could replace bulky electrodes." *Nature News* 12 August 2011. Web. 15 March 2012.