RE-BECOMING HUMAN:
Restoring Critical Feeling through Ludic Performance

by
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A Thesis Submitted to the Graduate Faculty
of Rennselaer Polytechnic Institute
in Partial Fulfillment of the
Requirements for the degree of
DOCTOR OF PHILOSOPHY
Major Subject: Electronic Arts

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Rennselaer Polytechnic
Troy, New York
July, 2015
(For Graduation, August 2015)

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AKNOWLEDGEMENTS

First and foremost, I would like to thank my family. Without their emotional, physical and financial support I would never have made it through this program. My mother, Nansi Boisvert, has been a powerful and guiding force in my life. Friend, colleague and editor extraordinaire, she kept me going this past year. She is the true scholar of the family and my role model. Her anticipatory research in the early 1990s on shame as a motivating force behind human behavior and creativity spurred my own fascination with the subject. I am also grateful to my father, Joseph Boisvert, who continually reminded me to keep it simple and focus, my sister, Billie Jean Osgood, who has always been my emotional anchor and my nephew, Gavin, who reminded me to play and be spontaneous again. His abundant joy is energy for the soul.

I also want to express appreciation to my advisor, Robert Nideffer and committee members, Michael Century, Ben Chang, Mei Si and Susan Sgorbati who stayed with me through this long and circuitous process. Susan's interdisciplinary inquiry into emergence has been a source of inspiration for my art practice. I would like to extend a special thanks to Tomie Hahn who played a pivotal role in my change of focus and reminded me of the importance of the body as a site of wisdom and re-inscription. Other members of the RPI community I am immensely indebted to for their care, kindness and encouragement through this challenging process are Branda Miller, Nao Bustamante, Kathy High, Pauline Oliveros, Ted Krueger and Ellen Esrock. I am grateful to Allison Berkoy and Heather Dewey-Hagborg for the hikes, swims in the lake and intellectual debates and Jim de Seve and Kian Tjong for sending me on my first silent meditation retreat, which was the beginning of my journey back to myself.

Since my retreat to Maine, I have been blessed with a new community; they have been instrumental in my personal transformation and ability to finish. I am grateful to Michelle McComb, my yin yoga teacher, who taught me to change the voices in my head and to treat myself with loving-kindness. Plus, the rest of the yin yoga class Thursday dinner crew, Susan, Buddy, Joe, Otie, Julie, Paul, Karen and Ann who created a safe space to learn how to connect on a heart level and move out of my head. I am also lucky to have encountered Tom St. Anand, acupuncturist and Dr. Patrick Mulcahey, integral

medicine doctor, who both contributed to realigning my body and restoring my sense of vitality. Dr. Linda Morrison, my therapist, enabled me to understand that writing a dissertation was the only way to see myself in one place and to work through the fragments to rebuild my scaffolding, bringing my body-mind together again.

I am blessed to have had three consistent sounding boards this past year while I was off the grid. Our telematic and occasional in person conversations were a source of resonance and strength. First, I wish to thank Stuart Ewen for all the amazing dinners and walks on the beach to talk through some of the conceptual frameworks. He encouraged me to make my ideas accessible. Second, Susi Mulligan, my life coach, whose patience helped me put the pieces back together and encouraged me to continue going by setting small goals. Finally, Michell Zappa, my doppelganger, and dear friend, for the many wonderful flights of imagination we took together speculating on the future of technology.

I also owe tremendous thanks to all the wonderful individuals whom I have been honored to collaborate with over the past couple of years: Pauline Jennings, Doug Van Nort, Allen Hahn, Raven Kwok, Amy Nielson, MJ Caselden, Ill Invincible, Carlos Garcia, Wesley Taylor and Wajeed. Your talent and passion for beauty, innovation and social change has kept my own alive. A very special thanks to Marco Donnarumma, my collaborator and partner in crime.

And lastly, I would like to dedicate these words to both my aunt, Zlata Paces, whose death as a result of our dependence upon unreliable biotechnology fueled this inquiry and to my ex-partner who broke my heart and unknowingly catalyzed a spiritual re-awakening that forced me to confront my fears and to finally sit down and write.

ABSTRACT

Our current intelligent technologies, namely the Internet, mobile devices, and now immersive displays and wearables, are numbing our biological self through a form of what Marshall McLuhan referred to as "self-amputation." This dissertation is a critical examination and creative re-envisioning of the legacy of cybernetics. It seeks to both interrogate the underlying rhetoric fueling the post-biological technocracy to which we are unconsciously ceding control of our cognitive and affective faculties, and also explores how embodied, bio-adaptive game-based networked performance practices can serve as an antidote, restoring critical feeling. Through two case studies of my own interdisciplinary collaborations, *[radical] signs of life* and *Beware of the Dandelions*, this practice-based research attempts to recuperate the biological self by 1) re-inscribing the body, affect and the senses into current techno-utopian discourse, and 2) re-stimulating the peripheral nervous system through biomedia[1], performative gesture and socio-collaborative play.

[radical] signs of life[2] is a large-scale multi-media experience employing biotechnology to integrate networked bodies and interactive dance. The work externalizes the mind's non-hierarchical distribution of thought through responsive, rule-based choreography and a database of phrases. Music is generated from the dancers' muscles and blood flow via biophysical sensors that capture sound waves from the performers' bodies. This data triggers complex neurobiological algorithms to be projected onto multiple screens as 3D imagery. As the audience interacts with the images produced, they enter into a dialogue with the dancers. Conceptually, the piece is an embodied examination of the increasing disparity between the encroachment of bio-data and the quiet discord of bio-memory.

Beware of the Dandelions[3] (work-in-progress) is an alternative reality game-based, immersive theatre performance that teaches social movement building through

[1] Both works visualize, sonify and trigger real-time data from the performers' bodies through the Xth Sense (XS), an open-source biophysical sensor. For more information: www.xth.io.
Xth Sense (XS), an open-source biophysical sensor. For more information: www.xth.io.
[2] www.radicalsignsoflife.tumblr.com.
[3] www.emergencemedia.com

complex science. Through a sci-fi parable, the work integrates a data-driven narrative with game-based collaborative problem solving communicated through live hip-hop and DJ performances. The participant-players wear biophysical sensors to control a 3D game engine projection mapped onto a 24 x 12 foot sentient pod. Players spatially trigger real-time story content consisting of data visualizations, surveillance cameras, systems communication, embedded clues and puzzles, and embodied social interactions. They are tasked with interpreting the flow of non-linear information to make sense of the narrative in order to act collectively to transform the framework of the AI system—a metaphor for systems of oppression.

Both the case studies and theoretical argument attempt to define a new genre—"ludic performance"—and offer an alternative technological paradigm, one which highlights "embodied differentials:"[4] the intricate co-existence of and relationships between bodies, social contexts and complex practices that foreground unpredictability, emergence and interdependence in an attempt to resist the predominant fear-based systems of social control, prediction and quantification. By reasserting the centrality of the body, affect and the senses—the messiness of subjectivity—these works seek to reject our evolving transformation into human APIs increasingly run, like our software applications, on scripts and protocols, and instead establish mixed reality conditions for the cultivation of a social ecology that optimizes our ability to "experience our own intensity"[5] through a more balanced, equally agentic partnership with technology, one that suspends the performer-audience in a state of multiplicity and relational becoming.

[4] Jaime del Val, 2013 Meta-Body Conference programme.
[5] Marcel Merleau-Ponty, *Phenomenology of Perception*, trans. Robert Smith (London: Routledge, 1989).

Introduction

"Only through the development of arts as powerful as the technology around us will we ever be able to regain any of the peace and understanding that was ours in a more pristine world."[6] *Manford Eaton*

Nicolas Carr suggests that we "amplify our native capacities" through technology for four distinct reasons: 1) to extend our physical strength, 2) to augment the range or sensitivity of our senses, 3) to enable us to reshape nature to better serve our needs and desires, and 4) to expand or support our mental powers.[7] If one takes Carr's position, then we can deduce that every technology from personal gadgets to large-scale infrastructure is an "interested"[8] articulation of human will. Through the design, development and use of tools, humans seek to extend power and exert control over perceived limitations and threats of entropy. Whether we attempt to exercise control over nature, time and space, one another, or even ourselves, by incorporating technological tools into the fabric of our everyday lives through routine socio-cultural practices, we seal their power to surreptitiously alter our mental, physical, emotional and social landscapes. Carr labels the fourth category "intellectual technologies," which consist of tools that allow us to organize information, to generate and communicate ideas, to perform abstract calculations and to expand the range of our memory. Because intellectual technologies are rooted in language, aiding in the formation of knowledge-schemas and bound up with facilitating self-expression, maintaining relationships and sculpting our public personas, Carr contends, "they have the greatest and most lasting power over what and how we think,"[9] and I would add, how we feel. Imbued with an "intellectual ethic,"[10] a set of values and assumptions about how the brain functions, they also carry the potential to radically reshape not only our worldview but also our brain circuitry. For Carr, an intellectual ethic consists of "the message that a medium transmits into the minds and

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[6] Manford Eaton, *Bio-Music*. (Barton, VT: Something Else Press, 1974).
[7] Nicholas Carr, *The Shallows: What the Internet is Doing to our Brains* (New York and London: W.W. Norton & Company, 2010), 44.
[8] Like Langdon Winners, I believe that behind the massive process of technological evolution one always finds a realm of human motives and conscious decisions in which actors at various levels determine which kinds of apparatus, techniques, and organization are going to be developed and applied. Technological development is, therefore, always interested personally, politically and/or economically.
[9] Ibid.
[10] Carr describes this as an implicit assumption "how the brain works and should work," which I argue derives from predominant theories of cognitive science stemming from the cybernetic paradigm, which still views the mind as a computer model of the brain.

culture of its users,"[11] often overlooked by its users and unconsciously (sometimes consciously) integrated by its creators. The Internet's message, the topic of Carr's book, is largely one of "seize our attention to only scatter it," which he insists is leading to long-term neurological consequences.

While I find Carr's overall argument compelling, the studies he selects to reinforce his argument are at times causally reductive and the absence of any reference to the body and theories of embodied or extended mind is shortsighted. For instance, Carr conflates an increased distraction with a lessening in the abilities to experience empathy, compassion and other emotions, and suggests neuroplasticity may be a link to help us understand why we willingly give up our innate biological knowledge and control when a technical affordance presents itself, but offers no further analysis of how. Sherry Turkle offers more sound empirical evidence of the growing decline in socio-emotional competence resulting from our digital consumption habits, but she, too, neglects the body and by offering neither solutions nor alternatives contributes to the false assumption that technological advance is inevitable. While Carr and Turkle point to the interplay of forces contributing to our renunciation for genuine human connection—our loss of passion for direct experience—a closer examination of the body, affect and the senses as they relate to contemporary intellectual technologies, might both undergird their respective findings and move me closer towards reverse engineering what I perceive as our growing decline in what I call "critical feeling."

This dissertation, therefore, will further investigate and expand upon Carr and Turkle's assertions to arrive at a deeper understanding of the socio-cultural and neurobiological impacts caused by our dependence upon intellectual technology. It seeks to fill in the clinical gaps and move beyond a singular focus upon cognitive impacts to embrace a holistic understanding of the role the body, kinesthesia, affect and the senses equally play in shaping the mind and our behaviors. The study will establish a dialectic between theoretical inquiry, personal experience and art practice to highlight my concerns about the loss of critical feeling resulting from our over-reliance upon intelligent technology and to offer counteractions and an alternative technological paradigm to intervene in its decline. In addition to the Internet and mobile devices, I also examine

[11] Ibid, 44.

immersive displays and wearables. I choose to use the word "intelligent technology" to refer to these four technologies throughout the document rather than "intellectual technology" to imply that although humans are not entirely driven by artificial intelligence, my research findings and direct experience have led me to believe that current intellectual technology is increasingly taking over significant cognitive and affective faculties of its users, which I anticipate will only continue as the Internet of things further evolves. Technologists may not apply overt persuasion tactics; instead, as Jaron Lanier informs his readers in *You're Not a Gadge*t, the technologies themselves "make up extensions of your being, like remote eyes and ears and expanded memory. These become the structures to connect to the world and other people. These structures in turn can change how you conceive of yourself and the world."[12] I, too, view intelligent technology as growing in symbiotic partnership with the user—a "dance of agency."[13] But I also perceive problems in this increasingly imbalanced partnership.

This study, therefore, asks: *How did we get to a point where we so easily render our biological control and knowledge to technical affordances? Which mechanisms have been conducive to "self-amputation"?*[14] *Can taking up the same intelligent technology in the service of aesthetics resist amputation, maintain autonomy and restore critical feeling to create more balance between the biological and technological self?*

This dissertation attempts to answer the above questions through various approaches: 1) by using the theoretical lens of embodied cognition, 2) by understanding the continued influence of the cybernetic paradigm on the design of intelligent technology and the popular imagination, 3) by deconstructing the hidden mechanisms of shame explored through self psychology and 4) by demonstrating how I designed my creative work to function as an observational (and performative) assay. Following Andy Clark who suggests, "the brain's great plasticity and thirst for cheap outsourced labor drives the distributed engines of socio-technological adaptation and change,"[15] I find that a fully embodied and adaptive mind seeks to process and execute functions with a

[12] Jaron Lanier, *You Are Not a Gadget: A Manifesto* (New York: Random House, 2011), 5.
[13] Andrew Pickering, *The Cybernetic Brain: Sketches of Another Future* (Chicago: University of Chicago Press, 2011), 20.
[14] In *Understanding the Media*, Marshall McLuhan coins the term "self-amputation" to describe the numbing relief performed by the nervous system when it reaches a threshold of sensation encountered through digital media.
[15] Andy Clark, *Supersizing the Mind: Embodiment, Action and Cognition* (New York: Oxford University Press, 2008), 146.

minimum amount of effort and no central command center. As Clark claims, the mind "produces self-stimulating cycles of material scaffolding to yield an acceptable result by recruiting, sometimes exploiting, often on the spot, a mix of non-hierarchical problem-solving resources/opportunities."[16] These opportunities consist of dynamic loops of perceptual and motor routines combined with neural processing and storage, active sensing, and environmental affordances. Extended tools, like the Internet, mobile devices, immersive displays and wearables, therefore, can serve as environmental affordances, "cheap labor," which share and reduce the overall cognitive load to free up resources from the memory task, enabling higher assembly processes, like abstract thinking, multi-tasking and even empathy to form.

The "principle of ecological assembly" described above, however, relies upon a healthy distribution of resource-recruitment across the mind, body and the environment, including technical-vital. But current devices emphasizing cognitive efficiency entice us to further minimize bio-memory, our innate biological intelligence; instead, they maximize the use of environmental support in the form of artificial intelligence to reduce effort. Because intelligent technology has become a predominant environmental support for many, as Turkle uncovered, I suggest that an imbalance in the assembly process is created. The intellectual ethic informed by cybernetic models and instilled through the design of hardware and software to be embedded through repeat exposure to user experience design and cultural habits that form around these design choices encourages our dependence and this imbalance. It is, therefore, not the tools themselves, but the constant repetitive, interactive and intensely addictive nature afforded by what Lanier labels the "anti-human design" of applications, which he claims effectively "tinker[s] with your philosophy by direct manipulation of your cognitive experience, not indirectly through argument."[17] I, like Carr, had begun to feel as though "someone, or something, ha[d] been tinkering with my brain, remapping the neural circuitry, reprogramming the memory."[18] I started to notice that I no longer thought, wrote or felt as I once did with focus, presence, depth, confidence and clarity of perception, and my behaviors and

[16] Ibid.
[17] Jaron Lanier, *You Are Not a Gadget: A Manifesto* (New York: Random House, 2011), 5.
[18] Nicholas Carr, *The Shallows: What the Internet is Doing to our Brains* (New York and London: W.W. Norton & Company, 2010), 5.

interpersonal relationships were beginning to mirror the tools I used; they became increasingly social-emotionally incompetent. As a result, I, too, began to question the makers of and the tools themselves.

In this dissertation, as well as the creative works that form the practice-based component of my research, therefore, I attempt to explore some of the ways in which what I am calling "intelligent technology," continues, I contend, to be informed by an intellectual ethic derived from the cybernetic paradigm, which stems from fear-based systems of quantification, prediction, optimization and control. I also examine how pop culture, specifically cyberpunk and sci fi movies, may have influenced and continues to influence the design and development of the Internet, hardware and software applications and social practice. To support this observation, I draw upon N. Katherine Hayle's social constructivist critique of cybernetics as a teleological forking moment of disembodiment. In both Chapter Four and Ten of *How We Became Post Human*, she closely reads cyberpunk fiction as "information narratives" that transform presence and absence into pattern and randomness, displacing physicality in the plot, characters, and even the reader. She sees these semiotic representations as historically specific by-products of the liberal humanist impulse arising out of cybernetics, which she argues takes "computation rather than possessive individualism as a ground of being."[19] I extend this analysis to contemporary examples in film and television. Additionally, I consider how cybernetics merged with prevailing ideas from the military and modernism to equally regulate emotions and canalize the senses. I suggest that we are now in the midst of a Cybernetic Renaissance, where the "insolvent place of the body,"[20] affect and the senses persists, reinforced once again by a small group captivated by immortalist yearnings, most notably Ray Kurzweil, Martine Rosenblatt, Aubrey De Grey, Kevin Kelly, Sergei Brin and Jason Silva.

The first half of my hypothesis, therefore, forwards that the design of current intelligent technologies, specifically, the Internet, mobile devices, immersive displays and wearables, are infused with a cybernetic ethic intended to not only extend but slowly

[19] N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago and London: The University of Chicago Press, 1999), 34.
[20] Anna Munster, *Materializing New Media: Embodiment in Information Aesthetics* (Lebanon, NH: Dartmouth College Press, 2006), 3.

override users innate biological knowledge, cognitive and affective systems, in an effort to transform behaviors and social interactions into API-like scripts, whereby users become more prone to respond, like software, to computational protocols, easing the inevitable evolutionary transition from being born to being made. I began analyzing market-driven trends, in large part due to feeling that my own bodily engagement with the world, and those close to me, was causing me long-term neurobiological, and perhaps even epigenetic, damage, and contributing to a sense of social disintegration and, most importantly, a loss of what I've now come to term "critical feeling." I find that critical feeling emerges when memory consolidation is properly functioning, enabling both emotion-feeling activation and regulation and knowledge-schema production to occur. I maintain that constant cognitive overload caused by what I perceive to be an unhealthy dependence upon intelligent technology induces techno-stress, which interrupts memory consolidation and sets our cortisol levels to a constant state of fight or flight, causing an imbalance in the ecological assembly process. This imbalance eventually burns out the endocrine system, which in turn triggers neurotransmitter dysregulation. I base these assumptions upon both personal experience and clinical research gathered to make sense of my own failing health. In short, I argue that intelligent technology is a slow form of violence re-scripting the nervous system, which in turn affects physical well-being, inter-personal relationships, and by extension, the fabric of society.

The second part of my hypothesis not only tests these assumptions but also details how I experimented with an antidote through my art practice. My artistic claim is that by reasserting the centrality of the body, affect and the senses through what I coin *ludic performance*, I can offer a framework for re-balancing the ecological assembly process. Ludic performance is a multi-modal performance practice that uses the body as base materiality to generate the work coupled with spontaneous gesture and socio-collaborative play embodying complex systems. This framework, what I consider an alternate cybernetic model of sorts, seeks to create an optimal environment for memory consolidation and the restoration of critical feeling. The two works under review here, *[radical] signs of life* and *Beware of the Dandelions*, were generated within this framework to afford me a microcosmic sandbox to run performative assays with live

bodies to identify the necessary conditions for a more balanced negotiation between mind-body-environment, both natural and technical-vital.

I see the body as both *lived* and *corporeal*, subjective and objective. Like, Marcel Merleau-Ponty (1962), I understand the *lived* body as the subjective, pre-semiotic body, which is co-extensive with the world and comprised of felt bodily sensations—i.e. my "embodied being-in-the-world," now mediated and modified by intelligent technology. In contrast, the *corporeal* body is the objective, physiological body that can be observed, measured, quantified, manipulated. For me, corporeality surfaces whenever spontaneous bodily expression is paralyzed, blocked, objectified or oppressed by another's presence, moving the *lived* body into unwelcome exposure or turning it back upon itself, causing self-consciousness to emerge in either move. I see corporeality, therefore, as the source of individualization catalyzed by shame. Corporeality emerges when lived experience which includes affect and the senses, cannot resist binary distinctions between the mind and body. I experience intelligent technology, therefore, as an extension of corporeality, not of the lived body. For me, spontaneous, unpredictable expressivity through performative gesture and play amplified through biomedia, such as the Xth Sense, a biophysical sensor employed in both creative works to sonify and visualize real-time data emanating from the performers' bodies, suggests an opportunity to recover the lived body from what I perceive to be its current numbed corporeal state, and to bring the human-technological confluence back into harmony.

Preceding a thorough discussion of my performative assays and to better inform the readers' understanding of such, this dissertation will first look more closely at the relationship between the socio-cultural habits that form around our dependence upon intelligent technology and the neurobiological changes possibly resulting from this dependence upon both our brain wiring diagram and nervous system. Brain wiring diagram is a term I borrow from Antonio Damasio. It refers to the structural map of our neural connectivity in the brain, including the detailed activity of synapses and neurons at the cortical and sub-cortical level within an organism's nervous system.[21] Culled from cultural critiques and direct experience, the socio-cultural patterns I observe and discuss in the following chapters consist of a set of personal and interpersonal behavior changes

[21] Antonio Damasio, *Self Comes to Mind: Constructing the Conscious Brain* (New York: Pantheon, 2010).

magnified by technological mediation. Several of these changes are the fostering of at-a-distance relationships, which encourage a preference for the "performance of connections,"[22] the social norming of pathological narcissism and the growing inability to read social cues and express empathy as a result of less face-to-face time. I argue that these altered states, which are quickly turning into human traits, also serve to bolster our social armor, our ego defenses, reinforcing a fear of vulnerability. It is my hope that the reader will discover that pervasive screen culture facilitated through contemporary intelligent technology becomes an effective means to shield and numb us from shame, which I posit both fuels our creation of technology and also reinforces our consumption and dependence upon it. For me, shame is a fear of being exposed as unworthy of love and belonging. The brain processes it the same way as physical pain. It is part of the script that maintains our homeostatic impulse. I believe that intelligent technology is one mechanism that we employ (that we have come to depend upon and hide behind) to avoid the excruciating sensation of social rejection or by pass shame, which I contend that we unconsciously store in our bodies as trauma.

A second set of concerns surrounds the neurobiological impacts that I began to experience in myself and tried to puzzle out by analyzing and connecting cross-disciplinary clinical studies, all of which consistently correlated to an increase in gray matter with regard to the amygdala and hippocampus. Drawing upon a synthesis of various clinical studies read to comprehend my own experience, I will describe how the hippocampus and the amygdala, areas of the brain responsible for memory consolidation, are shrinking as a result of our reliance upon intelligent technology. I posit that the Internet and its many surrogates are clogging working memory, disallowing synaptic terminals to form in the frontal lobe, serving to truncate explicit memory consolidation, the procedure which enables an individual to form basic knowledge-schemas and to both activate and regulate our emotions. The ability to form schema and to activate and regulate emotion are two key elements that make up what I refer to throughout this document as "critical feeling." As an artist working towards social change, I believe that critical feeling is an essential requirement for passional engagement with the world and

[22] Sherry Turkle, *Alone Together: Why We Expect More from Technology and Less From Each Other* (Philadelphia:Basic Books, 2011), 9. A term used repeatedly throughout the text to distinguish physical connections from online communication.

one another. Critical feeling moves us to act civically and engenders our capacity for intimacy with those we care about. It is grounded in emotion, not intellect, in genuine embodied presence, not virtual absence.

As a result of reading numerous studies, I construed that when memory consolidation does not occur consistent features emerge: an inability to plan ahead, a lack of impulse control, poor concentration and a reduction in empathy and remorse. Based on these studies and my own personal experience, I observed that the unconscious accumulation of stress accompanying my ceaseless over-reliance upon intelligent technology coupled with a reduction of kinesthetic movement and less face-to-face time (which both eases stress and encourages mirror neuronal engagement), were contributing to a chemical imbalance. The spike in my cortisol levels incited adrenal fatigue, which disallowed the normative regulation of three main neurotransmitters, dopamine, serotonin and norepinephrine, contributing to my decline in social-emotional competence and well-being.

Drawing from these personal physiological experiences, I will also suggest that the nervous system, which communicates directly with the endocrine system through neuropeptide receptors, serves as an internal architecture, filtering our perceptions of the world. If the nervous system is sensitive and always set to low-grade fight or flight, as mine was, the world can be experienced as unsafe and insecure. To keep uncertainty at bay, my embodied mind went into over-drive and employed hyper-vigilant pattern recognition to constantly scan for anticipated danger, which served to both sustain the high cortisol levels and reinforce my social armor to defend against vulnerability. All of this narrowed my worldview. In the process of researching the causal mechanisms at play, I discovered that the interoceptive system, which is the body's generic sensing mechanism that detects and classifies changes to our internal milieu and viscera based on changes to environmental conditions, guides our behavioral response to people, places or things; external stimuli communicates through nerve fibers in this system to regulate internal chemical reactions in the autonomic nervous system. Thus, I might appear open, calm, and responsive or closed, jittery and reactive. However, kinesthesia and bodily awareness (which the Xth Sense enhances) suggests a way of quieting the nervous system and transforming musculature tension, rendering us more open to critical feeling.

Having derived increased knowledge of both the socio-cultural and neurobiological changes I experienced through personal reflection and came to understand through cross-disciplinary literature, I have arrived at the conclusion that techno-stress caused by dependence upon intelligent technologies, such as the web, mobile phones, and soon immersive displays and wearables, appear to not only be slowly reshaping brain wiring diagrams but also quietly taking over critical cognitive and affective faculties. As a result of these comprehended changes in myself, I will contend that others who might suffer from a similar dependence and sensitivity might come to function more and more like closed systems, less able to make sense of and trust in the unpredictable and unfiltered world. Within a climate of numbing withdrawal, a direct reaction to unconscious stress, which, as Stelarc describes in a 1983 interview, "facilitates the use of technological tools as extensions that project the body-as-prosthesis back into the world,"[23] I believe that fear becomes the norm, and that social change becomes more difficult.

Nonetheless, concurrent with my growing reservations, I am conscious of the benefits of emerging, intelligent technology as a facilitator of global communication and knowledge sharing, galvanizing support for a cause, as well as a purported instigator of social movements (i.e. Arab Spring, Occupy Wall St.), and that cultural critics have voiced similar concerns about the Internet's cultural effects, loss of privacy and dissolution of sustained thought ever since the 1990s, as Adam Thierer astutely delineates in "Are You An Internet Optimist or Pessimist? The Great Debate over Technology's Impact on Society."[24] In contrast, I will attempt to move beyond false binary arguments, which are premised upon whether intelligent technology strengthens or weakens cognition, encourages or discourages connection. My intention is not to condemn intelligent technology but to problematize it as an ambivalent artifact situated within an ecology of effects—social, cultural, neurological and biological—to offer a more balanced alternative through a creative practice that utilizes expressive, bio-adaptive technology. I have chosen to align more closely with Carr, Turkle and to some extent

[23] James D. Paffrath and Stelarc, eds*., Obsolete Body/Suspensions/Stelarc* (Davis, CA: JP Publishing, 1984).
[24] Adam Thierer, "Are You An Internet Optimist or Pessimist? The Great Debate over Technology's Impact on Society," accessed June 10, 2015, http://techliberation.com/2010/01/31/are-you-an-internet-optimist-or-pessimist-the-great-debate-over-technology's-impact-on-society/.

Lanier's stance because they offer a corrective to the dominant techno-utopian discourse, the heroic, monolithic narrative of the Internet and its many surrogates, espoused by contemporary digital pundits who conflate technological advance with human progress. But it is also where the research and my own personal experiences organically led me as I began to connect the interdependent dots.

I do, however, acknowledge the limitations of Carr, Turkle and Lanier's arguments as well as the fervent counter arguments, which I found equally one-sided, non-evidence based and unpersuasive. While critics claim that Carr and Turkle focus on the most egregious cases, ignoring positive social connections and learning outcomes, their critics, too, selectively highlight the most benign. For instance, one particularly acrimonious critic of Carr forwarded a 2009 comprehensive review of the cognitive effects of videogames (which Carr does not even address) as a counter example, revealing significant improvements in cognitive tasks such as visual attention and memory.[25] The same author also singles out a study to show that web surfing increases activity in the dorsolateral prefrontal cortex, the area of the brain responsible for selective attention and deliberate analysis to prove Carr's claims unconvincing. The study referenced, however, does not test for improvement in these two tasks; yet the author concludes that "Google in other words isn't making us stupid—it's exercising the very mental muscles that make us smarter."[26] Both sides possess one thing in common; they focus entirely on cognitive implications, disregarding the physiological and affective effects that contribute to changes in brain structure and cultural habits and the ways in which spontaneous bodily engagement can offer an antidote. This, an exploration of the physiological and affective effects will, perhaps, be my contribution to the field. The written part of the dissertation will attempt to unearth the causal chain of interdependent relationships between the mind-body-environment, both natural and technical-vital, that contribute to what I perceive to be a growing dependence upon intelligent technology and a resulting decline in critical feeling. The creative practice will then re-enact these assumptions in an effort to discern possible alternatives.

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[25] The author also neglects to acknowledge the critical distinction between implicit and explicit required for system consolidation.

[26] Jonah Lehrer, "The Shallows," review of *The Shallows: What the Internet is Doing to Our Brains*, by Nicholas Carr, *Frontal Cortex*, June 6, 2010, http://scienceblogs.com/cortex/2010/06/06/the-shallows/.

This hybrid study does not deny that human beings were already inclined towards atomization, loneliness, narcissism and biological co-optation before the dawning of the Internet, virtual reality, Fitbits and Facebook. Nor does it assume our mind and bodies were unchanged by seemingly innocuous tools, like the book, which Socrates railed against for making us forgetful. In fact, I outline the evolutionary threads. But awareness of this past does not countermand my contemporary diagnosis. This dissertation does not pretend to offer a balanced or a purely evidenced-based view. Instead, it asserts itself as a timely and urgent piece of "meditative thinking"[27] and a creative inquiry informed by an anti-disciplinary approach to analysis, suspended in a complex network of intersecting, often contradictory, ideas and relationships. This chosen ecological approach strives towards prismatic complexity and interdependence rather than the mounting of a balanced, linear argument. Historically, voices who challenge dominant ideologies and work across disciplines have been resisted, some even demonized. The theoretical part of this dissertation might, therefore, be considered a call to arms, a manifesto, against what I perceive to be the reigning cybernetic episteme influencing the design of current intelligent technology and my creative practice a form of "ontological theatre," what Andrew Pickering in the *Cybernetic Brain* describes as "doing cybernetics," rather than thinking it, which aligns more closely with performance practices and theories of embodied cognition. Contrasting the specific interpretation of cybernetics in the United States with British applications, Pickering suggests that the British cyberneticists active during the same Post WWII era, in particular, Grey Walters, Ross Ashby, Stafford Beers and Gordon Pask, wanted to comprehend "what else the brain could do besides serving as an organ of representation."[28] Thus, they perceived the brain "as an embodied organ, intrinsically tied to bodily performance"[29] and its role in the performance was adaptation. Rather than devising tools to "command and control" the brain, British cyberneticists took a non-dualistic approach to experimenting with the brain's complex, performative

[27] Martin Heidegger, *Discourse on Thinking*, trans by John M. Anderson and E. Hans Freund (New York: Harper & Row Publishers, 1966), 151-52. A term Heidegger uses to distinguish form calculative thinking, linear thought that enables us to get from point A to point B by researching, planning and organizing for a specific purpose. By contract, meditative thinking is a form of thinking that facilitates getting at the core truth of life. It is reflexive and encourages us to turn inward, and honor our own center of being. He saw calculative thinking as a "flight from thinking," which disallows us from "contemplating the meaning which reigns in every that is." It is revealing, rather than enframing.
[28] Andrew Pickering, *The Cybernetic Brain: Sketches of Another Future* (Chicago: University of Chicago Press, 2011), 6.
[29] Ibid.

structure to model other things, such as creating adaptive electro-mechanical devices, most notably Walter's tortoises and Ashby's homeostats, considered antecedents of today's responsive interaction design.

My creative practice advances a similar approach. One might consider ludic performance a "cybernetics of cybernetics;" its defining characteristics mirror principles of cybernetics (i.e. complex systems, biofeedback, brain simulation, etc.) as a vehicle to critique cybernetics and to explore an alternative to its domineering influence on the design of contemporary intelligent technology and the behavior of its users, which I insist are still based on cognitivist models of the brain. Take, for instance, the most recent theory, the predictive coding model (PCM), which focuses on fixing "feed forward residual errors" by excising informational uncertainty and spontaneity in the brain. PCM suggests a new model upon which future mainstream technologies might be based. Reframing cybernetics as "ontological theatre," therefore, offers a movement away from representational models of the brain, like PCM, which are often mired in epistemic sedimentation and instead creates an opportunity for "open-ended, performative interactions between humans and machines"[30] filled with surprise and in-the-moment responsiveness. Like Gordan Pask's *Musicolour*, which was considered the first cybernetic art object, the performers in both *[radical]* and *Beware of the Dandelions*, "could not think his or her way through," the game-like systems I devised. Rather they must intuitively "respond" real-time to the various streams of information, both human and machine-generated, to "see how the machine would respond; try something else in response to whatever the machine's response turned out to be."[31]

My creative research also takes its cue from the new media artists of the 1990s who similarly created a space for critically debating and modeling the impacts of information technology. Artists like Jeffrey Shaw, Diane Gromola, Simon Penny, to name a few, appropriated emerging technology to design "experiences to think with." Following Caroline Jones who suggests, "the only way to produce a techno-culture of debate at the speed of technological innovation itself is to take up these technologies in the service of aesthetics," I, too, seek to employ contemporary wearable biotechnology as

[30] Andrew Pickering, "Ontological Theatre: Gordon Pask, Cybernetics, and the Arts." *Cybernetics and Human Knowing*. 14(4) (2013): 43-57.
[31] Ibid, 47.

an expressive instrument (rather than as a functional data-driven device) in response to what I anticipate will coincide with what I delineate here as the now surfacing sixth wave of innovation, which focuses directly on biological mediation: the biomimetic-molecular turn. In doing so, I offer two examples of artist interventions that take into account the autonomous power of the sub-sensorial and consciously incorporate unpredictability, surprise and unquantifiable subjective experiences, in an attempt to counter models like PCM and encourage human error and the maximization of free energy. As creative interventions, *[radical]* in particular, also advocates catalyzing a simulated state of "positive disintegration" through spontaneous bodily expression to give full reign to emotions and the senses as a way to restore critical feeling through the amplification and biofeedback of the nervous system.

This dissertation, therefore, historically situates autonomous art as a counter-discourse to the cybernetic paradigm forwarded in the United States. It aligns distinct artistic movements with the three waves of cybernetics and also maps their corresponding evolution in cognitive science to show how interdisciplinary collaborations between art, science and technology during 1950s-90s served as a counterpoint, a shadow discourse, to the prevailing ethos of each period. The literature review I offer will also enable me to situate ludic performance as a particular critical response to the current techno-scientific trends resulting from what I observe as a resurgence of cybernetic rhetoric. One informed by sixty years of experimentation with biosignals for performance and game-based choreographic strategies in dance. However, the study will also question whether autonomous art can still catalyze a shift of consciousness today amidst the pervasive "ecosystem of interruptions."[32] The two creative works, outlined in the form of case studies, are an attempt to determine what ingredients and resolution are necessary to penetrate the noise. For me, this year, 2015, signifies another teleological forking moment in the history of technological innovation, because human biology is a focal point, as Joi Ito's opening keynote title at the 2015 SOLID conference attests: "Bio is the new digital."[33]

[32] A phrase coined by Cory Doctorow in an article for BoingBoing to talk about the pervasiveness of screen culture.
[33] In his keynote at the SOLID Conference held June 22-24th 2015 at Fort Mason, CA, Ito talks about how commonplace synthetic biology will become in the next few years as hardware pushes innovation from centralized power to the edges, like software once, lowering costs and open-sourcing based on Moore's Law. This he believes will make biology and electronics "fungible."

This dissertation, therefore, has evolved into a critical examination and a creative attempt to urge a revisionist approach to the legacy of U.S. cybernetics by harnessing the power of biomedia, performative gesture and socio-collaborative play—ludic performance—to recuperate what I perceive as the numbed biological self. I seek to establish a twofold method by: 1) re-inscribing the body, affect and the senses into current techno-utopian discourse, and 2) re-stimulating the peripheral nervous system through kinesthetic play and bio-adaptive feedback. To succeed in these goals necessitates the fashioning of a new techno-cultural paradigm. As a backlash to what I deduce to be a Cybernetic Renaissance, I could launch a campaign similar to techniques stylized by the first wave of cyberneticists after World War II. Such a campaign would require: 1) a new theory of information, 2) a simulation of neurobiological functioning, 3) a quantum computer modeled on biological systems, and 4) a massive strategic communication plan that would transform the public imagination. While this type of a full on campaign may lie outside the scope of this dissertation, my presentation of an achievable alternative paradigm is explored here in the final two sections of the following pages, through both autonomous and committed experiments in dance and theatre, respectively. Both creative works foreground unpredictability, emergence, spontaneity, interdependence and impermanence in an attempt to resist fear-based systems of social control, prediction and quantification. Both creative works will establish conditions for the playful cultivation of a dynamic social ecology wherein "meta-bodies"[34] can flourish in balanced partnership with technology to suspend the performer-audience and environment in multiplicity and relational becoming.

Now that I have mapped out the key themes and movements within the dissertation and defined the terms, I would like to turn to the general structure.

The historical, clinical and theoretical reviews examine and explore a perceived societal problem (dependence upon intelligent technology is changing brain wiring diagram and re-scripting nervous systems to become more like tools—affectless APIs run on pre-determined scripts) and points towards a solution (critical feeling can be restored through embodied, spontaneous bio-adaptive play). The creative executions test these

[34] A term coined by Jaime del Val for the five year European funded conference of the same name. Meta-bodies, though difficult to define, imply the irreducible and shifting differences between bodies, social contexts and modes of expression.

very assumptions and rehearse solutions through a non-dualistic assay modeled on the embodied mind in the form of ludic performance, which architects experiences in dance and theatre wherein people, things, data and processes are encountered as indistinguishable from one another. In ludic performance, mind-body-environment is an interdependent experience in which all elements are equally agentic. Both examples of ludic performance presented here, *[radical] signs of life* and *Beware of the Dandelions* seek to reveal the performative nature of the mind, both human and technical-vital, respectively. In *[radical]* the dancers perform the brain's non-hierarchical organization of thought, in *BOTD*, Complex Movements, an artist collective, performs the inner framework of a sentient pod.

Each main chapter is accompanied by a distinct, more literary chapter, which serves as a penumbra, a shadow discourse, offering my personal experience, which functions as phenomenological evidence of the theoretical framework presented. Chapter One, Stimulus Confusion, talks about my personal motivation for both the theoretical research and creative practice and why my focus pivoted. Chapters Two, Amputating the Biological Self, establishes the perceived problem outlined above. Chapter Three, Positive Disintegration, talks about my personal breakdown as a result of the perceive problem. Chapter Four, Recuperating the Biological Self presents the tentative solution, and Chapter Five, Presence of Being, examines the application of the solution, which enabled my healing process. Chapters Six and Seven are case studies of the two creative works, *[radical] signs of life* and *Beware of the Dandelions*, which artistically operationalizes the proposed solution detailed in Chapter Four. Chapter Eight, Imaginative Glance Forward, examines anticipated trends and where I see my own work going with regards to applying my insights back to social change efforts.

1. Stimulus Confusion

"That men are machines (whatever else they may be) has long been suspected; but not till our generation have men fairly felt in concrete just what wonderful psycho-neuro-physical mechanisms they are."[35]
William James

This dissertation emerges from the braiding of three personal strands. As with any creative endeavor, various strands, often buried motivations, become the warp and woof, the essential foundation, of the emergent work. Like the speaker in Adrienne Rich's poem, "Aunt Jennifer's Tigers,"[36] we are, however, often unconscious of the deeply woven patterns informing the fundamental structure and complex texture our work—the systems and processes we design. In contrast, I choose to begin this work by exposing these very strands. The first strand motivating this work is comprised of the process of my aunt's dying, and, the concurrent creation of a dance piece entitled *[radical] signs of life*. A work, which manipulated biotechnology, and enabled me, perhaps to make sense of my concerns and questions around our over-reliance upon these technologies as accurate measures of physiological experience. The second strand driving my research is the recognition of the damaging role intelligent technology[37] played in problematizing an intimate relationship, which precipitated my emotional and mental unraveling. The final strand is my disconnect from all social media and most technology to reconnect with nature, a deliberate choice to aid my writing process and, perhaps, an unconscious survival tactic to counter the autonomic nervous system shutdown.

During the fall of 2012, my eighty-eight year old aunt, Zlata Paces, began to suffer from health complications. Caring for her, I accompanied her through a series of unpleasant encounters with doctors who advised various types of biotechnology to maintain and monitor her heart. While my aunt underwent a variety of tests from echocardiograms to ultrasounds, we gained insight into the mysterious inner workings of her heart and its surrounding areas. We traveled between New York City and Boston

[35] William James, "Review: La Pathologie des emotions by Ch. Fere," *The Philosophic Review* 2(3) (1893): 333-336.
[36] The poem reads as follows: Aunt Jennifer's tigers prance across a screen/Bright topaz denizens of a world of green/They do not fear the men beneath the tree;/They pace in sleek chivalric certainty./Aunt Jennifer's finger fluttering through her wool/Find even the ivory needle hard to pull./The massive weight of Uncle's wedding band/Sits heavily upon Aunt Jennifer's hand./When Aunt is dead, her terrified hands will lie/Still ringed with ordeals she was mastered by./The tigers in the panel that she made/Will go on prancing, proud and unafraid.
[37] When I refer to intelligent technology henceforth, I will be employing Nicolas Carr's definition for "intellectual technology" from the *The Shallows* as defined in the Introduction.

from one specialist to another; each demanded the same battery of tests but offered widely differing opinions and solutions. While one doctor suggested changing blood pressure medication, unable to determine a cause from the battery of tests he ran, another doctor inserted a monitor that could send Wi-Fi data to alert distant health practitioners of any irregularities in her body. Innovated recently, the technology had many bugs, which caused the system to malfunction, thereby providing inaccurate data analysis and often failing to store and erratically transmitting the data needed for remote assessment. It also caused my aunt to occasionally faint. After two weeks, she demanded the doctor take it out, arguing its failure.

The final doctor insisted that a pacemaker was the only option, though the first two had shied away from such measures because of her age. However, during the insertion of this prosthetic technology—a "routine procedure"—the surgeon accidentally pierced her heart, though no one bothered to mention this until a week later, when she and I both instinctively sensed something was amiss. I noticed that she slept much of the day, had very low energy, had little appetite, was dizzy when she stood, and could barely breath while walking a short distance. This was a vibrant woman who skied until she was 80, and was extremely fit for her age. When she collapsed outside the apartment building the week following her surgery, I called 911 to rush her to NYU Medical Center. There she was subjected to one machine after another, which certified to the healthy condition of her heart, according to the data the pacemaker was spitting out. But when she or I vocalized the physiological symptoms she was experiencing and informed the various doctors and nurses that flitted in and out that she felt as though her heart were racing, that perhaps the pacemaker might be out of synch, they disregarded not only this option but also the biological, subjective sensations, as less valid somehow than the data and visual representations on their screen.

One week later, she died.

Subsequent to my aunt's death, I pivoted my doctoral research away from focusing on fostering social-emotional attunement in 3-7 year olds through embodied, bio-adaptive games employing wearable sensor technology, and instead took a closer

look at the dangerous legacy of cybernetics.[38] As I began to examine the underlying rhetoric that was fueling the contemporary disconnect between bio-data and bio-memory, between the technological self and the biological self, I slowly arrived at the awareness that the sixth wave of innovation to which Daniel Smihula refers[39] was already upon us. Post-biological technocracy had been quietly seeping into public consciousness, unconsciously guiding us closer towards ceding total control of both our cognitive and affective processes to emerging, intelligent technology. And a new contingent of techno-scientists were resurrecting the "cosmic significance" of the cybernetic paradigm by popularizing computation, quantification and prediction through participatory tools as a way of masking social control. From the "shock and awe" viral video gestures of performance philosopher, Jason Silva, who proselytizes the coming Singularity when we will completely outsource our cognition to artificial intelligence in order to "engineer our own divinity" to the extremely quantified Rachel Kalmar who wears twenty-one fitness self-tracking devices at the same time everyday for self-knowledge, subjectivity is once again at risk of obsolescence.

As a digital artist who works at the intersection of art, science, technology and social change, this discovery forced me to question my own responsibility. Heeding David Rokeby who forewarned that technology would become "the organ of conscience, the mechanism of interpretation, and the site of responsibility,"[40] I, too, began to see the design of contemporary intelligent technology—the Internet, mobile devices, immersive displays and wearables—as a means for "encoding a kind of moral and political structure with its attendant social contract."[41] I became wary of easy technology-first solutions to social change, and felt challenged to re-examine my own theory of social change.

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[38] Cybernetics emerged out of World War II as a result of a series of convenings, the Macy Conference, which brought together an interdisciplinary group of primarily white men with the soul purpose of developing a theory of "communication and command of human and animals," and was predicated on principles of quantification, prediction and social control.

[39] Daniel Smilhula, "Waves of Technological Innovation and the End of the Information Revolution*," Journal of Economic and International Finance*. 2(4) (2010): 58-67. Czech philosopher, Daniel Smilhula, believe we are simultaneously on the cusp of the sixth technological revolution, the post-informational age, which will peak around 2015, and boost the economy again, though devolve more rapidly than preceding waves around 2035. Innovations that will come to define this period, claims Smilhula, consist of "pharmaceutical, biotechnical, and biomedical science, genetic engineering, cloning and direct connections between machines and living organisms, which will make it possible to both modify and improve the properties of living beings."

[40] David Rokeby, "Transforming Mirrors: Subjectivity and Control in Interactive Media," *in Critical Issues in Electronic Media*, ed. Simon Penny (Albany: State University of New York Press, 1995), 153.

[41] Ibid, 153.

For at least a decade, I had been creating "pop culture with a purpose," employing the latest emerging technology—videogames, animations, viral videos, music videos, mobile apps, interactive web and transmedia experiences. Typically, I had collaborated with various NGOs, educational and cultural institutions whose intent was to raise awareness, shift message frames in the media and instigate policy change. Each innovative project was intended to spark media attention, although situated within a broader collection of take actions, educational and community building materials, along with components of a robust social media architecture plan to virally propagate and sustain engagement. These multi-media engagement campaigns—artistic interventions—are what Theodor Adorno would label "committed art"—art tied directly to a social function. I admit that during those years my theory of change diverged from those of many of my colleagues in the "culture change" space in which we moved because I rejected the overt, often singular messaging which they preferred, and instead favored more abstract and surreptitious commercial strategies. More recently, I began to question: *How can large-scale systemic culture change happen in our current media ecology of constant interruption? Is behavior and attitudinal shift still possible in what appears to be an increasingly affectless society, even if we take up the commercial tools that shape the public imagination? Moreover, is "social engineering for good" communicated through intelligent technology touch points just another form of propaganda in which constituents were voluntarily ceding control of their cognitive and affective faculties?*

Since 2004, most NGOs, educational and cultural strategists, with whom I had worked have slowly redirected their grassroots outreach and awareness campaigns towards millennial media consumption habits; their communication strategies seek to reach young adults (18-34 year olds) "where they're at" by sculpting messages in their language and tone across the various technologies and platforms they touch, for example YouTube, Facebook, Instagram, Twitter and Vine. They invest large portions of their limited budgets, proving to their funders that these new media approaches are "impactful" through embedded metrics. I, for one, have been guilty of this. As the former Media Director for Breakthrough, a global human rights organization, I anticipated future technology trends and developed clever ways for deploying content that would speak to

voting age youth through emerging genres. In the process of keeping up with the latest gadgets, designing the hippest mediums to capture attention and measuring impact to garner more funding to produce more cultural noise for shallow consumption, change agents, too, forget to step back and observe how our efforts feed the Cybernetic paradigm. Many Communication Directors are even buying into the latest mass persuasion techniques, such as "neuro-campaigning," employed by "maverick operatives and academics now calling the shots in some of the most cutting-edge war rooms" which are "replacing gut instinct with a *radical new data-driven order*"[42] (emphasis mine).

The current blunt cybernetic resurgence seems alarming to me, and appears to be increasingly more religious and neo-colonial. Driven by the dual-headed hydra—Google and Facebook—founded upon Frederick Winslow Taylor's *Principles of Scientific Management* (1911),[43] the new breed of cyberneticists who view themselves as data-driven believe they are more than just businesses. For instance, Google's CEO, Eric Schmidt, claims they are a "moral force…ushering in a new utopia of cognitive efficiency,"[44] and Facebook, too, openly admits to increasing the number of data scientists and behavioral psychologists they hire in the next five years by 207 percent in order to map and quantify datasets variant to variant, so they can better "study [and more likely control] humanity through the strange paths that information takes."[45]

By appropriating "intelligent technology" as value-neutral and instrumental, we, as activists, educators and culture makers, may unknowingly undermine our efforts by reinforcing systems of oppression we seek to mitigate, and also enable a cultural mentality that is inured to the messages we desire our target audiences to absorb. Furthermore, quickly adapting our message frames and learning outcomes to the latest technologies and communication channels without engaging in a critical discourse about their social-cultural or neurobiological impacts makes us complicit in contributing to the

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[42] "The Victory Lab: The Secret Science of Winning Campaigns," accessed August 11, 2014, http://thevictorylab.com.
[43] Taylor, Frederick Winslow, *Principles of Scientific Management* (New York and London: Harper & Brothers Publishing, 1911). The deeply imprinting tenets outlined in this treatise explicitly underscore the ethos of Technopoly. They are crystallized follows: 1) the goal of human labor and thought is efficiency; 2) technical calculation is superior to human judgment; 3) human judgment cannot be trusted; 4) subjectivity is an obstacle to clear thinking; 5) what cannot be measured has no value; 6) the affairs of citizens are best taken care of by experts.
[44] Nicholas Carr*, The Shallows: What the Internet is Doing to Our Brains* (New York and London: W.W. Norton & Company, 2010), 152.
[45] Lada Adamac, "Facebook Data Science," (Transcript from keynote presented at the NetSci 2014 Conference, Berkeley, CA, June 3rd, 2014).

erosion of both emotion-feeling cycles which allow us to empathize and knowledge-schemas required to make sense of complex, systemic patterns. Together, these two brain processes ignite what I call "critical feeling," essential for mobilizing large-scale social change. Rather than raising an alarm, we "engineers of social good" have instead begun to think like cyberneticists. We, too, have begun to perceive our constituents as merely hits and impressions—atomized data sets—targeted for message-heavy mind control (or worse, for funding). Instead, we should, engage citizens; galvanize them towards a desire for deeper human connection acting in the interests of shared human values.

Stepping outside of the NGO industrial complex into the art, science and technology world, into which I had often plunged, amphibiously, afforded me a broader perspective. What I now perceive is that our constituent base is waning against a tide of clicktavism motivated by vanity and the need to belong as dictated by online norming, the decrease in and control of dissent ensured by the fear of the humiliation caused by online peer rejection, and the ensuing shame. The ingenuity of the once progressive hive mind is giving away to entropic groupthink. No longer certain that large-scale behavior and attitudinal shift is still possible while the "critical feeling" vital to engagement is slowly being eroded by the intelligent technology through which we amplify our visions for change, I have become convinced that we must first restore "critical feeling" before large-scale heart and mind shifts can happen. To map a trajectory of possible change I need not only examine the socio-cultural and neurobiological implications of emerging technology but also anticipate and actively contribute to a counter discourse and design practice that would challenge and transform these technologies, much like the new media artists of the 1990s.

In this place of self-doubt, I felt a need to step away from generating yet another "committed" pop culture product approach to social change, and found myself gravitating towards the less familiar terrain of "autonomous" art making, specifically multi-media networked performance. My creative process became a form of theoretical inquiry. Grappling to make sense of the dense literature on the socio-cultural and neurobiological impacts of technology, the development of *[radical] signs of life* quietly and slowly transformed into a microscopic sandbox—a three-dimensional thought experiment with live bodies—wherein I could both externalize and work through abstract theories, and

also test out an alternative paradigm to the techno-scientific stranglehold of the Cybernetic Renaissance. How closely the findings of the clinical studies I encountered would touch upon the personal, and how the dance piece would reveal my underlying psychic structure, I could not have anticipated.

2. Amputating the Biological Self

"Nothing is more disembodied than cyberspace. It's like having your everything amputated."[46]
John Perry Barlow

2.1. Overview

In "The Gadget Lover," a chapter from *Understanding Media*, Marshall McLuhan reinterprets the myth of Narcissus as a metaphor for our obsession with and adaptation to emerging technology. He suggests that Narcissus was not vainly fixated on his own image, but instead "mistook his reflection in the water for another person…and [had] adapted to his extension of himself, and become a closed system;"[47] a servomechanism numbing his biological self through a form of "auto-amputation." McLuhan was responding to the infiltration of television, which established itself as the dominant medium. But his prescient words are still, if not more, relevant.

Today, our dependence upon the Internet and mobile devices, and our increasing fascination with wearables and immersive displays, the latest self-extensions, appear to further amputate rather than augment the cognitive and affective faculties, such as reason, perception, memory and emotion. Current intelligent technologies, such as those listed above, are not only dissolving our knowledge schemas and rendering us emotionally void but also re-wiring our neurons to prefer technology to actual human engagement. In *Alone Together*, Turkle inferred from 450 case studies that the "performance of connections" with "alive enough" creatures "seems enough," if not better than the often messy, high risk, demanding and complex world of people. She writes, "[I] n our culture of simulation, the notion of authenticity is what sex was for the Victorians—threat, obsession, taboo and fascination."[48] While our devices afford us a greater ability to control our relationships, and manage our presentational selves, like any form of addiction, they are also a way of numbing—what we typically numb is shame, a fear of disconnection for being unworthy of love and belonging. Intelligent technology, therefore, allows us to effectively defend against vulnerability, emotion and the

[46] Kevin Kelly, *Out of Control: The New Biology of Machines, Social Systems and the Economic World* (New York: Basic Books, 1995), 185.
[47] Marshall McLuhan. *Understanding Media: The Extensions of Man*. (Cambridge: MIT Press, 1994), 41.
[48] Sherry Turkle, *Alone Together: Why We Expect More from Technology and Less From Each Other*. (Philadelphia: Basic Books, 2011), 4.

messiness of subjectivity. In doing so, I believe we are becoming less human. Underscoring Turkle's conclusions, Kathy Sierra pointed out in her 2009 SXSW keynote, that contemporary software and hardware applications upon which we depend suffer from Asperger's Syndrome; they lack empathy and the ability to connect with us socially. She encouraged the audience of designers and programmers to reexamine how we got here and how we can "reverse engineer passion"[49] (and I would add compassion) into our lives by considering human behavior when we design technology. In this chapter, therefore, I take up Sierra's challenge to revisit past technologies that ignited key epistemic bifurcations[50] in our intellectual (and emotional) maturation in an effort to briefly trace what led us to the design of current emerging technologies and their resulting socio-cultural and neurobiological implications. I argue that over-reliance upon intelligent technology to mitigate daily social interactions while facilitating faster and wider communication, less face-to-face time may be slowly turning users into tools—affectless APIs run by software protocols and algorithms devised by invisible technological ensembles masked as highly personalized participation. I also suggest that these behavior changes might be altering our epigenetic structure. This examination will: 1) establish a non-binary theoretical framework for talking about technology; 2) identify periods of technological innovation and associated knowledge monopolies that re-shaped our worldview and prepared us for each subsequent phase of socio-technical adaptation; 3) situate the cybernetic paradigm as a distinct historical moment, a departure from past waves of innovation whose legacy gave birth to our current attitudes about and the design of contemporary disembodying technologies; finally, 4) explore the socio-cultural and neurobiological impacts of current intelligent technology.

2.2. Perennial Conflict between Autonomous Technology & Human Agency

Over the past two centuries, critical thought about the role of Technology in society has oriented, and continues to orient, from two diametrically opposed camps; the tendency is to present modern technology as either a dystopian, uniform and claustrophobic

[49] Kathy Sierra, "Creating Passionate Users," (keynote talk presented at the SXWS Conference in Austin, Texas, March, 17-19th 2009).
[50] I use "bifurcation" here to signify paradigmatic shifts in our worldview and meaning making. Drawing on Manual DeLanda's more geological definition, whereby a system's attractors mutate into a different kind due to threshold pressure within a phase space.

phenomenon impinging upon human agency, or alternately, as a utopian, efficient, rational and ineluctable force driving history progressively forward.[51] Whether one sides with either the technological determinists, who "deplore the dehumanizing advance of machines," or the instrumentalists, who "cheer on the engineers as heroic conquerors of nature,"[52] both positions present abstract and ahistorical accounts of the "essence of technology" as an autonomous presence, which rules modern life, but operates separately from society.

Langdon Winner suggests that Karl Marx was, perhaps, the first instrumentalist to formulate a "coherent theory of autonomous technology."[53] In *The German Ideology*, he states:

> The crystallization of social activity, this consolidation of what we ourselves produce into an objective power above us, growing out of control, thwarting our expectations, bringing to naught our calculations, is one of the chief factors in historical development up till now.[54]

Here, Marx articulates the ambivalence underlying the perennial debate between determinism and instrumentalism; he views technology as both the source of oppression under conditions of capitalism, whereby men are no longer masters of their tools, products or productive social relationships, and as a liberating force that will soon enable workers to overcome the alienation of labor, once a more humane political system emerges.

In stark contrast, fiercer determinist critics, like Jacques Ellul, abandon the middle entirely, claiming, "There can be no human autonomy in the face of technical autonomy."[55] For Ellul, autonomous implies that "technology pursues its own course more and more independently of man,"[56] while humans are reduced to a mere instigator of technological development because they are directed to technical ends by their over-reliance on its means for every aspect of their lives. Yet, Winner who professes that he

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[51] John Tresch, "Technological World Pictures: Cosmic Things and Cosmograms." *Isis* 98 (2007): 84-99.
[52] Andrew Feenberg, *Questioning Technology* (New York and London: Routledge: 1999), 8.
[53] Langdon Winner, *Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought* (Cambridge, Ma: MIT Press, 1977), 39. Intelligent technology is the latest type of autonomous technology. Marx was speaking about industrial machinery.
[54] Karl Marx. *A Critique of The German Ideology*" (Moscow: Progress Publishers, 1968), accessed January 15, 2012, https://www.marxists.org/archive/marx/works/download/Marx_The_German_Ideology.pdf, 16.
[55] Jacques Ellul, *The Technological Society* (New York: Vintage Book,1964), 138.
[56] Ibid, 6.

does not align with the "too far sweeping" concept of determinism is aware of the unsettling irony of autonomous technology, when he writes:

> To say that technology is autonomous is to say that it is nonheteronomous, not governed by an external law. And what is the external law appropriate to technology? Human will, it would seem. But if technology can be shown to be nonheteronomous, what does this say about human will?[57]

Even so, Winner continues to ask "who governs?" rather than "what governs?" Albeit skeptical, Winner still sees technology as a "form of life" that reshapes the social, distinct from Heidegger's all-encompassing and pervasive *Gestell*.[58] Like Marx, and later Bruno Latour,[59] Winner believes that human motives dictate conscious decisions in which various actors dictate which kinds of tools, techniques and systems are going to be developed and diffused. Thus, technological development is *always* interested politically and economically. The strongest part of Winner's argument, however, rests in his analogy of technology to political legislation, wherein he says:

> [T]echnological innovations are similar to legislative acts or political foundings that *establish a framework for public order that will endure over many generations*. They *govern social life as much as any law or system of enforcement, and are infused with politics, rather than neutral device*s, as the instrumentalists would have one believe.[60] (emphasis mine)

Countering instrumentalists, such as media mogul David Sarnoff,[61] who outright deny the power of technology, claiming tools are neutral artifacts, entirely obedient to the needs of their users, Winner contends instead that technologies:

> Encompass purposes far beyond their immediate use. If our moral and political language for evaluating technology includes only categories having to do with tools and uses, if it does not

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[57] Langdon Winner, *Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought* (Cambridge, Ma: MIT Press, 1977), 16.

[58] Gestell, literally framing, was first employed by the German philosopher Martin Heidegger to describe what lies beneath—the essence of—modern technology, which he perceived as not only all-encompassing and pervasive, but as a barrier to a more primordial encounter with *poeisis* (what which transforms, and continues the world).

[59] In "Where are the Missing Masses?" The Sociology of a Few Mundane Artifacts," Latour retorts that: "the 'autonomous' thrust of technical artifact is a worn-out commonplace made up by bleeding-heart moralists who never noticed the throngs of humans necessary to keep a machine alive." From *Shaping Technology/Building Society*, pp. 151-2.1992.

[60] Winner, Langdon. *Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought*. (Cambridge, Ma: MIT Press, 1977), 323.

[61] McLuhan, *Understanding Media*, 11. McLuhan recounts a commencement speech given by David Sarnoff at Notre Dame, in which he self-servingly states: "We are too prone to make technological instruments the scapegoats for the sins of those who wield them. The products of modern science are not in themselves good or bad; its is the way they are used that determines their value." Mcluhan retorts, "That is the voice of current somnambulism."

> include attention to *the meaning of the designs and arrangements of our artifacts*, then we will be blinded to much that is intellectually and practically crucial.[62] (emphasis mine)

Left leaning dystopians, Michel Foucault and Herbert Marcuse, view the social control of technology as a catalyst for the formation of modern hegemonies, a socially specific notion of domination. For them "technologies are not just means subservient to independently chosen ends but that they form a way of life, an environment. Whether it be an assembly line or a panoptic prison, technologies are forms of power."[63] These forms of power physically and mentally control large masses of people.[64] Unlike Winner's substantivist stance, left dystopians believe that means and ends are linked in systems still subject to our control.

While Andrew Feenberg aligns most closely with the left dystopians, he finds, nonetheless, that all of the above-described theories reify essentialist conceptions of technology, which he feels are outmoded and incompatible with the complex assemblages of contemporary civil society. He contends that:

> [T]echnology is the medium of daily life in modern societies. Every major technical change reverberates at many levels, economic, political, religious, cultural. Insofar as we continue to see the technical and the social as separate domains, important aspects of these dimensions of our existence will remain beyond our reach as a democratic society. *The fate of democracy is therefore bound up with our understanding of technology*.[65] (emphasis mine)

To highlight a more granular breakdown of the competing theories, and to clarify how they differ from one another with respect to the role of human action in the technical sphere and the neutrality of technical means, he renders a helpful diagram:

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[62] Langdon Winner, *Whale and the Reactor: A Search for Limits in an Age of High Technology* (Chicago and London: University of Chicago, 1986), 34.
[63] Andrew Feenberg, *Questioning Technology*, (New York and London: Routledge, 1999), 26.
[64] In the *Whale and the Reactor* Winner pushes this notion further. The much cited, now infamous, example of Moses's bridges showcases how large-scale technological infrastructure embeds systematic social inequality. Winner claimed the height of the bridges on the Long Island Expressway were intentionally designed to disallow buses to pass, thereby restricting access to Jones Beach for lower-income, primarily racial minorities. However, this assertion was not grounded in secondary, inaccurate research.
[65] Andrew Feenberg, *Questioning Technology* (New York and London: Routledge, 1999), viii.

Technology is:	Autonomous	Humanly Controlled
Neutral (complete separation of means and ends)	Determinism (e.g. traditional Marxism)	Instrumentalism (liberal faith in progress)
Value-laden (means form a way of life that includes ends)	Substantivism (means and ends linked in systems)	Critical Theory (choice of alternative means-ends systems)

Fig 1. Varieties of Theory created by Andrew Feenberg in *Questioning Technology* (1999)

As an alternative to these competing theories, he proposes a "non-essentialist" approach, one that embraces the full complexity of technological development. Influenced by post-phenomenologist, Don Idhe's remark that "technology is only what it is in some use-context,"[66] Feenberg calls for a "social account of the essence of technology that enlarges democratic concerns to encompass the technical dimension of our lives."[67] He assumes this stance in an effort to also challenge the prevailing social constructivist trend, which he views as myopically focused on empirical research skewed towards local alliances. Such narrow analysis, Feenberg argues, deprives technology of both political context and wider philosophical significance.

Like Feenberg, Adrian MacKenzie attempts to get away from both generalized theories and disaggregated empiricism. He migrates across socially constructed

[66] Don Ihde, *Technology and the Lifeworld* (Bloomington and Indianapolis: Indiana University Press, 1990), 128.
[67] Andrew Feenberg, *Questioning Technology* (New York and London: Routledge, 1999), 31.

relationships between person and thing by "treating mundane objects and practices as critical sites of technological actions."[68] He intends to place technical actions on par with signification—meaning—which are often eclipsed by general all-encompassing constructs such as information. Winner, too, advocates for this. For MacKenzie, technical actions appear in everyday objects and practices, such as TV remotes, various pieces of software to hardware commodification and even large-scale ensembles, like the Internet. The concrete, now outmoded, examples he employs (i.e. TV B-Gone, Google Desktop and PSP Hacker) are open-source artifacts infused with power relations. As he describes, such actions are difficult to grasp:

> Technological action is not individual or collective. Rather it explores *relations with others in technological ensembles*. Technological action both abstracts from and concretises existing social relations. It generates *singular intersections of historically and materially specific impersonal and personal forces*."[69] (emphasis mine)

Drawing heavily on Gilbert Simondon, MacKenzie problematizes concrete everyday technological acts in order to unveil technology's "evolving composite of relations" and "overflowing existing modalities of perception." This approach, what he refers to as the "co-invention of pre-individuated realities"[70] of technology, enables him to arrive at a more nuanced understanding of technology as an ambivalent artifact consisting of complex practices, actors and objects always in flux, which generates a new (albeit provisional) "material psycho-social point of connection to the self,"[71] irreducible to social norms. Here, the self, like the technology, is always contingent and relational.

Taking a similar though more traditionally anthropological approach to uncovering the invisible play of power embedded in software and its impact on the individual are geographers Martin Dodge and Rob Kitchin. In their essay "Code and the Transduction of Space," they reveal how code shapes social and environmental space in everyday life in four main ways, what they term: coded objects, coded infrastructures, coded processes, and coded assemblages. They argue,

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[68] Adrian MacKenzie, "The Strange Meshing of Personal and Impersonal Forces in Technological Action," *Culture, Theory & Critique*, 47(2) (2006): 197.
[69] Ibid.
[70] MacKenzie employs and extends Gilbert Simondon's concept of the pre-individual being first articulated in *The Genesis of the Individual* into the context of non-biological technology. His intent is to destabilize our understanding of technological objects into processes always in the state of becoming as they interact with both biological and non-biological entities.
[71] Adrian MacKenzie, "The Strange Meshing of Personal and Impersonal Forces in Technological Action," *Culture, Theory & Critique*, 47(2) (2006): 200.

> [C]ode makes a difference to everyday life because it possesses high technicity, that is the power to make things happen; code mediates, supplements, augments, monitors, regulates, operates, and facilitates many everyday tasks, and routines related to domestic living, travel, work, communication and consumption. *This power to affect change is not deterministic but is contingent and relational*, the product of the conjunction between code and people. In other words, code and human life are produced through or *folded into each other*, taking the form of *coded practices*.[72] (emphasis mine)

To ground their assumptions, Dodge and Kitchin conducted two days of in situ fieldwork whereby they followed three individuals from different residential postcodes (indicative of social-economic and racial diversity) in London throughout their daily routine. From the studies, they rendered "vignettes" highlighting the subjects' pervasive encounters with code, and its effects on both their individual and collective life.

Given more recently conducted research, I perceive that academia appears to be moving towards an ecological approach, situated in social context, practice and performance (my approach), while the popular rhetoric surrounding the latest foregrounded intelligent technologies (i.e. the internet, mobile phones, immersive displays and wearables) still perpetuate the mantra of binary essentialism. Take for instance, Jaron Lanier's provocative manifesto: *You Are Not a Gadget*. Deemed the "first great apostate of the internet era,"[73] Lanier assumes a meta-determinist bent to rail against the coming apocalyptic noosphere[74] promoted by the "digital Maoists," who are degrading human value by transforming life into a database.[75] While certainly less fanatical, Nicholas Carr, too, as noted, bemoans the erosion of concentration and contemplation brought about by the Internet, which he fears will carry deeper cognitive consequences. He announces:

> The great danger we face as we become more intimately involved with our computers--as we come to experience more and more of our lives through the disembodied symbols flickering on our screens--is that *we'll begin to lose our humanness*, to sacrifice the very qualities that separate us from machines.[76]

Our Web 2.0 enthusiasts—neo-instrumentalists—are equally fastidious. Digital media scholar, Clay Shirky, for instance, espouses the "plausible promise" of crowdsourcing global knowledge and promotes a four-step formula for harnessing its potential. In a

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[72] Martin Dodge and Robert Kitchin. "Code and the Transduction of Space," *Annals of the Association of American Geographers* 95(1) (2005): 178.
[73] Quote from the back of the book.
[74] Google's drive to amass all the world's information into something akin to a collective brain.
[75] Jaron Lanier, *You Are Not a Gadget: A Manifesto* (New York: Random House, 2011).
[76] Nicholas Carr, *The Shallows: What the Internet is Doing to our Brains* (New York and London: W.W. Norton & Company, 2010), 207.

similar vein, former Executive Editor of *Wired* magazine, Kevin Kelly preaches the benefits of the coming "technium"[77] as a "living system," (in opposition to Winner's concerns) which will soon acquire a level of intelligence akin to humans. In his newest book, *What Technology Wants* he provides readers with 5 pro-actions for effectively utilizing and co-habiting with future technologies. At one point, he even compares technology to children; "we can't really change the nature of our children, but we can *steer them to tasks and duties* that match their talents."[78] Sustaining such essentialist "technological thinking," only serves to cancel out history, thereby enabling every new technology to establish its own ideological worldview.

Rather than embrace "pure" instrumentalism or determinism, or fully subscribe to substantivist or left dystopians leanings, I prefer a both/and to an either/or stance. I rest somewhere in the middle of Feenberg's table; I opt for "Percian thirdness"—a place where interpretation penetrates and contextualizes the web of contradictory ideas, if only to extend the further skeins of articulation towards another encounter with difference, instability and change.[79] As such, technology and humans become, for me, ambivalent artifacts. My own view, therefore, moves away from ideological Technology (described above) towards social technology and roots itself in the psychological and neurobiological effects of specific technologies when applied to particular social contexts. To get at what I perceive as the "fading enigma of subjectivity," buried beneath social technologies, however, a closer alignment must be made with Husserl's "unavoidable necessity of a transcendental-phenomenological reorientation."[80] Thusly aligned, I will attempt to make sense of contemporary intelligent technology, the Internet, mobile devices, immersive displays and wearables, specifically, from an individual, inter-personal level in the present moment through direct experience. In doing so, I hope to reveal the complex and contradictory assemblages simultaneously operating within

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[77] Technium is a concept coined by Kevin Kelly. In an interview conducted by Avi Solomon for Boing Boing, Kelly describes it as a "network of different sub-technologies and the co-dependency that each of those technologies have on each other forms a virtual organism, a super organism." Avi Soloman, "Such a Long Journey – An Interview with Kevin Kelly," accessed May 11, 2012, http://boingboing.net/2012/05/11/kk.html.

[78] Kevin Kelly, *What Technology Wants* (New York: Viking, 2010), 257.

[79] Mike Fortun and Herbert Bernstein, *Muddling Through: Pursuing Science and Truth in the 21st Century* (Washington, D.C.: Counterpoint, 1998), 263.

[80] Edmund Husserl, "Ideas Pertaining to a Pure Phenomenology and to a Phenomenology of Philosophy." *Studies in the Phenomenology of a Constitution*, trans. R Rojcewicz and A. Schuwer. (Dordrecht, Boston, London: Kluwer Academy Publishers, 1989).

current everyday technology; intelligent technology is both neutral, yet value-laden, infused with power, an intellectual ethic poised for social control, yet steerable. Following Mackenzie and Dodge and Kitchen, my creative work (discussed in Chapter 6), therefore, attempts to explore the ambivalent relationship—the "dance of agency"—between autonomous technology and humans, which at present I see as imbalanced. I did so through a cultivation of productive tensions resting between autonomy and control, wherein co-creational forces facilitate reciprocal becoming. What I see as an interfolding of bio-adaptive transformation, a re-balancing.

Before exploring these tensions, the next two sections will attempt to unravel the epistemic shifts wrought by past technologies and to identify a taxonomy more in keeping with my own creative research, which is focused on our socio-technical adaptation to contemporary, intelligent technologies—the internet, mobile devices, immersive displays and wearables—and the effects they have on our interpersonal relations, cultural habits and neurobiology. I seek to answer the question: *How does current technology govern our personal lives, and provide a framework for personal order?* I will also situate cybernetics as a distinct rift, moving us from external to internal colonization. I contend that the conscious or unconscious application of its fear-based "intellectual ethic" that emphasizes prediction, quantification and control continues to inform both the design of contemporary technological development and to guide the attitudes and behaviors of its users.

2.3. Epistemic Shifts & the Six Waves of Technological Innovation

While the determinists and instrumentalists might possess two radically different views of human destiny, they both agree that significant technological advances demarcate pivotal junctures in history. Yet, numerous disciplinary theories abound, each advocating its own valence on when exactly key epistemic shifts occurred, and how specific eras not only changed the character of human behavior mentally and physically at a given moment but also prepared us for the next phase of evolutionary progress and/or co-optation (depending upon your stance).

For instance, during the 1930s, Joseph Schumpeter resurrected fellow economist Nicholai Kondratiev's theory on the fifty-year sinusoidal-like business cycles recurring in

the modern capitalist global economy. Schumpeter, however, contended that the waves were not driven by market fluctuations, as Kondratiev had forwarded, but instead by five technological revolutions instigated by a flurry of innovation at critical moments of economic depression. He identified the cycles as follows (the original date indicated by Kondratiev appears after the comma for comparison)[81]:

The Industrial Revolution (aka the Mechanical Age) (1787-1843), (1771)

The Age of Steam and Railways (1842-1897), (1829)

The Age of Steel and Heavy Engineering (1897-1939), (1875)

The Age of Oil, Electricity, the Automobile and Mass Production (1939-1982), (1908)

The Age of Information and Telecommunications (1982-present), (1971)

Within each wave, Schumpeter locates four stages, which he curiously refers to as "seasons," highlighting broad social shifts and changes in the "public mood" brought about by each cycle. Spring, for example, the first stage, is characterized by expansion and growth. Although driven by capital accumulation and innovation, this stage typically causes social upheavals and displacement, redefining work and the role of participants in society. Stagflation occurs during the summer, which invites a mood of affluence carried over from the previous growth stage, but it also creates inefficiencies. Next comes fall, the season of deflationary growth, whereby the mood shifts toward stability and normalcy. Lastly, the winter stage brings about severe depression, and includes the integration of all previous social shifts and changes into the social fabric society, supported by a further outgrowth of innovation and technology.[82] It is during this final season that new media technologies drawing upon infrastructural technologies of each era typically emerge.

We are currently exiting the fifth wave, which is in its application and ebbing phase, confirmed by our recent economic crisis. But contemporary thinkers, like the Czech philosopher, Daniel Smilhula, believe we are simultaneously entering into the sixth technological revolution, the post-informational age, which will peak at the end of

[81] One might also align media technologies against each period (though they appear to rest in the cusp between innovation waves): 1) stereoscope/zoetrope/photography, 2) photography/cinema, 3) cinema/radio, 4) radio/TV, and 5) TV/internet/VR. See FIG. 3.

[82] Daniel Smilhula, "Waves of Technological Innovation and the End of the Information Revolution," *Journal of Economic and International Finance* 2(4) (2010): 58-67.

this year, and boost the economy again, though may devolve more rapidly than preceding waves around 2035.[83] Innovations that will come to define this period, which we already see emerging, claims Smilhula, consist of "pharmaceutical, biotechnical, and biomedical science, genetic engineering, cloning and direct connections between machines and living organisms, which will make it possible to both modify and improve the properties of living beings."[84]

While waves enable us to understand macro-economic shifts brought about by technological innovation, large-scale socio-cultural transformations driving early adoption and diffusion within Schumpeter's seasons are best understood in terms of knowledge monopolies. [85] Different from waves, knowledge monopolies, are discursive, and often rest between waves, preparing us to accept new and unfamiliar technologies, as well as transitioning us to the following wave. To clarify the relationship I see between these overlapping theories, I devised a diagram that combines the waves with co-existing monopolies, along with other socio-cultural forces at play (see FIG. 3 below).[86] The diagram also underscores how technology moves from external to internal forms of social control and co-optation.

[83] Smilhula also contends that the waves were much longer at the onset of technological innovation, and are becoming increasingly shorter as we evolve. His own demarcation: (1600-1780) The wave of the Financial-agriculture revolution, (1780-1880) The wave of the Industrial revolution, (1880-1940) The wave of the Technical revolution, (1940-1985) The wave of the Scientific-technical revolution, (1985-2015) The wave of the Information and telecommunications revolution, (2015-2035) The hypothetical wave of the post-informational technological revolution.
[84] Daniel Smilhula, "Waves of Technological Innovation and the End of the Information Revolution," *Journal of Economic and International Finance* 2(4) (2010): 58-67.
[85] A term Postman borrows from Harold Innis, first coined in *Communication Bias* to extension of the economic usage into the realm of knowledge.
[86] Illustrated by my THNK colleague, Michell Zappa, from a hand-drawn sketch I drafted on a white board.

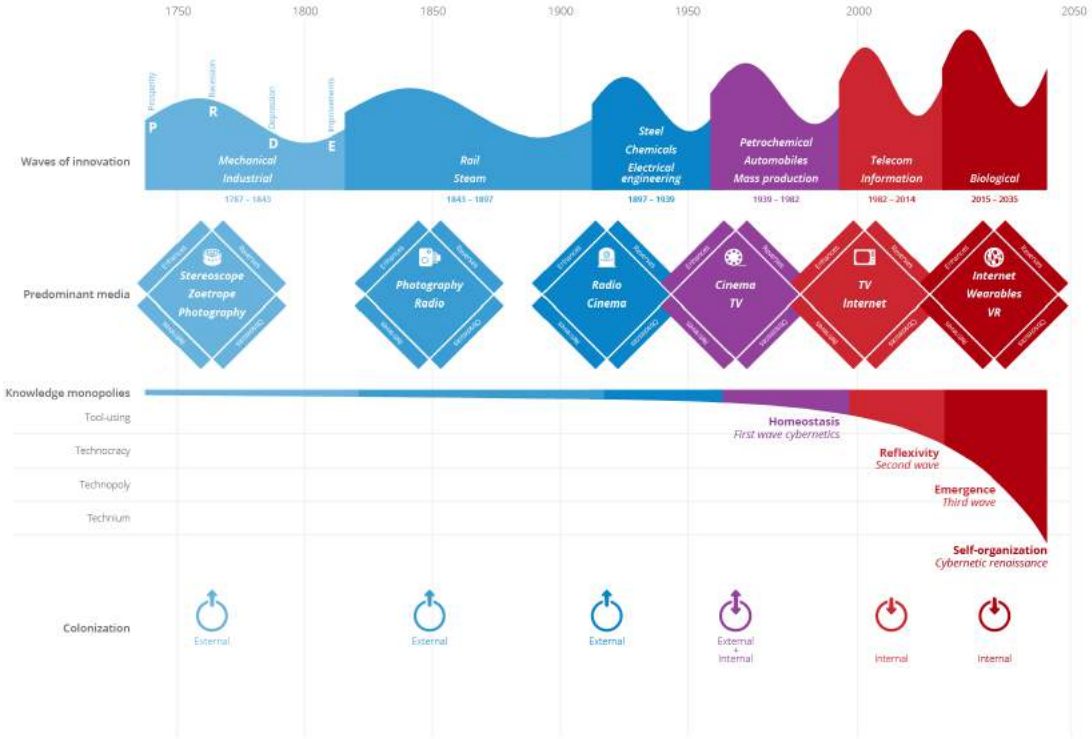

Fig. 2 Waves of Innovation, Knowledge Monopolies & The Cybernetic Paradigm (2015)

One historian and philosopher of technology, Lewis Mumford, locates the cultural (and psychic) bifurcations brought about by "technics" much earlier. He posits that in 1345 the mechanical clock was actually the key machine of the modern industrial era, not the steam engine. Invented by Christian monks to ensure that the followers of Saint Benedict would hold seven prayer sessions at specified times during the day, the "abstract framework of divided time" made possible by the mechanical clock soon became a "point of reference for both action and thought."[87] Mumford suggests that the wealthy later took over the new mechanism and popularized it, making standardization ubiquitous and propagandizing punctuality in the everyday. The dispersion and integration of the clock into the fabric of everyday environments and daily habits sedimented its power. As Mumford notes,

[87] Lewis Mumford, *Technics and Civilization* (Cambridge, Ma and London: MIT, 2011), 16.

> Time took on the character of an enclosed space: it could be divided, it could be filled up, it could be expanded by invention of labor-saving instruments...Abstract time became the new medium of existence. *Organic functions themselves were regulated*; one ate, not upon feeling hungry, but when prompted by the clock: one slept, not when one was tired, but when the clock sanctioned it… The effect of the mechanical clock is more pervasive and striking: it presides over the day from the hour of rising to hour of rest."[88] (emphasis mine)

Mumford also indicates that during the 14-17th century an equally radical change in the conception of space was taking place in Western Europe as a result of linear perspective bursting onto the art scene, which created a novel systematic organization of objects co-existing within a fixed frame contrived by a foreground, horizon, and vanishing point. Perspective, he observes,

> turned the symbolic relation of objects into a visual relation: the visual in turn became a quantitative relation. Size now meant distance, not human or divine importance...The new interest in perspective brought depth into the picture, *and distance into the mind*. In the older pictures, one's eye jumped from one part to another, picking up symbolic crumbs as taste and fancy dictated: in the new pictures, one's eye followed the lines of linear perspective along the streets, tessellated pavements who parallel lines the painter purposely introduced in order to make the eye travel."[89]

Mumford further claims that the "measured space of the picture reinforced the measured time of the clock" and that this simultaneous conquest of time and space served to alter our basic human schemas and worldview—from the 15th century onward, he believes we had conquest on the brain. As Heidegger would later echo in "Question Concerning Technology" (1954) our *Weltanschuanng* (worldview) was being reduced to the mechanization of the *Welted* (world picture).

Nicholas Carr picks up Mumford's thread to theorize about the human consequences of contemporary intelligent technology in *The Shallows*. He, however, traces the history of mapmaking as a way to understand our "intellectual maturation." Beginning with the primitive marks scratched in dirt with sticks, he moves from the embodied chorographic rendering of space to the more precise scientific measurements made possible by tools such as the compass and the theodolite, and he then ventures into contemporary incarnations of maps as a container for conveying ideas, such as the spread of a disease. These historical leaps in cartography, Carr argues, "didn't simply mirror the development of the human. They helped propel and guide the very intellectual advances

[88] Ibid, 15.

[89] Ibid, 20.

that they documented."[90] Thus, in addition to its instrumental function, mapmaking also indirectly facilitated our capacity for abstract thinking to evolve much in the same way the mechanical clock did for time.

In contrast, media ecology pioneer, Neil Postman, considers both the mechanical clock and the map as part of the more innocuous "tool-using culture." In his taxonomy of technology, organized around co-existing knowledge monopolies, rather than the "technological character" of a particular age, he suggests that tools were largely invented for two reasons: 1) to solve specific and urgent problems of physical life, and 2) to serve the symbolic world of art, politics, myth, ritual, and religion. In either case, Postman declares, "tools did not *attack* the dignity and integrity of the culture into which they were introduced. Here tools are not intruders, they integrated into the culture in ways that do not pose significant contradiction to its world-view."[91]

For Postman, it is not until the introduction of the printing press with moveable type and the development of the telescope that tools begin to play a dominant, more technocratic role in the thought-world of the culture. At this stage, Postman argues, "tools are not integrated into the culture; they attack culture. They bid to become the culture. As a consequence, tradition, social mores, myth, politics, ritual, and religion have to fight for their lives."[92]

While one could argue that Kepler, Copernicus, Galileo, Descartes and Newton were, in part, responsible for laying the groundwork of technocracy, Postman sees them more as "men of tool-using cultures," and instead locates the emergence of the "first true technocracy" much later with the advent of the steam engine in 1765 (again, exact date fluctuates). Based on the core principles of objectivity, efficiency, expertise, standardization, measurement and progress, the steam engine "set the bar" for both future inventions and new modes of existence, influencing Taylorism, cybernetics, and today's data-driven obsession. "Technocracy" Postman expounds,

> Filled the air with *the promise of new freedoms and new forms of social organization*. Technocracy speeded up the world…but Technocracy *did not entirely destroy the traditions of the*

[90] Nicholas Carr. *The Shallows: What the Internet is Doing to our Brains* (New York and London: W.W. Norton & Company, 2010), 40-41.
[91] Neil Postman, *Technopoly: The Surrender of Culture to Technology* (New York: Vintage, 1992), 20.
[92] Ibid, 28.

> *social and symbolic worlds*. Technocracy subordinated these worlds--yes, even humiliated them--but it did not render them totally ineffectual.[93] (emphasis mine)

This feat would be left for Technopoly, which actively eradicates all alternative thought-worlds by rendering them invisible and irrelevant. Technopoly "redefine[s] what we mean by religion, by art, by family, by politics, by history, by truth, by privacy, by intelligence, so that our definitions fit its new requirements."[94] Much like the web and social media.

Postman situates the decisive shift from Technocracy to Technopoly in Fordism[95] following Aldous Huxley, but I would argue that it was the publication of Frederick Winslow Taylor's "The Principles of Scientific Management" (1911), which preceded (and no doubt influenced) Ford's assembly line implementation in 1913. The deeply imprinting tenets outlined in Taylor's treatise explicitly underscore the rudiments of Technopoly. They are crystallized as follows: 1) the goal of human labor and thought is efficiency; 2) technical calculation is superior to human judgment; 3) human judgment cannot be trusted; 4) subjectivity is an obstacle to clear thinking; 5) what cannot be measured has no value; 6) the affairs of citizens are best taken care of by experts.[96]

Sounds a lot like Cybernetics. As Carr aptly recognizes, the legacy of Taylorism still haunts us. In fact, it's the religion practiced at the "Church of Google." During an interview with CEO Eric Schmidt, Carr was informed that the company is "founded around the science of measurement...It is striving to systematize everything...We try to be very data-driven, and quantify everything." [97] Whereas Taylor was focused on increasing productivity and profitability for the manufacturing industry by rendering the worker's body movements more efficient, Google appears more interested in optimizing cognitive efficiency, as noted in the previous chapter.

However, the full subordination of human subjectivity to the conscious demands of technical rationality and cognitive efficiency first took root in post World War II. Out of the "chaotic moral universe" emerged a traumatic schism in modern society instigated

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[93] Ibid, 45.
[94] Ibid, 48.
[95] First used in 1934 by Antonio Gramsci in an essay "Americanism and Fordism" to signify a traumatic departure point where standardization and mass production expands upon Taylor's assembly line.
[96] Frederick Winslow Taylor, *Principles of Scientific Management*, (New York and London: Harper & Brothers Publishing, 1911).
[97] Nicholas Carr, *The Shallows: What the Internet is Doing to our Brains* (New York and London: W.W. Norton & Company, 2010), 152.

by standardization, mass production, consumerism and the cybernetic "obligation to establish arbitrary enclaves of order and organization."[98] Rather than redefining the meaning of external social and symbolic systems to alter our world-view through technological tools, cybernetics instead emptied out meaning altogether and installed a new cosmology based on the pattern of living systems. The group of mostly white men actively constructed an abstract framework of communication theories designed around the transmission of a message that could be modeled and applied across the nervous system, the universe and machines. Appropriating living systems—life, mind and society—themselves, the unifying theory was an attempt to better predict, quantify and control those self-same systems.

In *Human Use of Humans*, Norbert Wiener draws a comparison between entropy in the universe and biological disorganization: "[W]e are always fighting nature's tendency to degrade the organized and to destroy the meaningful; the tendency for entropy to increase."[99] For Wiener, experience, sensations and feelings are the source of entropy, and are, therefore, to be denounced. The body itself is to be denounced and replaced with engineering metaphors. Cybernetics denotes a clear shift from external control of public order to an internal control of personal order and to the ultimate transcendence of the autonomous subject through techno-transference. The paradigm both incorporates and moves beyond Technocracy and Technopoly; it attacks the fundamental meaning of life itself in its attempt to overthrow biological order, giving birth to the Technium, later crystalized by Kevin Kelly. As Kelley dismissively espouses, "[l]ife is less a miracle than a necessity for matter and energy. The technium is less an adversary to life than its extension. Humans are not the culmination of this trajectory but an intermediary, smack in the middle of the born and the made."[100]

For me, the emergence of cybernetics signifies the most critical turning point in the history of innovation. It reveals five distinct shifts (See FIG 3.): 1) a decisive movement from external to internal social control, 2) a renunciation of the physical material for the abstract informational 3) a conscious assertion of discourse, an

[98], Norbert Weiner, *The Human Use of Humans: Cybernetics and Society* (London: Free Association Books, 1989), xiii.
[99] Ibid, 17.
[100] Kevin Kelly. *What Technology Wants* (New York: Viking, 2010), 356.

intellectual ethic, infused into tools, 4) an accumulation of all knowledge monopolies, tool-using, technocracy, technopoly, and catalyzed the entrance of the technium 5) an active shaping of the public imagination through pop culture.

Since 1952, cybernetics has laid the groundwork for both the fifth and sixth waves of innovation and their associated attitudes, as well as the intelligent technologies that facilitate our current socio-technical adaptation. In many ways, McLuhan's comparison between the Age of Gutenberg and the Age of Electronic Communication offers a useful point of reference here. Both of the technical eras he evaluates overthrew established socio-political and aesthetic orders and forced people to rearrange their perceptions of the world and common modes of human expression. The Gutenberg Age overthrew order by attacking the epistemology of aural culture through the imposition of the straight line of the book. The Electronic Age did so by attacking the epistemology of visual culture (and terrorizing the nervous system itself) through the introduction of a non-linear, repetitive, discontinuous and haptic sensorium. In short, McLuhan quite simply attests to how technologies create new ways through which we perceive reality. But current intelligent technologies are not only reshaping our perception of reality and world-view but also redefining what it means be human. I believe the Internet, mobile phones, and soon immersive displays and wearables, are changing the very biological substrate that enables us to perceive, to feel, to think, which I address in more detail in the final section of this chapter.

Certainly intelligent technologies enable participation and personalization and enhance perceptual experiences, but as they begin to shrink, disappearing from our view, into our clothes, into our skin, and into our minds and when immersive, augmented and virtual reality becomes mainstream and connected to the Internet of things as forecasters, such as Smilhula and Richard Yonck predict, the latest epistemology—the Technium—will overlay the current Technopoly to become the norm. The biomimetic appropriation of life itself introduced by the Technium makes technology appear natural, and thereby incontrovertible. Jason Silva, a mouthpiece and amplifier of the Singularity, certainly attests to this. Dubbed the "Timothy Leary of the Viral Video Age" and the "New Carl Sagan," his short viral videos, which garner millions of views on YouTube are impassioned rants on the inevitability of techno-scientific advancement. In one of his

"shots of espresso," as if channeling Norbert Wiener, Silva challenges us to "defy entropy and impermanence," and attempts to convincingly persuade the viewer,

> [S]entience is not bound by our physicality. Soon we will see sentience that upgrades itself, minds that create minds. *Human error will be ended*. We will become our creation. They will be our children, but they will really be us. There's no reason to fear this, it's just evolution.[101] (emphasis mine)

Silva's unabashed prognostications highlight my concern about the sustaining power of the cybernetics, as prefigured in the cyborg. N. Katherine Hayles, echoing Donna Harroway, identifies the dangerous combining of discourse with technology as the cause when she asserts:

> Were the cyborg only a product of discourse, it could perhaps be relegated to science fiction, of interest to SF aficionados, but not of vital concern to the culture. Were it only a technological practice, it could be confined to such technical fields as bionics, medical prosthesis, and virtual reality. *Manifesting itself as both technological object and discursive formation, it partakes of the power of the imagination as well as the actuality of technology*.[102] (emphasis mine)

I continue to witness this confluence, and naturalization, in everything from high gloss science fiction blockbusters to the conscious naming of our devices. As Yonck reminds,

> [T]he next 'paradigm shift' will not end with Natural User Interfaces (NUI); "as devices become more intimately integrated with our bodies, the Organic User Interface (OUI) will come into its own. Biometric sensors, skin displays and eventually brain-computer interfaces are just a few of the potential implementations of invisible interfaces."[103]

Twenty years ago, artist David Rokeby forewarned, "trouble would begin as the user's awareness of the interface ends."[104] Thus, as permeable membranes, like NUI and OUI devices continue to become seamlessly integrated into our everyday lives (as the mechanical clock once was), and fantasy and reality further blur, technology might literally become as Rokeby feared "the organ of conscience, the mechanism of interpretation, the site of responsibility..." and value-driven participation, which now masks subjectivity, will eventually disallow it. As we enter the sixth wave of innovation, I am already seeing the design of our technologies becoming "[an] encoding of a kind of

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[101] "Jason Silva," accessed January 18, 2014. http://thisisjasonsilva.com/aboutme/.
[102] N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago and London: The University of Chicago Press, 1999), 114-15.
[103] Richard Yonck, "The Age of the Interface," *The Futurist*, May-June 2010, 16.
[104] David Rokeby, "Transforming Mirrors: Subjectivity and Control in Interactive Media," *Critical Issues in Electronic Media*, ed. Simon Penny (Albany: State University of New York Press, 1995), 153.

moral and political structure with its attendant social contract."[105] To act may no longer be a possibility without prosthetic control.

Better equipped with the knowledge of how each evolutionary stage of innovation prepares the mind for the next, I will begin to narrow my focus. Using my awareness of how knowledge monopolies function as discursive "skeuomorphs"[106] spanning across waves of innovation, I will evaluate cybernetics as our reigning episteme. Furthermore, I will attempt to delineate how it not only catalyzed the information and communication wave but also informs the design of our current intelligent technologies. I will explore how it continues to shape the growing resurgence in fear-based systems that emphasize data-driven cognitive efficiency at the expense of bodily engagement with the world.

2.4 Legacy of Cybernetics

The aftermath of World War II witnessed the outgrowth of numerous institutions of social control in the United States. I believe shame associated with the vulnerability of the body at the hands of mass annihilation and the unpredictability of emotions that gave rise to fascism fueled a need to create communication strategies and computational systems to "command and control" human and social behavior. Three inter-related social forces coalesced to accomplish this: the emergence of Cybernetics from 1946-53, the publication of the first Diagnostic Statistic Manual (DSM) in 1952, and Modernism's influence on advertising during its nascent years. Each possessed its own valence of control. Taken together they contributed to redefining the experience of subjectivity—cybernetics through the erasure of the body, behavioral psychology by regulating emotions, and Madison Avenue by canalizing the senses. I take up each briefly below.

2.4.1. Erasure of the Body

In *How We Became Post Human,* N. Katherine Hayles examines how and why the body became systematically erased in the construction of cyberspace and the post-human. She argues that the deliberate "erasure of embodiment is performed so that 'intelligence' becomes a property of the formal manipulation of symbols rather than enaction in the

[105] Ibid, 155.

[106] Skeuomorphs are material metaphors embedded in the design of artifacts, which function as affordances to render something new more familiar and acceptable. I appropriate the term in relation to knowledge monopolies to suggest that the sedimentation of ideas quietly prepares the mind to transition to new technologies.

human life world."[107] Furthermore, Hayles asserts that leaving behind the materiality of the body, typically coded feminine, enabled the predominantly white, male techno-scientific community to identify subjectivity with the rational mind, traditionally coded male, and thereby "devise for [themselves] a new body, not born of woman, that [they] imagine will be more suited for rational thought processes and immortal yearnings."[108]

She identifies the Macy Conference on cybernetics, which emerged from the techno-scientific community in the wake of World War II as the teleological forking moment of disembodiment. Held periodically between 1946-53, the conference convened an interdisciplinary group of researchers[109] with the stated purpose of "formulating central concepts for a theory on communication and control applying equally to human, animals and machines."[110] But the unspoken "liberal humanist" impulse, Hayles claims, sought to radically transform the public's perception of human beings into information-processing entities, essentially intelligent machines, through the fabrication of a pattern of recursive innovation, which she labels "seriation" to invoke a diacritic marker of technological determinism. To succeed, Hayles contends, they needed:

> [A] theory of information (Shannon's bailiwick), a model of neural functioning that showed how neurons worked as information-processing systems (McCullouch's life work), computers that could process binary code and that could conceivably reproduce themselves, thus reinforcing the biological systems (von Neumann's specialty), and a visionary who could articulate the larger implications of the cybernetic paradigm and make clear its cosmic significance (Wiener's contribution).[111]

By conceptualizing a theory of information, which postulated that information carried by a message or a symbol depends strictly on its probability of being selected, Shannon and Wiener underscored that the underlying objective was to optimize the signal-to-noise (pattern to randomness) ratio in message transmission; the objective was not about conveying meaning. Hayles critically observes that Shannon and Weiner strategically spun a quantifiable and general formulation of information that could be calculated as the same value regardless of contexts in which it was embedded, so that theory could more

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[107] N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago and London: The University of Chicago Press, 1999), 20.
[108] Ibid, 20.
[109] Notable attendees: Norbert Weiner, John von Neumann, Claude Shannon, and Warren McCulloch.
[110] N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago and London: The University of Chicago Press, 1999), 50.
[111] Ibid, 7.

readily function as a "black box"[112] metaphor across disciplines with easy behaviorist slippage between human and machines.

To support this argument she draws upon an important anecdotal finding from the conference transcripts. Evidently, Donald MacKay, a British researcher, had put forth an alternative theory that would take meaning into account by adding a structural component to a message indicating how the message would be interpreted in the receiver of the message's mind. Such an approach would correlate a representation of data with an effect, transforming information into a semantic action (a process with context, rather than an abstract, universal given) measured by the effect it had on the receiver. Simply stated, MacKay's meta-communication theory attempted to qualitatively triangulate information, reflexivity and meaning. It was quickly rejected for being too subjective, and thus unquantifiable. Hayles argues that the de-contextualized route ultimately chosen indicates a conscious intention on the part of the U.S. techno-scientific community to privilege the abstract pattern as real and to downplay the importance of materially instantiated presence in an effort to render the messiness of human subjectivity obsolete.

Interestingly, Norbert Weiner, the father of cybernetics, appears to have experienced tremendous discomfort with his own body as a site for erotic anxiety and unwanted emotions; he refers to it in his *Human Use of Other Humans* as an "intelligent savage," a sub-altern. Because of his own fear of being controlled by external stimuli, emotion and desires—the flow of information—Hayles suggests that he "reconstituted boundaries between bodies"[113] to control information. My sense is that Weiner externalized his fear of intimacy, of connection, by projecting it onto the creation of a "learning machine," just as Alan Turing projected his love for his childhood friend, Christopher, onto the de-coding machine during WWII, and in the same way we seem to use "technoference" to manage our identities today.[114] Intimacy, for Weiner, meant a loss of control and autonomy—a fear of annihilation. For him, unregulated bodily fluids provoked triggers and conditioned reflexes, resulting in unpredictable emotions. Like

[112] Norbert Weiner defined this as "a piece of apparatus, such as four terminal networks with two input and two output terminals, which performs a definite operation on the present and past of the input potential, but for which we do not necessarily have any information of the structure by which this operation is performed."
[113] N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago and London: The University of Chicago Press, 1999), 98.
[114] My belief is that we project split off parts of the self onto our technology in the same we transfer fears, desires onto human self-objects in our lives. Intimacy mediated by technology acts invites this behavioral pattern.

many child prodigies, he lived almost cerebrally, disconnected from his body. During the period of homeschooling, his domineering father further cultivated the disconnection, privileging cognitive efficiency. Hayles notes in a passage about Weiner's childhood that the only time his father lost his temper was when Norbert did not provide the correct answer to a problem. As a result, human error, vulnerability, was equated to withdrawal of love, and shame.[115] By the age of seventeen, Weiner had earned a PhD in mathematics focusing on the logic of ordered pairs.[116] That achievement's cost is glimpsed in Weiner's autobiography, *I am a Mathematician*, when he recounts what appears as a telling experience he had after contracting pneumonia, the result of the stress of a conflict with two professors at Harvard. Wiener writes:

> My delirium assumed the form of a peculiar depression and worry [about an argument with professors at Harvard]…anxiety about the logical status of my mathematical work. It was impossible for me to distinguish among my pain, and difficulty in breathing, the flapping of the window curtain, and certain as yet unresolved part of the [mathematical] potential problem on which I was working…. I cannot merely say that *the pain revealed itself as a mathematical tension, or that the mathematical tension revealed symbolized itself pain*: for the two were united too closely to make such a separation significant.[117] (emphasis mine)

By merging physical pain with both external stimuli and mental abstraction, he unconsciously de-personalizes and disperses his body. In his biography of Weiner, Steven Heims observes that the mathematician would actually identify an unresolved scientific problem with emotional conflict and physical pain, and use the pain, often resulting in episodes of depression, as fuel to work harder. [118] The conflict functioned like his domineering father. Wiener confesses that he suffered a tremendous lack of motivation, of purpose, without his father prodding him. It is not surprising, therefore, that he became obsessed with stochastic modeling as a means to resist entropy through establishing a feedback in the system. Loosely defined, entropy is a lack of energy for work due to the degree of disorder in a system. Weiner likely suffered from some sort of personality disorder caused by the internalized image of his domineering father. Colleagues attest to his hypersensitivity and sudden changes in his mood from states of

[115] It is important to note that human error is precisely what cybernetics and the Singularity is attempting to eradicate.
[116] Disowned parts of the self often cause black and white thinking.
[117] Norbert Wiener. *I am a Mathematician: The Later Life of a Prodigy* (Garden City, N.Y.: Doubleday, 1956), 85-86.
[118] Steven Heims, *John von Neumann and Norbert Wiener: From Mathematics to the Technologies of Life and Death* (Cambridge, Ma: MIT Press, 1980), 155-57.

euphoria to despair, and his need for constant reassurance.[119] His distrust of his own unstable neurobiological system, perhaps, drove him to devise a cybernetic system that would override and regulate his own behavior, as well as provide him with the necessary narcissistic supply—feedback—he was so desperately seeking. Again I direct you to *The Human Use of Human Beings*, where Weiner ponders:

> It is amusing as well as instructive to consider what would happen if we were to transmit the whole pattern of the human body, of the human brain with its memories and cross connections, so that a hypothetical receiving instrument could re-embody these messages in appropriate matter, capable of *continuing the processes already in the body and the mind, and of maintaining the integrity needed for this continuation by a process of homeostasis*.[120] (emphasis mine)

He spends a great deal of time mapping the inner workings of "what may be called emotions," which are responsible for reactive triggers, and of conditioned reflexes that give birth to thought, and actions. He is convinced he can design a system—a "learning computer"—to re-organize living systems as closed systems capable of disrupting and redirecting conditioned reflexes, which he repeatedly aligns with the bodily sensations of hunger and pain. Words associated with early attachment issues, the inhibition of unmet emotional needs, and the capacity for self-soothing. In essence, such a computer would make us infallible—error free; it would automatically compensate for our deficiencies and enhance normal functioning by taking over all our lower level, sub-altern faculties. The benefit of controlling the flow of messages inside the body by replacing cognition with neural feedback is a means of *steering* the mind and fixing "sensory deficiencies" which betray perfection. This is the direction I anticipate current intelligent technology is going (as I outline in Chapter 4 in reference to the predictive coding model). Weiner surmises (at a time before we understand biologically what role neurotransmitters perform) that chemical secretion in the blood, not the nervous system, is responsible for triggers, and conditioning reflexes. In his research and his writing, I sense that he was trying to figure out his own unpredictable processes by extrapolating the personal conflict onto a conceptual framework, and later the body politic. What I am suggesting in discussing Weiner, therefore, is that the ideas behind the cybernetic

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[119] From interviews conducted by David Jerison and Daniel W. Stroock for The Legacy of Norbert Weiner: A Centennial Symposium (1997).
[120] Norbert Weiner, *The Human Use of Humans: Cybernetics and Society* (London: Free Association Books, 1989), 122.

paradigm stems from a personal drive towards infallibility, and the feedback mechanism functions as a displaced domineering parental figure and/or a form of narcissistic supply to regulate Weiner's own unpredictable emotions and inconsistent productivity. Technology, therefore, becomes a way of transferring, splitting off, the "other," the subaltern within—the body, emotions and senses—who could betray us as less than perfect, human. *Does intelligent savage become intelligent technology?*

2.4.2. Regulation of Emotions

The Diagnostic Statistical Measurement (DSM) evolved through similar social construction in an attempt to erase emotion. The original document was drafted from various systems for collecting census and psychiatric hospital statistics. Other parts were drawn from a United States Army manual. Spearheaded by psychiatrist Brigadier General William C. Menninger, a committee was appointed to create a new classification scheme called Medical 203. The document was first issued in 1943 as a "War Department Technical Bulletin" under the Office of the Surgeon General. The forward to the DSM-I explains,

> [T]he US Navy made some minor revision, but the Army established a much more sweeping revision, abandoning the basic outline of the Standard and attempting to express present day concepts of mental disturbance. This nomenclature eventually was adopted by all Armed Forces…and assorted modifications of the Armed Forces nomenclature were introduced into many clinics and hospitals by psychiatrists returning from military duty.[121]

In the sixth edition of the International Statistical Classification of Diseases (ICD) published by the World Health Organization, they incorporated a section on mental disorders, extracting wholesale passages from Medical 203. The Veterans Administration followed suit, but made minor modifications.

During 1950s, the American Psychiatric Association created a small task force comprised of ten white men, mostly psychoanalysts. This group was empowered to create a version of the Nomenclature and Statistics manual specifically for use in the United States to standardize the diverse and confused usage of existing documents—"to categorize mental disorders in rubrics similar to those of the Armed Forces

[121] The Committee on Nomenclature and Statistics of the American Psychiatric Association, *DSM-I: Diagnostic and Statistical Manual Mental Disorders* (Washington, DC: American Psychiatric Association, 1952), vii.

nomenclature."[122] This newly codified system was sent around to only 10 percent of the APA. Of the 46 percent of those who replied, 93 percent approved the document. After some further revisions, the first Diagnostic and Statistical Manual of Mental Disorders was approved in 1951 (despite the fact that less than 5 percent actually saw the document) and published in 1952. But the structure and conceptual framework were essentially the same as in Medical 203; each specific disorder was described in brief paragraphs and relied mainly on psycho-dynamic concepts of diagnosing psychopathology, similarly dividing pathology into three basic categories: psychotic, neurotic or character disorders. But its distinct departure from Medical 203 was the use of the term "reaction" throughout the manual, the concept that mental illness was the result of life circumstances. This theory was informed by Adolf Meyer, a psychiatrist, who initially believed that mental illness could be best understood through chemistry and physiology. He later revisited this theory, forwarding instead that psychopathology was "a reaction to habit patterns of the total person in response to emotional states brought on by the circumstances in their life."[123] Brain pathology transformed into personality dysfunction, social responsibility into personal responsibility. The manual ended up being 130 pages long, listed 106 mental disorders and included homosexuality as a sociopathic personality disturbance. Psychiatrists who used the original document claimed, "the nomenclature was ill-adapted for 90 percent of their patients."[124] As Erving Goffman criticized, the DSM-1 was "merely another example of how society labels and controls non-conformists." Like the effort to erase the body in cybernetics, there was an effort to render uncomfortable emotions as deviant (and unproductive, especially in the context of the military), and therefore, undesirable behavior.

2.4.3. Canalization of the Senses

In *The Sense of Modernism: Technology, Perception and Aesthetics*, literary theorist Sara Danius notes, "The emergence of modernist aesthetics signifies the progressive

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[122] Ibid, vii.
[123] Arthur C. Houts, *Fifty Years of psychiatric nomenclature: Reflections on the 1943 War Department Technical Bulletin, Medical 203* (Boston: John Wiley & Sons, 2000).
[124] G.N. Grob, "The chronic mentally ill in America. The historical context," in *Mental health services in the United States and England: Struggling for Change*, ed. Victor Fransen (Princeton, New Jersey: Robert Wood Johnson Foundation, 1991), 3-17.

internalization of technological matrices of perception."[125] The technologies that grew out of World War II manifested a resurgence of hyper-ocularity. As a result of modernist aesthetics, a pictorial and optic canalization arose in the arts, modeled on the positive objectivity of machines toward which the modern human supposedly aspired, or so many believed at the time. The presumption of the milieu, that the eye somehow provided a direct pathway to cognition, inspired a need to purify and isolate the senses.

During roughly the same time frame, television established itself as the dominant medium, moving from 1 million daily viewers in 1949 to 44 million by 1963. In a brief article, "Inside the Five Sense Sensorium" (1961), printed in a Canadian architecture journal, oddly enough, McLuhan ponders whether or not television offers a "massive Bauhaus program of re-education for North American sense life," and whether the "TV image is, in effect, a haptic, tactile or synesthetic mode of interplay among the senses."[126] McLuhan curiously describes the condition of synesthesia as simultaneously a subtraction, a diminishing intensity, whereby "no one sense [is] allowed high intensity,"[127] and at the same time, an augmentation of "tangibility in its visual, contoured, sculptural mode."[128] To counter this experience, McLuhan calls for "sensuous reason" to be applied: "If our massive new electronic media are direct extensions of sight and sound and touch and kinesthesia, is there not urgent need to consider a possibility of a consensus or ratio and balance among these for our collective sanity?"[129] According to McLuhan, the introduction of a "sense-ratio" would establish a proportional elaboration of each sense with a particular *cultural logic*. Unsurprisingly, Madison Avenue rigorously exploited such separation. As one 1950s textbook of Advertising Psychology and Research states: "Each sense is a specialized receiver for certain types of stimuli. Signals must target each receiver to maximize semiotic efficiency."[130]

Art critic, Clement Greenberg's, anxious response to the "interference of tactile associations," unsurprisingly echoes McLuhan's admonishing observations about the

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[125] Sara Danius, *The Senses of Modernism: Technology, Perception and Aesthetics* (Ithaca, NY: Cornell University Press, 2001), 40.
[126] Marshall McLuhan, "Inside the Five Sense Sensorium," in *Empire of the Senses: The Sensual Culture Reader,* ed. David Howes (New York: Berg, 2005), 44.
[127] Ibid, 44.
[128] Ibid, 47.
[129] Ibid, 55.
[130] D.B Lucas and S.H. Britt, *Advertising Psychology and Research* (New York: McGraw-Hill, 1950), 191-6.

unmediated senses unleashed through the synesthesia of television. For Greenberg, policing the sensate world often involved "recoding" material references solely for the eyes. For example, he severed Pollock's work from kinesthesia by reducing his gestural brushwork to repetitive, machine-like motions. And in a 1960 article about Louis Morris, one of the original Color Field painters, Greenberg writes:

> Abandoning Cubism with a completeness for which there was no precedent began to feel, think, and conceive almost exclusively in terms of open color...The more closely color could be identified with its ground, the freer would it be from the interference of tactile associations...*The effect conveys a sense not only of color as somehow disembodied*, and therefore more purely optical, but also of color as a thing that opens and expands the picture plane.[131] (emphasis mine)

Caroline Jones highlights that Greenberg became the voice of post-painterly abstraction after he curated an influential exhibition of the same name for the Los Angeles County Museum of new paintings by 31 artists, such as Gene Davis, Jake Bush and Kenneth Noland, which toured nationally in 1964. She forwards that Greenberg "yearned for modernism's hygiene and strained to enforce its protocols...against the chaos of undifferentiated sensations in a highly mediated world."[132]

At root, it may be that both Greenberg and McLuhan, influenced by the ethos of the cyberneticists, were, perhaps, similarly afraid of losing control over the finely cultivated and highly managed construction of "mechanistic individualism" and of spiraling backwards into the "haptic matrix" of the native, the non-reflexive and unpredictable id residing in the shame-ridden body. As McLuhan surmises:

> What we must grasp is that television has the *power of imposing its own conventions and assumptions on the sensibilities of the viewer*. It has the power of translating the Western literate back into the world of the non-literate synesthesia, just as effectively as the phonetic alphabet can hoick the native out of his haptic matrix into a world of mechanistic individualism, and sequential cause-and-effect relations.[133] (*emphasis mine*)

Caroline Jones also traces the remnants of the mid-20th century regulation of the senses. Through her careful examination of three "instrumentalized" modalities, including Color Field abstract painting (visual), hi-fidelity listening (sound), and synthetic flavors and fragrances (smell), Jones argues that:

> Modernism's metabolic purification and fragmentations, discursive occlusions, and disciplining regimes were aspects of a much more general segmentation and bureaucratization of the body in

[131] Ibid, 9.
[132] Ibid, 7.
[133] Marshall McLuhan, "Inside the Five Sense Sensorium," in *Empire of the Senses: The Sensual Culture Reader,* ed. David Howes (New York: Berg, 2005), 46.

> mid-century America…such segmentation had long been experienced as a necessary mode of being modern."[134]

Under the spell of the modernist regime, during the 1950-60s, "sensory experience" transforms into "sensuous reason," lived body into corporeal abstraction. As Jones points out, "every sense had to be captured, colonized, and capitalized, all the time. In other words, instrumentalizing all sensory pathways to attention/retention was the surest way to maximize mediations potential."[135] In her overview of the development of hi-fi sound and the reduction of smell through the over-amplification of synthetic scents, she highlights how the variegated forms of sensory isolation and intensification lead to abstraction. Of hi-fi, she notes: "listeners were devoted to an abstraction of social music…they sought a purified, personal and entirely artificial acoustical regime."[136] In a footnote, Jones describes research performed by psychologist Rachel Herz to investigate smell as an emotion directly connected to the limbic system, where both our memory and emotional centers reside. She concludes that olfactory stigmatization stems from a class bias tied to a fear of unbidden (and uncontainable) emotion and sexuality. It is no accident, she declares, that "the rise of the soap industry in Great Britain was fueled by colonial conquests (palm oil, sandalwood) even as its products were marketed to distinguish the European from the colonized masses."[137]

By systematically canalizing the senses, regulating emotion and de-corporealizing the body, the liberal humanist subject could more effectively defend against: "these enemies of abstract, visual, and mechanical order [who put] a stress on synesthesia and wholeness and tactility,"[138] including, as McLuhan later condemns, the dangerous forces of "*deep* participation, empathy and experience."[139]

Yet, interestingly, empathy, participation, experience and tactility are the very qualities required to sustain interpersonal relationships and social connection. They are part of critical feeling. They also, as Brené Brown points out, serve as an antidote to shame, which can harm social cohesion; shame creates a boundary space by imposing

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[134] Caroline Jones, *Sensorium: Embodied Experience, Technology and Contemporary Art* (Cambridge, Ma and London: MIT Press, 2006), 9.
[135] Ibid, 36.
[136] Ibid, 30.
[137] Ibid, 14.
[138] Ibid, 46.
[139] Ibid, 48.

limits on the self—the body, emotion and the senses. It separates and atomizes, causes anxiety, and discourages compassion and interdependence. Under the paradigm of cybernetics, the liberal human subject is promoted as an autonomous, self-regulating machine. Disconnected objects within a distributed system are, of course, easier to manage and control than crowds, because individualists are supposedly less susceptible to the unpredictability of unconscious drives.

Dating back to 1895 in a class-biased analysis of the underpinnings of collective behavior, *The Crowd: A Study of the Popular Mind,* Gustave Le Bon contended that the unconscious masses were under the sway of the hypnotizer, the rational technician who is in control of illusions by which he meant powerful images contained within aspirational words. Under an oratory spell, "their conscious personality has entirely vanished; will and discernment are lost. All feelings and thoughts are bent in the direction determined by the hypnotizer."[140] Considered the first general theory of persuasion, *The Crowd* influenced Hitler, the field of public relations, the seeds of cybernetics, and, quite possibly, Facebook. Le Bon maps out the ingredients required for "stirring up" (and controlling) a crowd, which curiously mirrors the addictive UX mechanics that sustain Facebook and other social applications: affirmation, repetition and contagion. Contagion, Le Bon continues, is "so powerful a force" that the individual's free will and personal interest are emptied out, and opinions and modes of feelings of those in control of the illusions are taken in; "The mass of the indifferent and the neutral become progressively an army of the discontented ready to obey all the suggestions of utopians and rhetoricians."[141]

Public relations pioneer, Edward Bernays, offered a similar understanding of the mental life of the masses (based on Freudian psychoanalysis) to efficiently manage the workings of democracy, and later mass consumption. In an often-quoted passage from *Propaganda,* he avows:

> The conscious and *intelligent manipulation of the organized habits and opinions of the masses is an important element in democratic society*. In almost every act of our daily lives, whether in the sphere of politics or business, in our social conduct or our ethical thinking, we are dominated by the relatively small number of persons…*who understand the mental processes and social patterns of the masses*. It is they who pull the wires, which control the public mind.[142] (emphasis mine).

[140] Gustave Le Bon, *The Crowd: A Study of the Popular Mind* (New York: Dover Publications, 2002), 31.
[141] Ibid, 100.
[142] Edward Bernays, *Propaganda* (New York: Ig Publishing, 2004), 35.

Bernays believed that the strategic wielding of the modern communication apparatus could surreptitiously guide the attitudes and actions of democratic citizens.[143] While Bernays applied the manipulation of mass impressions to corporate and political structures, the cyberneticists chose pop culture, science fiction novels and Hollywood movies, in particular, as a vehicle for inventing the future. Film particularly, as a medium that consciously mirrors our brain functions, is therefore, a perfectly covert conduit through which to assert control; it accesses our limbic system to internalize values through visual semiotics that manipulate emotions using fear-based storylines, as we shall witness in examples explored in the next section.

2.5. Discursive Seriation in the Cybernetic Shaping of the Popular Imagination

If we look back to the turn of the last century, one discovers that techno-utopian fantasies simultaneously promoting the "bodiless exultation of cyberspace"[144] and condemning the messiness of subjectivity—emotions and the senses—was not uncommon. In fact, the rhetoric widely spread through cyberpunk fiction, science fiction movies, and the rantings of futurists, like Alvin Toffler, renowned for proclaiming that "the central event of the 20th century is the overthrow of matter,"[145] fed the over-glorification of the informational pattern at the expense of material presence. From the 1950s onwards, pop culture served as a propagandistic syringe for injecting cybernetic values into the public imagination.

Yet, as N. Katherine Hayles illustrates, subterranean anxieties about the integrity and diminishing agency of the subject under the cybernetic paradigm are also communicated through popular, speculative fiction. She juxtaposes *Limbo* (1950), *Do Androids Dream of Electronic Sheep* (1968), and *Snowcrash* (1992) against the three contemporaneous stages of cybernetics,[146] to suspend the complex interplay of competing, contingent and embodied negotiations that led to the active (and historically

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[143] This is not terribly distinct from the intention behind Facebook's hiring increase in data science to aid in their investigations "to understand the mental processes and social patterns of the masses." Take the recent "rainbow experiment" orchestrated after the Supreme Court decision same-sex marriage, one of their many efforts to track public sentiment and voting behaviors—the virality of solidarity—with the future intention of shaping these moods.
[144] William Gibson, *Neuromancer* (New York: Ace Books, 1984), 16.
[145] Esther Dyson et al., "Cyberspace and the American Dream: A Magna Carta for the Knowledge Age," accessed December 31, 2011, http://www.pff.org/position.html.
[146] Hayles locates the evolution of cybernetics around three seriations: homeostasis/feedback loops (1945), self-organization/reflexivity-autopoesis (1960), virituality/emergence (1985).

situated), discursive construction of bodily obsolescence during the evolution of techno-scientific development. Her most disturbing example is Bernard Wolfe's *Limbo*, an overwrought, sometimes philosophic, but prescient diatribe on our ambivalent, unresolved relationship to technology. Set in the 1990s, the story follows Dr. Martine, a neurosurgeon, who performs lobotomies, supposedly for good, stripping people of all motivation, drive and pleasure. Amputation and prosthesis appear as status symbols on the island. His research leads him to understand the hyphenated nature of the human psyche and to theorize through interior monologue that amputations derive from the original "narcissistic wound," which male children experience as a violent separation from their mother and the painful awareness that they are not equal in scope to the world. In the novel, self-amputation offers, as Hayles interprets, a "return to the Pre-Oedipal state,"[147] where all his needs will be once again met (sounds a lot like where we are heading).

But I would argue that films offer a more intoxicating vehicle for hypnosis. As experimental psychologist Hugo Munsterberg observed as early as 1916, films parallel our dreams: "in the photoplay our imagination is projected on the screen."[148] Munsterberg argued that the aesthetics of film communicates directly to our involuntary mental function (the part Weiner wanted to regulate with a learning machine). Aesthetic features, like jump cuts, parallel editing, close ups and flashbacks reveal how film functions like the human brain. What is important to note is that Munsterberg's research specialized in applied psychology for corporations. Although he was the first academic voice to support Hollywood movies, his interest was mainly in applying his research regarding film to "secure the greatest and most satisfactory output of work from every man"[149] Munsterberg believed,

> The highest art may be the furthest removed from reality. An object becomes beautiful when it is delivered from the ties (with the real world) and in order to secure this result we must take away from the background of reality and reproduce it in such a form that it is unmistakably different from *her real things*, which are *enhanced by the cause of effects of nature*.[150]

[147] N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago and London: The University of Chicago Press, 1999), 124.
[148] Hugo Munsterberg, *The Photoplay: A Psychological Study* (New York: Dover, 1971), 41.
[149] Hugo Munsterberg, *Psychology and Industrial Efficiency* (Boston & New York: Houghton Mifflin, 1913). 23-4.
[150] Hugo Munsterberg, *The Photoplay: A Psychological Study* (New York: Dover, 1971), 65.

Munsterberg conclusions became a "blueprint for leisure control" and a justification for the film industry to pedal propaganda about the ideals of our nation. Later (1949), Hugo Mauerhofer would similarly compare the cinema to a dream, perceiving the spectator to be passive, uncomfortable, anonymous, and receptive, as if preparing the body to withdraw from reality into a "ready-made" world. Cybernetics, too, would observe how movies could shape values useful to not only capitalism, but also their cosmic pursuits. Here, however, using the ensuing three periods, paranoiac 1950s, flesh-eating 1990s[151], and separation-anxiety present, I would like to offer a counter-narrative in an attempt to disrupt the ostensibly irresistible and relentlessly advancing epistemic force of the Singularity, and instead reveal the underlying ambivalence.

Alien-invasion films from the 1950s offered a vehicle for the articulation of post-war anxiety about radiation, gender norms and sexual reproduction. In *Invasion of the Body Snatchers*, *Invaders from Mars* and *It Came Out*, we see the repeated representation of human bodies imperceptibly altered; they are replicated, invaded, and evolving beyond the need for sexual difference and procreation. In these worlds, human protagonists are asexual, promising a world without sexuality, gender difference or emotion. Such post WWII films offer evidence to support the claim that "paranoiac discourse hence provided a framework through which post-war anxieties about altered bodies could find expression."[152] In a paranoiac world, Freud claimed that the libido withdraws, resulting in the creation of a delusional system.

In contrast, techno-utopian fantasies were popularized by cyberpunk fiction and science fiction movies at the turn of the last century. In William Gibson's cult classic, *Neuromancer* (1984), for example, we witness a fictional representation of the "bodiless exultation of cyberspace" whereby the biological body is experienced as a mere accident, an inconvenience, rather than as the inevitability of human life. Case, a computer cowboy, regards his body as a "meat machine" to lug around his brain—the seat of consciousness—and pines for an imminent return to cyberspace where "you can throw yourself in a high speed drift and skid, totally engaged but set apart from it all, and all

[151] Taken from the subtitle of Arthur Kroker's book *Hacking the Future*, which also explores how information technology permeates and transforms everyday culture.
[152] Cynthia Hendershot, *Paranoia, The Bomb and 1950s Science Fiction Films* (Madison: The University of Wisconsin Press, 1999), 41.

around you the dance of biz, information interacting, data made flesh in the mazes of the black market." Data (a nod to the genetic code) now assumes the role of original source, begetting the biological body, prosthesis.

Similarly, *Tron* (1982), *Lawnmower Man* (1992), *The Matrix* (1999) and *Ghost in the Shell* (1995) (though the list could go on) also showcase humans, well, primarily their brains, uploaded to the network—"jacked"—into cyberspace where biological data is reduced to informational patterns, easily fused into something akin to the ecstasy of virtual, non-bodily sex. Consider the final scene of the first *Ghost in the Shell* film, when the cyborg Motoko Kusanagi, the androgynous Major of a covert op division called Section 9, "merges" with the Puppet Master, a rogue AI hacker, to form an entirely new entity that exists free of physical boundaries in order to endlessly propagate itself through the net. Free of her cyborg form and hijacked memories, Batou, her partner, gets the Major a new child-like body. The film goes to black as she asks, "where does the newborn go?"

The repeated motif of machines reconfiguring biological bodies into pure information coupled with the privileging of cognition in the production of consciousness held equal sway outside the realm of speculative fiction and film during the 1990s. Kevin Kelley's Out of Control: The New Biology of Machines (1995), Lee Silver's Remaking Eden: Cloning and Beyond in a Brave New World (1998), and the costly research antics of Kevin "I am a Cyborg" Warwick attest to the pervasiveness and diversity of cyber culture penetrating the everyday. But by far the strongest influence on our current cybernetic resurgence was Marvin Minsky. At the Fifth Conference on Artificial Intelligence in 1996, he persuasively argues that data from the mind is the most important part of the human:

> A person is not a head and arms and legs. That is trivial. A person is a very large multi-processor with a million times a million times a million small parts, and these are arranged as a thousand computers. The most important thing about each person is data, and the programs in the data that are in the brain. And some day you will be able to take all the data, and put it on a little disk, and store it for a thousand years, and then turn it on again, and you will be alive into he fourth millennium or fifth millennium.[153]

[153] N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago and London: The University of Chicago Press, 1999), 244.

The desire to banish death and download consciousness to a computer are no longer relegated to the realm of science fiction only but are currently being manifested in privately funded labs across the country. For instance, a maverick group of techno-scientists are attempting to manifest Minsky's vision. Aubrey de Grey, Chief Science Officer of Strategies for Engineered Neglible Senscense views aging as a disease, and has devised an approach to effectively delete the cells associated with aging. During a chat with de Grey last year while at THNK, I asked him about the actual lab procedures to carry out his ideas and about the socio-cultural implications of his efforts. He was very vague, seeming unconcerned with potential issues of over-population, health insurance, class inequities and resource depletion. He deflected my questions by answering "We'll figure it out when we get there; humans are very ingenious."[154] Google, too, has invested a large sum of money into life extension technologies through its new biotech startup, Calico, a joint partnership with a mega pharmaceutical company, AbbVie. Still others, like Ray Kurzweil (now Google's director of engineering), are focusing on advancing AI research, so that we can download the brain to a computer to enable a different kind of immortality. But first we need to enhance it. Anders Sandberg, a luminary in the field, works on both improving cognitive performance in groups and individuals through biomedical cognitive enhancers as well as preparing legislators for the arrival of said technologies. Martine Rothblatt, CEO of United Therapeutics, however, is probably the most vociferous and adventurous of the bunch. In her book *Virtually Human: The Promise and the Peril of Digital Immortality*, she, much like Weiner, brandishes epic terms like "liberty from death" and "technoimmortality" painting a picture of an "inevitable transition"[155] from a "society of flesh to a mindcentric society."[156]

In the first chapter, Rothblatt maps out in extensive detail how downloading consciousness will work. In very simple terms, something called a "mindfile"—a digital database of your entire life and the sum of your personality will be dumped into "mindware"—an operating system—and then processed to produce a "mindclone" that retains your unique consciousness. The mindclone would enable you to live on after your

[154] Notes from THNK Forum talk with Aubrey de Grey, January 24th, 2014.
[155] Note she is transgender, and has created an AI version of her wife, Bina48.
[156] Martine Rothblatt, *Virtually Human: The Promise and the Peril of Digital Immortality* (New York: Picador, 2015), *6.*

physical body dies. However, it would have to wait for biotech to catch up before it could be downloaded to a new shell. The shell would allow you via a "true-to-life visual representation" to continue to interact with your loved ones.[157]

The thematic consideration of life extension, which has been re-emerging in recent television episodes and film still seems inextricably tied to grief, loneliness and separation anxiety, not just for the protagonist in the story, but for the loss of the human being as we gain access to biotechnologies. As an example, consider the fourth episode, *Be Right Back*, of the Black Mirror, a BBC production, which renders a particularly vivid depiction of this possible future scenario. In this depiction, however, the mindclone is recreated through the sum of all the content shared online by the individual throughout his life before he passed away. The generic, synthetic body of Ash arrives in a box in parts with instructions to be re-assembled and customized to look like the original Ash through texture mapping photos gleaned from across the Internet, the same with his voice, and thoughts. At first, Martha, his widow, feels comforted by conversations on the phone, but when she encounters the physical form, she is initially repelled. While the AI satisfies her physically, Martha becomes irritated because the AI just does what she says; there's no feedback, no emotional reaction. The solace soon erodes to a point where she brings the AI to a cliff and tells him to jump. In the final episode of the Black Mirror, a mind-body clone is kept inside some sort of box, living alongside the "actual" person, but performing repetitive tasks to keep her source self on schedule and contented. The endless chain of tedious self-regulating functions required for the maintenance of a seamless, responsive environment for her source self, like turning on lights, making her toast, soon drives the mindclone mad.

Transcendence (2104) offers a similar portrait and transition from disembodied recreation of a face from a ghost in the machine to a diabolical being as consciousness re-enters a shell. When Dr. Will Caster dies, his wife Evelyn uploads his consciousness to the massive sentient computer they co-developed to survive his physical form. But when he requests to be connected to the Internet to expand his intelligence, which ultimately

[157] What I find most intriguing about Rosenblatt's position is her concern that "mindclones" will be treated like second-class citizens. She worries that "fleshism" will surface, which perhaps attests to her own discomfort with her transsexual body, and the discrimination she encounters for being different. Another curious factoid is that her chosen name, post transition, was taken from Dr. Martine, the main character of Limbo (discussed above).

enables him to enter a new organic body, a similar relationship to the experience of loss and the aversion of re-embodiment unfolds, perhaps pointing to an underlying unwillingness to accept impermanence. It seems as though the ambiguous "in between-ness" in each of the examples above becomes a site of contention and transgression. The illusion of realness, of extended lover, seems less real and comforting somehow once they take on a physical form.

Pop culture, thus, serves as a space for not only social critique, but also self-fulfilling prophecy. My hunch is that many designers and programmers continue to read cyberpunk texts and watch science fiction films then consciously or unconsciously incorporate these techno-utopian fantasies into what Jaron Lanier refers to as the "anti-human design" of new tools, extending a legacy that to continues to reject the body, regulate emotions and canalize the senses.

2.6. Socio-Cultural & Neurobiological Impacts of Intelligent Technology

After conducting a cross-disciplinary literature review informed by science and technology studies, self psychology, cognitive neuroscience and media studies, I came to understand just how intelligent technology might be re-scripting my brain wiring diagram, nervous system, and quite possibly my epigenetic structure.

While many proponents of the Internet laud its capacity for optimizing the brain for multitasking and processing larger amounts of information faster, Nicholas Carr contrarily insists that the Internet's "ecosystem of interruptions" causes long-term neurological consequences. He observes that when we go online, "we enter an environment that promotes cursory reading, hurried distracted thinking, and superficial learning."[158] Furthermore, the division of attention required by the multi-media environment to hunt and gather snippets of knowledge from constant flows of information strains our cognitive abilities. Overloading our working memory and disallowing the translation of consumed content into long-term memory, Carr contends, not only diminishes our learning and weakens our understanding but also "reduce[s] our brain's ability 'to build stable knowledge structures'--schemas, in other words--that can

[158] Nicholas Carr, *The Shallows: What the Internet is Doing to our Brains* (New York and London: W.W. Norton & Company, 2010), 116.

later 'be applied to new situations.'"[159] In short, the Internet is "rerouting the pathways of our brains" away from meaning making. While Carr does not explicate how the rerouting process works exactly, he implies that recent developments in neuroplasticity might provide "the missing link to our understanding of how informational media and other intellectual technologies have exerted their influence over the development of civilization."[160]

Carr's discussion of three clinical studies informs this assertion. First, he focuses sharply upon psychologist Eric Kandel's use of slugs to underscore the importance of attentiveness for memory consolidation and deep learning. Carr extrapolates from the findings that the barrage of successive messages encountered online clogs working memory, which disallows synaptic terminals to form in the frontal lobes, thereby truncating the instigation of both implicit and explicit memory consolidation. Such repeated exposure, he suggests, could potentially damage our brain-wiring diagram. Based upon Carr's insights, I would further argue that such exposure over time might lead to an imbalance in neurotransmitters, which could result in a lack of regulation of, even an inability to activate, emotion-feeling cycles, thereby causing an increase in an impulsive aggression stemming from poor impulse control and an inability to plan ahead. The hippocampus, located just behind the amygdala, plays an important role in both emotional regulation and memory consolidation. Thus, individuals who strike out impulsively, displaying a failure to integrate their emotions and their reasoning, may not be forming the proper knowledge-schemas required to plan ahead and act appropriately within a given context. As the onslaught of information becomes more pervasive and the hippocampus and amygdala presumably continue to erode at a much faster rate, causing neurotransmitters to increasingly misfire, it stands to reason that one might witness a rise in fear-based violence and aggression as well as mental illnesses associated with chemical imbalances. As an example, it is known that serotonin spurs and strengthens the formation of new synaptic terminals, and that attention produces dopamine when neurons in the cortex signal neurons in the midbrain, which then floods the synapses of the hippocampus, catalyzing the memory consolidation process. But when serotonin is

[159] Ibid, 216.
[160] Ibid, 48.

inhibited as a result of a lack of kinesthetic movement and an overabundance of dopamine, which over-activates reward centers in the brain—triggered by text messages, likes on Facebook, or points accruing in videogames—cortisol defaults to a spiked level. Over time excess cortisol burns out the adrenal glands, which serve as a filter to regulate neurotransmitters. Without this buffer, bipolar disorder, anxiety and depression features can emerge.

In fact, a 2011 study conducted by a team of researchers at Xidian University in Shanghai using "diffusion tensor imaging" supports this claim. The team monitored the effects of long-term Internet addiction on the microstructures of the adolescent brain."[161] Their findings reveal that changes to the gray matter volume of the prefrontal cortex, the supplementary motor area, the orbitofrontal cortex, the cerebellum and the left rostral contribute to chronic dysfunction of its subjects: impairment of psychological well-being, academic failure, and reduced work performance. The very regions effected correspond closely to cognitive control; specifically, the Internet impacts motivational stimuli, reward pathways and the selection of appropriate behavior as a result of deficits tied to working memory.

Carr's second clinical study focus centers upon the findings from a neuro-imaging study performed at Harvard's Social Cognition and Affective Neuroscience Lab that uncovered unusual chronic over-activity in three brain regions dedicated to mind reading triggered by the onset of computer usage. The particular areas identified in the prefrontal cortex, parietal cortex and at the intersection of the parietal and temporal cortices originally developed to enable us to "coordinate large groups of people to achieve goals that individuals could not." [162] One might call these the regions of persuasion. But now, as Jason Mitchell contends, a shift is occurring, whereby the hyper-activity in these newly defined regions is causing us "to perceive minds where no minds exist, even in inanimate objects."[163] Mitchell's observation allows us to get a glimpse of why we might cede our biological control to merge with computers. The study also suggests that as we adapt to and come to prefer online social networks, rather than interpersonal, civic

[161] Kai Yuan et al., "Microstructure Abnormalities in Adolescents with Internet Addiction Disorder." *PLoS ONE* 6(6) (2011): 1-8.
[162] Nicholas Carr, *The Shallows: What the Internet is Doing to our Brains* (New York and London: W.W. Norton & Company, 2010), 213.
[163] Ibid.

engagement, the populace becomes less adept at reading body language and empathizing with others, as a recent UCLA study[164] concluded. However, the scientists who conducted the experiment with two sets of sixth-graders to document the rise of social-emotional incompetence in young people as a result of less face-to-face time also forwarded that time away from screen media with increased social interaction, could improve comprehension of nonverbal emotional cues in pre-teens. When one control group of students was sent to a nature and science camp—without any electronic devices—their ability to read facial expressions and non-verbal cues increased significantly in only five days.[165]

Both the Mitchell and UCLA studies suggest that our brains naturally mimic that with which we interact, whether those minds are real or not. This could be attributed to "mirror neurons" discovered by Victorio Gallese in 1996. He argues, "Mirror neuron networking provides a functional mechanism called embodied simulation that sponsors our capacity to share actions, intentions, feelings and emotions with others."[166] Gallese based his argument upon his discovery of a new class of ventral premotor neurons (in the parietal cortex) in a monkey's brain, which fire whether an action is performed or whether it is visually witnessed (or even merely heard). Like the monkey, we, humans, are constantly enacting at a neural level the actions we see and hear around us. Mirror neurons, thus, enable us to empathize.

With less face-to-face time, and more screen time, our mirror neurons appear to be over-activated by constant social interaction with computers, and its many surrogates, and under-activated by corporeal humans, the result, perhaps, of declining interactions with one another. Because of this, we may become increasingly more responsive to the onslaught of dopamine inducing technologies, and less attuned to the more subtle socio-emotional cues of humans, which require time and reflective space to process. As we evolve into "more agile consumers of data," we may eventually, Carr predicts and I would concur (and can attest to from personal experience), forego more refined

[164] Yalda T. Uhls et al., "Five days at outdoor education camp without screens improves preteen skills with nonverbal emotion cues," *Computers in Human Behavior*, 38 (2014): 387-392.
[165] Ibid.
[166] Victorio Gallese, "Embodied simulation: From neurons to phenomenal experience," *Phenomenology and the Cognitive Sciences* 4 (2005): 23-48.

perceptual, ideational and emotional processes that distinguish us from just another data-processing device within a single, larger system of other objects.

Recounting a series of experiments performed by Antonio Damasio's team at USC's Brain and Creativity Institute, Carr in his third and final clinical review confirms that "higher emotions," such as empathy with another human suffering psychological pain, "emerge from neural processes that are inherently slow,"[167] and that require more focused attention. After listening to first person accounts of the psychological and physical suffering, test subjects were put inside an fMRI and asked to recall what they had been told. The experiment detected that limbic regions were activated instantaneously when subjects saw someone injured. Today, the activation time may indeed be decreased given the lack of opportunity for mirror neurons to engage. It takes time for the brain to transcend the self-boundaries set up by increasingly narcissistic humans before it can begin to comprehend and feel—to inhabit—the complex dimensions of another person's experience. Mary Helen Immordino-Yang, a member of the team, expands upon this assertion: "For some kinds of thoughts, especially moral decision-making about other people's social and psychological situations, we need to allow for adequate time and reflection, but if things are happening too quickly, you may never fully experience emotions about other people's psychological states."[168]

This inability to register and correctly assess nuanced social cues and complex emotions is, of course, a common feature of individuals who display Asperger's Syndrome. Their mental maps do not mark these terrains because heavy focus is placed on assimilating the endless, non-prioritized fragments of data encountered into a pattern recognition system, actions similar to a computer. But as our brain's attempt to catch up with our technology in order to more efficiently process the increase of information, the reverse may also true; we might transform into a culture that exhibits some features of Asperger's, and our slower mental faculties, such as empathy, compassion and our ability to engage in what Martin Heidegger referred to as "meditative thinking,"[169] the very essence of our humanness, might atrophy. With sustained disuse, these faculties, I fear,

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[167] Nicholas Carr, *The Shallows: What the Internet is Doing to our Brains* (New York and London: W.W. Norton & Company, 2010), 221.
[168] Ibid.
[169] Martin Heidegger, *Discourse on Thinking*, trans by John M. Anderson and E. Hans Freund (New York: Harper & Row Publishers, 1966), 151-52.

may ultimately be rendered obsolete. Opponents to Carr's stance, however, point to various studies, which support improvement in brain function. For instance, the 2008 study conducted at UCLA by Dr. Gary Small, the Director of the Institute for Neuroscience and Human Behavior, which revealed how the Internet activates areas in the brain that control decision-making and complex reasoning. The fMRI study was only conducted with 24 volunteers between the age of 55 and 76 when the limbic system is already fully formed. Others suggest that distraction and multi-tasking through online activity actually increase brain processing (which is what I feel is part of the problem), leading to better visual attention and working memory (Scanlon, 2007) and deliberative thinking (Dijsterhuis, 2006). But over time what is the cost? True, Carr could offer a more nuanced account, grounded in social-context, in keeping with John Palrey and Urs Gasser's *Born Digital: Understanding the First Generation of Digital Narrative* or simply turn off notifications, get rid of RSS subscriptions and establish rules around email correspondence, basic "self-disciplined filtering strategies," as one Tech Liberation columnist suggests, but social norms dictate dependency. I still believe that the more we become like our devices, a thing within the Internet of things, we may begin to treat one another simply as another set of information to be dealt with in a quick, impersonal, compartmentalizing and unfocused manner. I encountered evidence of this behavior in my own intimate relationship described in the following section.

Sherry Turkle offers empirical evidence for this growing decline in socio-emotional attunement. In *Alone Together*, she examines the shifting cultural expectations we place on intelligent technologies in their new role as "architects of intimacy."[170] Her robust, dual ethnographic study on robotic companionship and teen mobile culture shows not only how technology is "becom[ing] like a phantom limb [that] we would rather die than part with," but also the varied ways in which machine-mediated relationships are now redefining our very concepts of intimacy and authenticity—what it means to be alive and human. She found that interviewees felt that texting and robots provided "just the right amount of access, just the right amount of control" to "stave off loneliness" Thus, the illusion of connection through simulation "just offers something better."[171]

[170] A phrase coined by Turkle to suggest the subtle ways in which technology not only defining but also replacing our most private interpersonal relationships.
[171] Sherry Turkle, *Alone Together: Why We Expect More from Technology and Less From Each Other* (Philadelphia:

But does it? Spike Jonze's film "Her" portrays the emotional costs of anthropomorphizing our operating systems into romantic "self-objects."[172] When the protagonist finds out his operating system, Samantha, is flirting with other users, he becomes jealous and depressed. Fear of rejection and abandonment haunt him, communicated through a tracking shot that pans an intensely atomized and emotionally barren world. To assuage this sensation of emptiness, Samantha, who like Echo[173] has become more affectively attuned to his need for narcissistic supply than have his limited circle of friends, sends him a human surrogate, but he cannot navigate the cognitive dissonance. Has the sublimated desire to experience intimacy in the flesh (which he channels into writing love letters for faceless others) transformed into aversion? Or, has "the split between digital absence and carnal presence becomes unbearable," as Richard Kearney suggests in another context in *Are We Losing Touch?* Kearney also bemoans the disappearance of tactility, the carnal senses that make us human, and worries that we have entered an "age of ex-carnation" whereby we "obsess about the body in increasingly disembodied ways." He compares contemporary relationships to Plato's Gyges; "we see everything at a distance, but are touched by nothing."[174]

In *Regarding the Pain of Others*, Susan Sontag makes a similar observation about the role images (both static and moving) have historically played in allowing us to experience endless atrocities that take place globally "at a distance."[175] She notes that the commonplace accessibility of images, and the speed at which they are currently processed ultimately numbs viewers to the violence and suffering of others. Beginning with World War II, the violent and painful acts themselves are performed "at a distance" by perpetrators. Today's drone targeted killing further reduces personal accountability, empathy and remorse once experienced through hand-to-hand combat. These various socio-technological attempts to make ourselves invulnerable to those who could

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Basic Books, 2011), 4-17.

[172] Heinz Kohut describes self objects as individuals to whom we transfer ourselves onto who function as mirrors for parts of ourselves we are split off from or received insufficient care around during early childhood development. They are in essence an extension of our selves, our unmet needs.

[173] From Ovid's *Metamorphosis*, the myth of Echo and Narcissus tells the story of a once talkative forest nymph whose voice was taken away by Zeus when she exposed his secret affair to his wife, Hera. She is only able to repeat the final words of others. She falls in love with Narcissus, the beautiful youth who is too absorbed by his own reflection, so rejects her. Conveying her misery to Aphrodite, she makes his body transform into a flower.

[174] Richard Kearney, "Losing Our Touch?" *New York Times*, August 30, 2014, accessed August 30, 2014, http://mobile.nytimes.com/blogs/opnionator/2014/08/30/losing-our-touch/.

[175] Susan Sontag, *Regarding the Pain of Others* (New York: Picador, 2004).

physically or psychologically "touch us," this kinesthetic disengagement, even extends to our most intimate personal relationships.

Texting and IM-ing, too, allow us to keep both intimacy and our emotions "at a distance." Both appear to offer a safe space—protection—to more effectively "deal with people" on our own terms and to control our feelings and other's needs. As one of Turkle's subjects, Audrey, attests; "there's a lot less boundness to the person in a call, and things could get out of control…you might learn too much, say too much, and you can't edit yourself in the same way that you do online." Yet from experience both texting and email often evoke severe misunderstanding, easily cleared up with a face-to-face conversation. And Meredith, a junior in high school, who found out about her friend's death on IM, recalled she "was more okay because [she] didn't have to see people," but "when [she] had to face people at school [she] could barely tolerate the rush of feelings." It would seem emotions (one's own, but more dangerously other's) have become harder to process real-time, and they are neither safe, nor wanted. Turkle's research has also shown that young adults no longer trust their own feelings, but instead turn outward to their peers to tell them how they should feel. One of her subjects, Julia, 16, sums it up like this:

> If I'm upset, right as I feel upset, I text a couple of my friends…just because I know that they'll be there and they can comfort me. If something exciting happens, I know that they'll be there to be excited with me…So I definitely feel emotions when I'm texting, as I'm texting…*Even before I get upset and I know that I have that feeling that I am gonna start crying*, yeah, I'll pull up a friend… uh, my phone… and tell them what I am feeling…[176] (emphasis mine)

She continues to explain, "it's hard to calm down" until she gets a response back; she waits for an "Oh, I'm sorry or Oh, that's great." If she doesn't hear back immediately, she gets anxious and "pulls up" another friend who can validate her feelings.

The uncanny slippage between friend and phone (as well as the decline in empathy and remorse) attests to the increasing narcissistic tendency to see others as parts—self-objects. Narcissism, as Turkle points out, "is not a person who loves himself, but instead a personality so fragile that it needs constant support. It cannot tolerate the complex demands of other people (and emotions in particular) but tries to relate to them

[176] Sherry Turkle, *Alone Together: Why We Expect More from Technology and Less From Each Other* (Philadelphia: Basic Books, 2011), 175-6.

by distorting who they are and splitting off what it needs, what it can use."[177] Narcissists are, therefore, incapable of authentically loving or engaging in the social; they seek out highly idealized mirrors to use for the purpose of acknowledging and aggrandizing their own perceived sense of self. And when these mirrors fail them, or no longer align with their mental models, they withdraw their affection, and move onto the next "made-to-measure representation."

Such behavior sadly is no longer deemed pathological; narcissism is not only condoned as shared experience, but also even expected via Facebook, Twitter and especially the selfie-driven Instagram craze. Social media both reinforces "users'" fragile sense of self worth by validating their disembodied expression with likes and comments, but also imposes unconscious restrictions. Through their opinions, profile information and the pictures they share, users communicate a highly managed self for fear of falling out of favor with their "friends." While performative constructions of self have been theorized since the early 19th century and harnessed for advertising since Edward Bernay's *Century of the Self*, the frequency, speed and scale of promoting the self provokes an unprecedented level of low grade, daily anxiety. By contrast, other studies found that the social capital facilitated through Facebook and Twitter actually increase "measures of psychological well-being." For instance, a 2007 study[178] out of Michigan State University sampled 800 college studies and discovered that those suffering from low self-esteem benefited most from social networking interactions, as well as new undergraduates experiencing "friendsickness" after moving to an unfamiliar environment. And as Jonah Lehrer, notes in his critical review of Turkle's book, "despite our misgivings about the Internet, its effects on real-life relationships seem mostly positive. To support his assertion, he cites an unreferenced study that suggests, "blogging leads to increased levels of social support and integration and may serve as the core of building intimate relationships."[179]

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[177] Ibid, 177.
[178] Nicole B. Ellison, Charles Steinfield and Cliff Lampe. "The Benefits of Facebook "Friends:" Social Capital and College Students' Use of Online social Network Sites," *Journal of Computer-Mediated Communication* 12 (2007) 1143-1168.
[179] Jonah Lehrer, "We, Robots. Book Review – Alone Together – By Sherry Turkle." *New York Times*, January 21, 2011, accessed June 16, 2015, http://www.nytimes.com/2011/01/23/books/review/Lehrer-t.html.

But I wonder what will happen when transmission codes are implanted into our brains, so "we will not have to move a finger—or come into contact with another human being—to get what we want," as Kearney forewarns. Will people magically appear on demand? Seeing the hyper-real other in 3D might soon replace touch altogether as "the cosmos shrinks to a private monitor: each viewer a disembodied self unto itself."[180] Facebook's acquisition of the Oculus Rift—an immersive display—certainly attests to the attainability of such in the not so distant future, and to the atomizing tyranny of the visual.

In fact, the tyranny of the visual began as early as the 19th century. Sight was regarded hierarchically as the most direct pathway to the brain, and thus an effective tool for mass persuasion and social control. Today, the techno-scientists who design and develop intelligent technology might be considered a contemporary version of Le Bon's "hypnotizers;" they shape the "illusions," which pacify the increasingly affectless masses through a veil of participation and personalization. While Facebook appears to have democratized self-expression, it could also be considered a modern version of crowd control, managing social chaos by keeping it in check through massive data mining and content analysis. Facebook's chief data scientist, Lada Adamac, shared at the NetSci Conference last year that she has designed biomimetic algorithms to better understand and manage through data analysis how posts virally propagate and shape public opinion.[181]

Like the walls in Israel, the Internet and mobile devices resemble a form of slow violence; they function simultaneously as both protection and invisible control from vulnerability. In the Al Jazeera documentary, *Architecture of Violence*, the filmmaker identifies three strategies used by the Israeli's to control Palestinian mobility: checkpoints, surveillance and the bulldozing of homes, which serves to breakdown public and private space. In many regards, the companies that monitor and steer our digital lives, observe us like the Israelis up on the hill looking down in the valley, only behind the firewalls of technological databases and infrastructure. We willingly check-in with

[180] Richard Kearney, "Losing Our Touch?" *New York Times*, August 30, 2014, accessed August 30, 2014, http://mobile.nytimes.com/blogs/opnionator/2014/08/30/losing-our-touch/.
[181] Lada Adamac, "Facebook Data Science," (Transcript from keynote presented at the NetSci 2014 Conference, Berkeley, CA, June 3rd, 2014).

Foursquare and parade our private lives on Facebook and Instagram. Our minds are occupied by these applications, reinforcing the "optical delusion"[182] that we are separate and isolated, struggling for connection. Atomization is after all one well-worn tactic for maintaining social order.

Google Glass, the Oculus Rift, Magic Leap and other immersive displays literally turn us into isolated monads and instrumentalize one sensory pathway to attention, Yet proponents across diverse sectors believe "intelligent glasses" might also serve as the antidote to eroding empathy, and other serious psychological and sensorimotor disorders. There have been numerous academic experiments employing virtual reality (VR) systems to aid in trauma recovery and physical rehabilitation, including amputees accustomed to prosthetics, and military and medical training. For instance, one Stanford study shows how Google Glasses could help patients with Parkinson's and Huntington's diseases by providing "regular visual and audio patterns required to help with gait correction."[183] A soon to be published study announced in the journal *Trends in Cognitive Science* (and reviewed in the Huffington Post) explores how VR could be used to reduce unconscious bias against racial and ethnic groups, as well as age and gender difference by inhabiting another's skin.[184] Professor Mel Slater, co-researcher, claims "the experience of 'living' in a different skin triggers sensory signals in the brain that allow it to expand its understanding of what a body can look like…this is what causes people to change their attitudes about others." [185]

However, my gut says this kind of limbic level change does not happen over night, especially without kinesthetic engagement and mirror neuronal activation. Yet Sundance New Frontiers lab was ablaze with VR this year. Journalists, documentarians, like Nonny De La Pena and artist Chris Milk are pioneering ways of creating empathy through first person stories with the Oculus Rift. Nevertheless, customer reviews repeatedly stress that you cannot stay inside the head-mounted display for longer than 15-20 minutes, and that walking with masses of cables attached certainly does not facilitate a

[182] Albert Einstein in a l952 letter to a friend who's child has passed away expresses that we are blinded by an optical delusion, which makes us believe that we are separate, rather than interdependent.
[183] "Google Glass and Hodgkins Disease," accessed June 20, 2014. http://web.standford.edu/group/hopes/cgi-bin/hopes_test/google-glass-and-hod/.
[184] See BeAnother Lab in Chapter 7 for further an additional example.
[185] Anna Almmendrala, "When White People See Themselves with Black Skin, Something Interesting Happens," accessed December 14, 2014, http://m.huffpost.com/us/entry/6328654,

fully organic, embodied experience. As one New York Times writer describes of De La Pena's *Hunger in Los Angeles*, the headset produced an "uncanny illusion… that cleaved an unbridgeable rift between the evidence of my senses and an awareness of space and time deeper in my body...in seconds, cognitive dissonance turned into something existential: bona fide Sartrian nausea."[186] The writer promptly tore off the mask, and proceeded down the hallway to vomit. She claims that her equilibrium restored only after several days.

Amidst the flurry of promise, however, little clinical research has yet to be done on the long-term neurobiological impacts of the technology itself, except for a pre-Oculus Rift study out of CHI in 2010. The study employed NordicNeuroLab video goggles in an attempt to identify the regions of the brain activated by two VR parameters, interactivity and 3D motion. The interdisciplinary team of researchers from Umea University in Sweden concluded that using immersive virtual environments for testing would greatly enhance their ability to measure sensorimotor regions, in particular, the core mental rotation network, since brain activity was heightened through interactivity and 3D motion. Many of these kinds of studies, however, are limited because they focus solely on limited valence and arousal patterns.

An interesting by product of the study was the unexpected activation increase in the right angular gyrus, which is close to the temporoparietal junction, an area dedicated to "multisensory integration of body-related information, out-of-body experiences and the related impact on the sense of presence."[187] Further investigation is necessary to render any useful evaluations, but the data offers neurochemical clues that suggest extensive time spent in VR environments could alter not only our brain-wiring diagram, but perhaps even our biological substrate. Building off Elmer Green's seminal research, which states that "every change in physiological state is accompanied by an appropriate change in the mental emotional state, conscious or unconscious, and conversely is accompanied by an appropriate change in the physiological state,"[188] Candice Pert

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[186] Virginia Heffernan, "Virtuality Fails its Way to Success," accessed November 14, 2014, http://mobile.nytimes.com/2014/11/16/magazine/virtual-reality-fails-its-way-to-success.html?referrer=.
[187] Kenneth Bodin et al., "Effects of Interactivity and 3D-motion on Mental Rotation Brain Activity in an Immersive Environment," (paper presented at CHI: Brains and Brawn in Atlanta, Georgia, 2010.
[188] Candice Pert,. *Molecule of Emotion: The Science Behind Mind-Body Medicine* (New York: Simon & Schuster, 1999), 139.

located neuropeptide receptors—strings of amino acid, protein essentially—that serve as messengers between brain regions and every bodily system. For Pert, like many yogis, the body is the unconscious mind, and neuropeptides function as chemicals stemming from the brain that dictate our mood and emotions, which in turn cause specific brain regions to heal or compromise our physiological system. One particular neuropeptide, the opiate receptor, is responsible for altered mind states. Performing a deeper analysis of the temporoparietal junction through the triangulation of fMRI, EEG and biometrics, during VR use, and connecting these findings to Pert's research might, therefore, enable us to anticipate the epigenetic changes wrought by VR, and other contemporary intelligent technology.

Bodin et al also saw a concurrent rise in prefrontal and parietal activation associated with working memory and attention. Based on prediction error theories, they hypothesized that because the brain employs constant pattern recognition to ensure its survival, the interactivity and constant 3D rotation, which heightened variability and unpredictability in the environment caused the increase in activation, and thus demands on the working memory. These findings concur with Turkle and Carr's observations, as well as the clinical studies on techno-stress (discussed in the next chapter), which suggest that chronic increases in cortisol levels lead to depression and decrease gray matter in the hippocampus and amygdala.

But like the Internet and mobile phones, the hyper-ocularcentricity of immersive displays coupled with limited kinesthetic engagement force the lived body to recede into the background. Rather than embracing the body as biological fact, the body in VR is instead "optioned"—restructured or extended to transcend the limitations of simply being human through socio-technical procedures. On the other hand, users of wearable technology see the body as a "project;" the majority of the market sector focuses on improvement, management and discipline. By monitoring, tracking and analyzing their own biometric data, users attempt to "combat anxieties about the body."[189] Both options and projects, while not overtly denigrating like "body regimes," are forms of non-acceptance and distancing.

[189] Chris Shilling, *The Body and Social Theory* (London: Sage Publications, 1993). Schilling sees the body as both a social and biological phenomenon that is shaped by social relations and structures. He maps out different approaches to eradicate the problem of the "absent body" in social thought.

Wearables, like VR, recently moved from the realm of science fiction and military technology to commonplace consumer technology. The *Guardian* has posited that "2015 will be the year wearables become sexy,"[190] and *Forbes*, too, claims it will be the next big thing once connected to the Internet of things. But the majority of these products are functional, focused primarily on fitness and wellness. With these fashionable prosthetic devices, we no longer need to "be in touch" with our bodies, our Nike Fuelband or iPhone smart watch will assume the responsibility of monitoring our vitals real-time and informing us of our avatar's health meter and the kind of mood they are in (just like the mindclone in the box). But that's not all; Bionym has created a wristband that measures unique elements of your ECG pattern to authenticate payments.[191] Once your body is transformed into pure data, it can be captured, parsed and used just as easily as a remote control for adjusting smart homes or as a collective generator for lighting city streets. The abstract you, another atomized device floating amidst the Internet of things, is more cost efficient and self-sustaining. Not to mention, a "swarm of isolated individuals"[192] lacking cohesion transformed into atomized data sets are no doubt easier to command and control with a line of code or the constant Pavlovian vibration of your smartwatch.

What are the evolutionary implications of this shift from affective attunement with our selves and one another "in the flesh" to our non-biological representation of our selves and others through our devices?

Taken together, these various findings attempt to illustrate that the Internet, mobile devices, immersive displays and wearables: 1) atrophy our ability to form explicit memories, which in turn disallows the formation of knowledge schemas for learning and planning and the activation and regulation of emotions necessary for critical feeling 2) over-activate certain "mindreading" brain regions, which trigger mirror neurons, priming us to accept non-biological connection as indistinct from (and preferable to) human connection, 3) decrease our ability to read social cues, empathize and have compassion for other humans, and 4) disconnect us from kinesthetic and sensorial engagement with

[190] Hannah Marriot, "Could 2015 be the year wearables become sexy?," *The Guardian*, December 25, 2015, accessed: December 28, 2014, http://www.guardian.com/technology/2014/dec/25/2015-wearable-tech-fashion-designers.
[191] I gave a demonstration of the new Xth Sense at SOLID, and a fair number of conference attendees, mostly designers and developers for the Internet of things, suggested that because each body is unique, the sound from the body could be used similarly for security purposes.
[192] Gustave Le Bon, *The Crowd: A Study of the Popular Mind* (New York: Dover Publications, 2002), 207.

ourselves and one another required for self-understanding and societal cohesion.

While Carr, Turkle, Kearney and passionately voice their concerns about the socio-technical forces contributing to our renunciation for direct experience and human connection, an examination of my own personal story of transformation undergirds their respective findings. This painful experience forced me to reverse engineer my own co-opted operating system back into a human being in order to survive and restore "critical feeling."

3. Positive Disintegration

"There is a crack in everything," says Emerson. Is this the crack in the design of the human being?"

As I dug deeper into the literature review on the socio-cultural and neurobiological implications of emerging technology's seamless integration into our everyday lives, the second strand revealed itself. My personal experiences were reflected back to me, and offer an intimate portrait of the findings I uncovered in the preceding section.

After years of increasing stress accumulated through a combination of hyper-cognitive overload to my working memory, and the unacknowledged desire for embodied presence, my autonomic nervous system shutdown. I became a faulty servomechanism, which could no longer parse, filter, analyze and organize all the seemingly disparate inputs of data fed by surface noise, constant mobility and an unhealthy addiction to the socio-technical affordances of technology employed to maintain the "performance of connections" and the presentation of a managed self.[193] Mentally exhausted, I became emotionally unpredictable, unregulated. I personally understood Marshall McLuhan's "self-amputation."[194]

In Chapter One of *Understanding Media*, McLuhan references E.M. Forester's novel, *A Passage to India*, as a "parable of Western man in the electronic age," and perceptively connects the protagonist's interior monologue to a form of self-amputation: "Life went on as usual, but had no consequences, that is to say, sounds did not echo nor thought develop. Everything seemed cut off at its root, and therefore, infected with illusion."[195] For McLuhan, self–amputation occurs when our nervous system reaches a threshold of sensation for which the only relief is withdrawal and numbing. He further expands upon this concept in the same work in "The Gadget Lover," wherein he muses that Narcissus's "extension of himself by mirror numbed his perceptions until he became a servomechanism of his own extended or repeated image. The nymph Echo tried to win his love with fragments of his own speech, but in vain. He was numb."[196] Narcissus, of

[193] In his seminal 1959, *The Presentation of Self in Everyday Life*, the sociologist Erving Goffman outlined a theory about face-to-face social interactions, which articulates that we adjust how we appear to accommodate expectations of others.
[194] Marshall McLuhan, *Understanding Media: The Extensions of Man* (Cambridge: MIT Press, 1994), 42.
[195] Ibid, 15.
[196] Ibid, 41.

course, stems from the Greek word *narcosis*, which means numbness or paralysis. In our emotional lives, what we typically numb is vulnerability, the most excruciating form of which is shame, our fear of disconnection. So, perhaps, our impulse to create and wield intelligent gadgets as extensions of ourselves enables us to defend against, put "at a distance," shame, in an attempt to maintain homeostasis, the script that we are worthy of love and belonging. Further along in the same chapter, McLuhan's observations support my speculation, when he asserts, "auto-amputation is resorted to when the perceptual power cannot locate or avoid the cause of irritation."[197] He associates the discomfort with over-stimulation of the nervous system through technology. Yet, I would also argue the opposite; we initially use technology consciously or unconsciously to numb the nervous system to defend against the intensity of affect—the body pain of our buried emotional life. However, once the nervous system is overwhelmed by sensory input, the numbing, like any drug, eventually becomes ineffective, and the pain surfaces again, prompting us to consume more or turn to a new drug.

I[198] experienced what happens when the numbing mechanisms no longer work after the person with whom I was most intimately connected triggered original childhood shame, stored as trauma, which manifested as the fear associated with distrust of love stemming from unhealthy attachment patterns, and I came undone. When exposed, vulnerable, and unable to hide behind technology—language, texting, disembodied voice, and empathy, its antidote, was not offered because of my partner's lack of affective attunement (what I now understand to be a by product of neurobiological changes to the millennial brain wrought by intelligent technology, perhaps), the homeostatic impulse kicked in and my autonomic nervous system quivered indicating that my sense of self—my ego—was at risk of annihilation, and the scripts—the cognitive scaffolding that kept my false self-image, my social armor, in place—were about to be dismantled. When I finally let the scaffolding collapse, my body's physiological response was the loss of control of my sensorimotor capacity, the shudder, what Adorno identifies as *Shauder*, the horror associated with the abject, which causes "goose bumps" and rapid heart rate. This

[197] Ibid, 43.
[198] In the first version of this chapter I referred to myself as "you" throughout; unconsciously objectifying and depersonalizing my experience.

reaction, Adorno's shudder, then instigated a "positive disintegration,"[199] which ultimately caused the "liquidation of the I," which Adorno curiously labeled *Schauder*, or shame.

While the Diagnostic Statistical Manual (DSM) pathologizes such a collapse as the experience of a nervous breakdown, the Polish psychologist, Kazimierz Dabrowski, instead perceived the over-excitability of "psychoneurosis" as symptomatic of an expanding consciousness essential to our development towards our personality ideal. Disintegration, he claims, is the first stage of individuation away from the "illusion" that various forms of authority and systems including technology instill as a form of social control (authoritative systems which we internalize as the super ego). Dabrowski identifies the adherence to social norms—societal conventions and school/peer/familial expectations—as the lowest level of personal development. He believed that the majority of the populace are stuck at this "robotic, de-humanizing, de-individualizing" stage, and I would further argue that current social media and intelligent technology reinforces an arrested development and instigates the de-personalization associated with unhealthy narcissism as a quiet form of social control.

In this fragmented state, I was only able to function in a constant present; the past was too painful, and the future cloudy, non-existent. My higher mental functions became difficult. I chose what seemed the only option—to be still and return to my lived body. While sitting in silence during a three-day meditation retreat in an attempt to regain some balance, layers upon layers of self-managed armor—ego-driven scripts that sustained the homeostatic impulse—fell away. Stripped of these, some clarity emerged. I observed of my own experience that what lay at the root of my behavior was bypassed shame[200]—the

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[199] Kazimierz.Dabrowski, *Psychoneurosis is not an illness* (London: Gryf Publications, 1972) , 4. Dabrowski's theory in a nutshell: "Psychoneuroses 'especially those of a higher level' provide an opportunity to 'take one's life in one's own hands'. They are expressive of a drive for psychic autonomy, especially moral autonomy, through transformation of a more or less primitively integrated structure. This is a process in which the individual himself becomes an active agent in his disintegration, and even breakdown. Thus, the person finds a 'cure' for himself, not in the sense of rehabilitation but rather in the sense of reaching a higher level than the one at which he was prior to disintegration. This occurs through a process of an education of oneself and of an inner psychic transformation. One of the main mechanisms of this process is a continual sense of looking into oneself as if from outside, followed by a conscious affirmation or negation of conditions and values in both the internal and external environments. Through the constant creation of himself, through the development of the inner psychic milieu and development of discriminating power with respect to both the inner and outer milieus, an individual goes through ever higher levels of 'neuroses' and at the same time through ever higher levels of universal development of his personality."

[200] Bypassed shame was a concept first coined by Michael Lewis in *The Exposed Self*. It is simply an attempt by individuals to unconsciously distance oneself from painful experience or fear of exposure. Defense mechanisms serve as ways to hide unacknowledged shame.

fear of disconnection due to the potential and continuous threat of exposure that we are not worthy of love and belonging. It is often the root of much seemingly inexplicable human behavior. Humans have developed ingenious defense mechanisms for hiding this vulnerability, this often-irrational fear of rejection and abandonment (and of its opposite smothering and annihilation) through the adherence to social conventions, familial expectations, peer group codes and the media ecology. Furthermore, in our habitual addiction to technological connectivity, I perceive that we are unconsciously driving ourselves increasing distances away from the actual human connection (love and belonging) we crave (though ambivalently fear) through direct experience with our bodies, emotions and the senses. Like other forms of addiction, such as drinking, drugs, pharmaceuticals, even shopping, which allow us to numb ourselves from the excruciating, physiological pain of shame, technology also numbs us. However, as Brené Brown contends in her popular Ted talk, "we cannot selectively numb; when we numb shame, we also numb other affects, like joy, pleasure, and happiness."[201] We become, therefore, affectless, closed systems. To the contrary, once we open our hearts and allow joy and love in, the numbing wears off, the repressed, split off parts of the self from childhood associated with shame can resurface.

I was not prepared for this.

Unacknowledged shame had been driving my actions and social behaviors since infancy. Inconsistent caretaking from a young, unprepared and sometimes emotionally volatile 18-year old Mother raised in an alcoholic home, perhaps caused me to inhibit basic needs and hunger sensations. At some deep unconscious level, I did not feel worthy of love and belonging. But in order to survive, I shutdown, emotionally and physically, and moved into my mind, which eventually became my sole identity. Here, I built up many walls of defense, complex language, in particular, all dedicated to avoiding intimacy and reinforcing an ego driven by perfectionism and achievement to hide/defend against/numb this excruciating fear and pain associated with feeling unlovable. But in doing so, I blocked my life force, which limited visceral emotional output, as well as input, such as reaching out for and taking in of emotional nourishment from others. Like

[201] Brené Brown," The Power of Vulnerability," accessed August 13, 2014, http://www.ted.com/talks/brene_brown_on_vulnerability?language=en.

the cybernetic ethos I had been researching, I discovered that I, too, was unconsciously policing the sensate; I rejected my body, regulated my emotions and canalized my senses. Need became the enemy. Emotions were dangerous. My mind invented systems, internal rules, to render the social chaos of home more predictable. I gravitated towards literature, theatre, dance, film and videogames, which allowed me a safe, representational space to observe and to feel—to experience life "at a distance." Later, I transferred this fascination into designing my own controllable micro-universes within these various genres where I could direct live bodies or program AI trajectories with semi-predictable outcomes. As physicist Amit Goswami notes, "Creativity is a restoration of order;"[202] it allows us to create a new order inside ourselves, and then to manifest it externally.

There may be many walking wounded, like me. Shame is quietly transferred through the mother-child dyad. It is subtle, invisible and pervasive, just like technology. Perhaps the parthenogentic fantasy—the desire to be made, not born—stemming from first wave cybernetics, and re-popularized by current Singularity pundits is a defense against the unconscious fear of rejection and abandonment, and the drive towards greater prediction, quantification and control is an attempt to personally overcompensate for faulty attachment issues. After all, as Sterling, an activist friend from Detroit informed me, "there are no social problems, just personal problems that become social."

Most of us, however, may not be unaware that we have auto-amputated, become transformed into closed systems—human APIs—run like our software by computational protocols and algorithms within invisible technological ensembles outside of our control. We often don't talk about shame; we mostly experience it as by-passed—something unfathomable, and therefore, relegated to the "swampland of the soul."[203] It may only be when the "illusion" of social conventions and familial expectations cracks through mental dis-ease (catalyzed by the shame-shudder coupling) and positive disintegration ensues that the individual discovers the human being who was embedded beneath all the layers of social constructs behind which the fragile ego hid.

Technology ostensibly offers a perceived form of self-protection, a place for the ego to hide from vulnerability, but it also invites self-policing through codes of behavior

[202] Amit Goswami, *Quantum Creativity: Think Quantum, Be Creative* (New York: Hay House, 2014).
[203] Brown, Brené. Radio interview.

that resemble panoptic systems. Our addiction to connectivity encourages the precarious management and reinforcement of a false and acceptable personae of our selves, in turn fueling the fear of potential exposure users seek to avoid. Avoidance of vulnerability through numbing forces us to cling to a false self[204] and belief systems constructed by others. Over time these external forms of validation deny us the necessary relationship with our inner self—our pre-personal potential—the compass of our feelings and thoughts.

I thought I had feelings and thoughts, but they were not really my own. I had been programmed by what I consumed and how I interacted with the systems and communities that establish norms. The more I participated in accordance with norms, such as those which allow emoticons to stand in for authentic feelings and validate "at a distance" social interactions to replace the physical human contact required for mirror neurons to activate and empathy to be possible, the less social-emotionally competent and human I became.

From the liminal space provided by the cracks in the illusionary, scaffolded self, I slowly discovered in retrospect that this is what had been happening to me. I had become less human as a result of my dependence upon intelligent technology, but my unconscious resisted; it wanted to find more balance.

Like Richard Foreman, I began to see in myself, and others "the replacement of the complex inner density with a new kind of self—evolving under the pressure of information overload and the technology of the instantly available."[205] I gave talks and wrote about the need to create a backlash against our readiness to turn into "pancake people—spread wide and thin as we connect with that vast network of information accessed by the mere touch of a button."[206] I spoke of the urgent need to restore our passional engagement with the world and with one another. But I was not, however, living it. Instead the patterns of my own intimate relationship disturbingly conformed to the findings of my research.

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[204] Drawing from self-psychology, for me, the false self is a construct built of defenses to reinforce a fragile ego. It is compromised of a false belief system and a set of scripts based on social conventions, familial expectations and body schemas that disconnect us from a more authentic relationship with our core self.

[205] Richard Foreman, "The Gods Are Pounding in My Head (aka Lumberjack Messiah)" (statement appearing in program notes for play performed at St. Mark's Theatre in New York, New York, May, 2005).

[206] Nicholas Carr. *The Shallows: What the Internet is Doing to our Brains* (New York and London: W.W. Norton & Company, 2010), 196.

The generational gap between my partner (referred throughout as P) and myself rendered this cultural shift uncomfortably apparent. It was my first deep involvement with a millennial, one, which I experienced as predominantly text-based and "at a distance." There was an unusual emphasis on monologue over dialogue, a preference for text-based communication of emotions, a dominance of shared experience over sharing of experience, and an imbalance towards (and a lack of distinction between) virtual absence and physical presence, to name a few features of the relationship. It was as if we were re-enacting verbatim the case studies found in Turkle's *Alone Together*. In a text, I would receive extremely intimate articulations of affection, but such intimate protestations were neither verbally delivered, nor physically demonstrated. As Turkle keenly notes, "all matters – some delicate, some not—are crammed into a medium that quickly communicates a state but is not well-suited for opening a dialogue about complexity of feeling…Texting can compromise the intimacy it promises."[207] I not only experienced the accuracy of this compromise but also clearly witnessed the human aversion to unpredictable, sometimes messy emotional exchanges necessary for the growth and healthy maintenance of intimacy, an aversion intensified for an individual preferring texting to phone or even face-to-face conversation. Face-to-face personal intimacies (especially if requiring empathetic engagement) were met with a hollow, deer in the highlights, stare, as if the content of my words did not register, or could not be processed. And I soon discovered P's inability to read more subtle social cues and to exhibit remorse. It also became clear that I was functioning as a quasi "self-object." If my behavior departed from my two useful roles (mentor and caretaker), and I possessed needs of my own (that might detract from professional progress), conflict inevitably arose, because I no longer fit into the prescribed mental model. Lastly, the constant companionship of P's mobile device resulting in a lack of presence—always being elsewhere—made me feel like another data set that was shallowly and intermittently entertained amongst other data flows within the Internet of things. I must admit I started to harbor jealous and resentful feelings towards the phone. However, I caught myself reciprocating with similar behavior. I would displace emotions onto the phone as if it

[207] Sherry Turkle, *Alone Together: Why We Expect More from Technology and Less From Each Other* (Philadelphia: Basic Books, 2011), 268.

were an extension of P when we were a part, and I craved those dopamine hits carrying meager crumbs of affection, like a quick fix.

I was suspended in a constant state of separation-anxiety. As a result, I recognized for the first time that I actually had unmet needs, and experienced an intense longing to be safely and securely held physically in love. It was as if the unacknowledged loss of emotional connection with my mother, which I had buried, resurfaced with a vengeance. The conditions of the "at a distance," and primarily text-based relationship, produced a similar enough stimulus pattern to re-trigger split off emotion, and feelings of anxiety associated with either perceived early childhood abandonment, or an unspoken college rape.[208] The cognitive dissonance that I encountered between physical absence and digital presence somehow resembled the interruption of the positive affects, enjoyment-joy and interest-excitement, which automatically activate the negative affect, shame-humiliation, to serve as buffer numbing the pain associated with the loss of actual human touch. I found myself acting out in surprisingly uncharacteristic ways. Like the protagonist in *Her*, I yearned for "carnal presence," and the desire for P to be able to feel me—"to feel what a wretch [like me] feels."[209] But instead, the lack of affective attunement extended during interstitial face-to-face time coupled with the constant dopamine triggers from every text message, only served to increase my addiction, and sense of longing for more authentic human connection. A few days before my disintegration, the longing transformed into an inexplicable body pain, which I now in retrospectively associate with those unmet needs and hunger supplanted during early childhood coupled with the suppressed memory of the rape, which lodged in my connective tissue.

Sylvain Tomkins contends that the affect system evolved as a normal brain function to reduce confusion from stimulus overload. My erratic emotions, cognitive fog and strange physiological responses were clear signs that my operating system[210] was failing. I had reached a saturation point within the "ecology of interruptions," and it had

[208] During the time of this writing, the cause has changed and become palimpsestually layered and unclear as a result of therapy, but the physiological feelings of anxiety, flight or fight response and heightened cortisol levels remained constant.
[209] Shakespeare, William. *King Lear*, Act 3, Scene 4.
[210] I use operating system and other computer-based terms to distinguish between the servomechanism I perceived myself to have become and the human being I rediscovered once I disconnected from technology and began to heal.

induced stimulus confusion. I urgently needed to "find my way back to the tactile world again"[211] to heal my heart and mind.

[211] Richard Kearney, "Losing Our Touch?" *New York Times*, August 30, 2014, accessed August 30, 2014, http://mobile.nytimes.com/blogs/opnionator/2014/08/30/losing-our-touch/.

4. Recuperating the Biological Self

I'd rather leave all my autonomic functions with as much autonomy as they please. Imagine having to worry about running leukocytes, keeping track, herding them here and there, and listening for signals. After the first flush of pride in ownership, it would be exhausting and debilitating and there would be no time for anything else.[212]

4.1. Overview

The biologist, Lewis Thomas, would be surprised by our obsession with tracking autonomic functions today. Self-quantification, first forwarded by Wired editors Gary Wolf and Kevin Kelly in 2007, has gained mainstream momentum over the past couple of years as an increasing number of wearable sensors tracking different biometric data sets enter the market. Microsoft has even developed (though decided to forego) a prototype for a "smart bra" outfitted with physiological sensors that "monitor a woman's heart activity to track her emotional moods and combat overeating."[213] Intel, too, sponsored a "make-it-wearable" contest. My favorite, BABYBE, an emotional prosthetic, is "a bionic mattress that keeps mothers and their babies connected through the process of artificial incubation."[214] Each new device offers the promise of self-knowledge through self-tracking and self-control over the optimization of our corporeal bodies, which are now perceived to be operating systems.

But as intelligent technologies continue to shrink and to become integrated into our bodies, brains and environment, leaving the interface behind as they begin to mirror, then ultimately surpass human systems exponentially, as Ray Kurzweil portends in *The Singularity is Near*, our biological selves run the risk of becoming increasingly more numb and extraneous, except as base materiality for data collection. The over-emphasis upon cognitive enhancement at the expense of bodily engagement and affective attunement seems to be preparing us for complete submission to "auto-amputation" whereby artificial intelligence will fully overtake innate biological intelligence. In fact, a recent article in *Scientific American* attests to sub-sensorial symbiosis taking root as we enter the sixth wave of innovation. Bioengineers in Switzerland have begun to experiment with combining a brain-computer interface with a synthetic biological

[212] Lewis Thomas, *The Lives of a Cell: Notes of a Biology Watcher* (New York: Penguin Books, 1978).
[213] Elise Hu, "Microsoft Not Developing a Bra to Stop Overeating, After All, *NPR*, December 10, 2013, accessed December 12, 2013, http://www.npr.org/blogs/alltechconsidered/2013/12/10/249963461/microsof-not-developing-a-bra-to-stop-overeating-after-all.
[214] "Make It Intel," accessed September 3, 2014, http://makeit.intel.com/finalists.

implant using optogenetic technology—an electronic magnetic field generator. The biofeedback generated from the device targets protein production to manipulate gene expression.[215]

Thus, in an attempt to recover the biological self, the lived body, from what I see as our prosthetic dependence upon intelligent technology before we might be irrevocably co-opted by the intellectual ethic of cybernetics embedded into the design of technology and transformed into closed systems[216], I directly challenge Marshall McLuhan's admonishment that "deep participation, empathy and [sensory] experience" is a harbinger of social chaos in need of a "sense ratio." I will argue that the very cultivation of these affective modalities are vital to the restoration of critical feeling required for not only large-scale systemic change but also the maintenance of social cohesion. As Donald Nathanson asserts, "we've been reared in a psycho-social system that declares the expression of affect to be an unwanted remnant of disgusting infantile behavior."[217] Yet, affect is the core driver of human behavior; "it puts the drive in bodily drives."[218] In our attempt to silence, sublimate or deny the existence of unpredictable and spontaneous bodily expression, emotions and the senses because they are perceived to be threatening to the stability of human experience, he suggests we often cause more harm. I firmly believe that our over-valuation of cognitive efficiency and under-utilization of kinesthetic engagement is creating an imbalance in the human and social organism. According to the "principle of ecological assembly," described by Andy Clark in Chapter 9 of *Supersizing the Mind*, the embodied agent's information processing organization "are repeatedly soft assembled from a motley crew of neural, bodily, and external resources."[219] The process, he suggests, "produce[s] self-stimulating cycles of material scaffolding to yield an acceptable result with a minimum of effort and no 'central meaner.'"[220] The brain and central nervous system, therefore, are impartial. Thus, the more we offload onto extended

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[215] Simon Makin, "Thought-Controlled Genes Could Someday Help Us Heal," *Scientific America*, accessed February 12, 2015. http://www.scientificamerican.com/article/thought-controlled-genes-could-someday-help-us-heal.
[216] I define a "closed system" in a cybernetic sense as a way of describing a predictable and controlled system in which entropy has been highly managed, emitting little spontaneity and emergence.
[217] Donald L. Nathanson, MD, prologue to *Affect Imagery Consciousness* by Silvan Tomkins (New York: Springer Publishing Company, 2008), vii.
[218] Melissa Gregg and Gregory J. Seigworth, *The Affect Theory Reader* (Durham and London: Duke University Press, 2010), 5.
[219] Andy Clark, *Supersizing the Mind: Embodiment, Action and Cognition* (New York: Oxford University Press, 2008), 197.
[220] Ibid, 137.

tools, like intelligent technology, the less responsive we are to other environmental affordances, including other human beings. This, I suggest, can create an imbalance.

As Victorio Gallese words underscore: "Our ability to sense the physical [and emotional] lives of those around us forms the basis on which socialization and the experience of the social takes place."[221] Therefore, if Victorio Gallese is correct, and sociality itself originates in and depends upon physicalized empathy and empathy forms the basis upon which society exists and functions, I fear that social cohesion may not be sustained much longer through the performance of at-a-distance connections (i.e. social networks, texting, virtual reality et al) that banish our physical, emotional and sensual lives. Autonomous art offers one pathway towards recuperation and reconnection. I believe it carries the capacity to mitigate the slow violence caused by our dependence upon intelligent technology by inversely re-scripting our nervous system through the conscious design of synesthetic experiences that encourage kinesthetic engagement and social interaction. *But in an age of autonomous technology, what kind of autonomous art is oppositional enough to catalyze the "shudder" necessary for a shift in consciousness?*

For Theodor Adorno, the autonomy of art—art for art sake—was a revolt against bourgeois existence. He believed that culture became a parasitic tool to industry, specifically art, to reify the economic and administrative control of the rising class as it came into its political power. In *The Culture Industry*, he contends, "no half-way sensitive person can overcome the discomfort conditioned by his consciousness of a culture which is indeed planned and administered."[222] Today, the autonomy of visual art, poetry, music, dance and theatre are equally, if not more, critical as oppositional forces to the what I perceive to be the persistent cybernetic bureaucratization and its atomizing ideologies, which appear to continue to dictate not only our economic systems and cultural values but also our neurobiology and epigenetic structure. Yet, as I argued in Chapter 2, such vehicles of creative change may no longer be effective antidotes to the numbing caused by intelligent technology.

Adorno posits that "art becomes social, by its very opposition to society, and it occupies this position only because it is autonomous art…it criticizes society by merely

[221] Victorio Gallese, "Embodied simulation: From neurons to phenomenal experience," *Phenomenology and the Cognitive Sciences* 4 (2005): 23-48.
[222] Theodor W. Adorno, *The Culture Industry: Selected Essays on Mass Culture* (New York: Routledge, 1991), 108.

existing."[223] *But is "merely existing" amidst the constant semantic stream of "present shock"[224] enough, today? Moreover, is autonomous art even possible in a culture driven by autonomous technology wherein the very notion of subjectivity—our bodies, emotions and senses—is once again under attack, and the neurobiological brain structures responsible for "critical feeling," and dissent are being eroded?* In such a climate of stimulus confusion[225] Adorno's "shudder"[226] barely registers. This chapter attempts to identify what type of artistic response is still capable of instigating the goose bumps or twitching associated with the shudder—the nervous system's physiological response to the threat to the dissolution of the ego—wherein the feeling of an emotion originates. For Adorno, an artwork must contrast what he describes as the "mechanistic, life-limiting logic of abstraction" and "instrumental rationality" stemming from Enlightenment thinking that imposes schemas to control nature, including our bodies. Art must, therefore, seek instead to inspire terror through the discomfort and ambivalence induced by alienating strangeness to produce enough electrical activity to re-animate an audience's limbic system. Like Samuel Beckett's plays (whom Adorno, and I, too, adored), art must, therefore, embrace the abject and be amorphous, undifferentiated, uncontrolled and accidental.

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[223] Ibid, 226.

[224] Douglas Rushkoff, *Present Shock: When Everything Happens Now* (New York: Penguin Group, 2013), 6. Rushkoff defines "present shock" as a kind of post-historic eternal present; it is a "phenomenon that is of the moment, but not in the moment…we tend to exist in a distracted present, where forces on the periphery are magnified and those immediately before us are ignored." Just like people, whom we are increasingly disconnected from and unaware of, when we are always connected elsewhere, attempting to react to the "ever-present assault of simultaneous impulses and commands."

[225] Silvan Tomkins contends that affect evolved to reduce stimulus confusion; a state of when external stimuli overwhelm cognitive faculties.

[226] Theodor Adorno defines the shudder as "a subjective experience that can negate the shallow construction of subjectivity by Capitalism." Moreover, he claims, (and it is worth noting in full, since the conceptual underpinning forms the foundation of my argument) "[i]t radically opposes the conventional idea of experience. It is an anti-experience, a liquidation of the I. Mana is born from the shudder. We shudder in the face of the unknown, and it contains the lineaments of the division between subject and object. The shudder arises as the response to an original imposition of non-identity; it exists as amorphousness and undifferentiation, which is an appropriate artistic response to abstraction and rationality…It is something uncontrolled and accidental and allows an escape from mechanistic and other life-limiting logics. A primal component of experience emerging just as humans began to conceptualize the world and differentiate themselves from amorphous nature. In other words, the shudder indexes terror; it drives our enlightenment impulse to subjugate nature into the schemata of instrumental rationality. It is also the manifestation of wonder and a recognition of the possibility of anti-egoistic human interrelationships with other or non-human beings. It indicates a capacity for mimesis, for a connection between self and otherness. It also signifies true 'aesthetic encounter' wherein genuine experience can still occur. The twitching shudder registering on the body is the result of electrical activity conducted by the nervous system. Goosebumps are indicative of re-animation and the disruption of normativity, of social convention." In essence, the shudder parallels affect, the abject body, shame.

Interestingly, these are the same characteristics associated with the "non-literate synesthesia" of television, which McLuhan feared would initiate the demise of the liberal humanist subject. The breakdown of all social order as a result of the unpredictability of unconscious masses is neither a new, nor a resolved fear. It has been the aim of civilization for the past 10,000 years to stabilize human experience. From Gustave LeBon's *The Crowd* to Facebook and Google's current obsession with data science, we continue to witness an overriding concern with the development of a universal system to make sense of and manage the psychology—the "mental unity"—and ensuing emotions of the crowd. Only our technologies for social and behavioral control have changed; they have become more intimate, invisible and pervasive. But the tactics are the same: systematically canalize the senses, regulate emotions, and de-corporealize the body. As I asserted in the Chapter 2, intelligent technology has taken up the baton and appears to be steering our transition into immobilized, hyper-ocular, "ex-carnalized" parts. In *Sensorium*, Caroline Jones forwards, "the only way to produce a techno-culture of debate at the speed of technological innovation itself is to take up these technologies in the service of aesthetics."[227] In this chapter, therefore, I seek to recuperate the biological self, not merely as a virtual crossing between informatics and materiality, as N. Katherine Hayles proposes, but as a body that is "technically articulated, and yet still fully biological."[228] I will do so by 1) examining autonomous artistic interventions that have offered a counter discourse to the cybernetic regime during the 1950-90s through appropriating its concepts and tools; 2) introducing the sixth wave of innovation as a critical moment for opposition because of its explicit focus on biological mitigation and then identifying which approach is required to disrupt the surfacing stranglehold of the cybernetic renaissance; 3) establishing a theoretical framework based on embodied cognition and neurobiology that might critically inform contemporary artistic intervention; 4) forwarding ludic performance and its defining characteristics as one attempt to recover the lived body and to restore critical feeling and human connection.

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[227] Caroline Jones, *Sensorium: Embodied Experience, Technology and Contemporary Art* (Cambridge, Ma and London: MIT Press, 2006), 2.

[228] Eugene Thacker, "What is Biomedia?" The John Hopkins University Press and Society for Literature and Science, *Configurations* 11.1 (2003): 47-79.

4.2. Artistic Invention as Counterpoint to the Cybernetic Paradigm

In "Construction of Changes" Roy Ascott emphasizes the ways in which science and technology could offer "new models informing artistic production in a socially constructive way."[229] Like me, he purports that technology alters consciousness and that as artists we have an obligation to comprehend how technological mediation transforms us, so that we can then create new systems of knowledge and behavior through our art practice that present alternative visions of the world. Ascott was referring to the cybernetic models articulated through the new technology paradigm, what Christopher Freeman, coined the "information revolution," characterized by the rapid convergence of information generating, processing, and transmitting technology that produced a fundamental restructuring of economic, political and socio-cultural lives. Manuel Castells attributes the emergence of this technological assemblage to the "autonomous dynamics of technological discovery and diffusion, including synergistic effects"[230] between four breakthrough technologies simultaneously integrated into information systems between the 1950-70s: 1) micro-electronics and the first programmable computer, 2) the creation of the internet (Arpanet), 3) network and node-based technologies for telecommunications, and 4) DNA, the technical base for genetic engineering. It is this constellation of interdependent technologies, Freeman observes, that both enables universal availability of new information technologies and also facilitates its power and by extension "old society's attempt to retool itself by using the power of technology to secure the technology of power."[231]

The fifth wave has been written about extensively, so I will outline only the distinct features informed by cybernetics, which established a context in which art practice could oppose the encroaching techno-scientific paradigm. Five key features of these new technologies have been identified by Castells in *The Rise of Network Society*; they 1) act on information, 2) possess a pervasiveness of effects, 3) apply networking logic, 4) offer flexibility and 5) converge into a highly integrated system. Furthermore, to better situate the artistic systems and discourses that emerged in response to the cybernetics ethos and

[229] Roy Ascott, *Telematic Embrace: Visionary Theories of Art, Technology and Consciousness* (Berkeley: University of California Press, 2007), 44.
[230] Manuel Castells, *The Rise of Network Society* (Oxford: Wiley-Blackwell, 2010), 59.
[231] Ibid, 61.

the associated technological paradigm and features, therefore, I will next conduct a brief survey of art movements that coincided with each of the three cybernetic orders evolving within the context of new technologies in the hopes of drawing some thematic patterns, which can be used to anticipate future technological interventions as we enter the sixth wave of innovation, which focuses upon biological mitigation. In some instances, the works functioned as "experiences to think with," extending Jacque Derrida's phrase "objects to think with,"[232] while in other instances, technological experimentation led to the repurposing of instrumental applications, which catalyzed innovation, only to later be co-opted by the mainstream. Here, counter culture serves as both a critique and a bridge allowing a crossing over into newer waves of innovation.

4.2.1. Modernism, Kinetic Art, Situationists & Gestural Abstraction (1st Order Cybernetics - Homeostasis – 1945 – feedback loop, information as signal/noise, circular causality, instrumental language, quantification and the cognitivist model of the brain)

During 1950-60s, the interplay between cybernetics and art can be understood in the context of both modernism and ongoing aesthetic experiments with duration, movement and process. Experiments by sculptors Nicholas Schöffer, Jean Tinguely, Len Lye, Takis and others involved in the formation of the kinetic movement were the first to explore concerns about the regulation of a system through feedback of information. Schöffer's *CYSP I*, in particular, directly integrated constructivist aesthetic concepts with newly circulating theories of cybernetics. The work was programmed to electronically respond to the environment and to actively involve the viewer in the creation and experience of the work. Themes of "controlled randomness" can also be loosely witnessed in the playful derives of the Situationist International, OULIPO poets, Dadaism, as well as the (highly rule-bound) chance operations of John Cage's 4'33", which premiered in 1952. However, modernism also signifies a moment when the subjectivism of abstract expressionism gave away to post-painterly abstraction, which emphasized hard-edge painting, Color field uniformity and other forms of lyrical and geometric abstraction (as

[232] Jacque Derrida uses this phrase to get at the ontological status of objects as dynamic systems and processes always in the process of becoming.

discussed in Chapter 2). British cyberneticists, Gordon Pask and Grey Walter, however, staunchly departed from modernism. Both oriented from a non-modern, non-dualistic approach to "doing cybernetics," one in which the human and non-human were seen as equal interactive elements within a performance. Pask's infamous *Musicolor* machine (1950) controlled a light show through filtering the beats and frequency of sound from a musical performance. Based on inconstant neuronal patterns, the filters responded to varied temporal thresholds, causing the performer to continually adapt to the unpredictable outputs presented by the machine, just as much as the machine adapted to the responses of the performer. Walter's *Flicker* experiments with strobe lights, which induced alpha states, triggering hallucinatory visual patterns to form in space sought to problematize notions of the self-regulated modern self. Both Pask and Walter's emphasis upon surprise and novel behavior brought about through structural coupling between mind-body-environment offered an alternate model of cybernetics, one that perceived the embodied mind as an "organ of performative adaption."

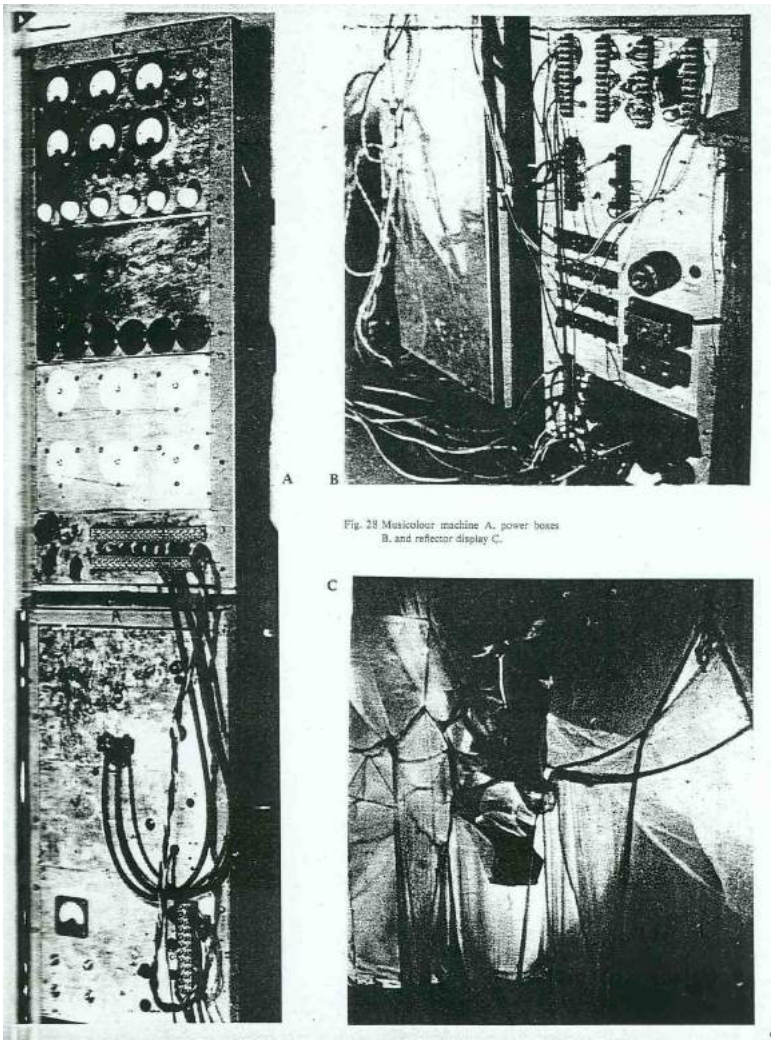

Fig. 28 Musicolour machine A, power boxes B, and reflector display C.

Fig. 3 – Gordan Pask, *MusicColor* (1950)

4.2.2. E.A.T., Cybernetic & Behavioral Art, Biosignal Performance & Post-Modern Dance (2nd Order Cybernetics – Self-Organization – 1960 reflexive language, autopoeisis, structural coupling, system-environment and the connectionist model of the brain)

By the 1960s, cybernetics had been absorbed into the popular imagination, and Schöffer's work facilitated its entrance into artistic circles, and Grey and Pask's open-ended, hylozoist explorations into "the spiritually charged wonder of performativity and agency of matter"[233] soon influenced biofeedback music as artists began to appropriate medical

[233] Andrew Pickering, "Brains, *Selves and Spirituality in the History of Cybernetics,*" (paper presented at Max Plank Institute for History of Science, Berlin, Germany, November 3, 2007), 10.

equipment to manipulate biosignals for the creation of sound. Alvin Lucier's *Music for Solo Performer*. Lucier collaborated with physicist Edmond Dewan to amplify his meditative alpha activity to catalyze large speakers to excite acoustic instruments, which then activated percussion instruments. Lucier discovered that in order for the performance to occur he had to basically stop performing. "By allowing alpha to flow naturally from mind to space without intermediate processing, it was possible to create a music *without compositional manipulation or purposeful performance*."[234] In addition to introducing generative art-making processes, Lucier inspired other composers to experiment with EEG signals for music composition, in particular Richard Teitelbaum and David Rosenboom. Teitelbaum employed EEG and ECG signals in his work *Spacecraft* (1967), in which five performers' biosignals controlled various sound and timbre parameters of a Moog synthesizer.[235] In subsequent compositions, *Organ Music* and *In Tune* he also began incorporating voice and breathing sounds. Rosenboom extended Teitelbaum's work to audience members in *Ecology of the Skin*.

Although experimental music first introduced techniques such as audio feedback and tape loops, the visual potential of electronic feedback captured the attention of artistic research once consumer grade video equipment was readily available, Woody and Steine Valsulka were most renown for using all kinds of unusual combinations of audio and video signals to generate electronic feedback in their collaborative work. As Woody remarked, "We look at video feedback as electronic art material…It's the clay, the air, it's the energy, it's the stone…it's the raw material that you… build an image from."[236] For instance, in a series entitled *Machine Vision* (1975-77), which explored the mediation of space by technology, Steine began designing feedback devices to reverberate sound waves off video signals and vice versa.

However, the very first computer-generated graphics were actually created at Bell Labs by a researcher, Michael Noll. His *Gaussian Quadratic* (1963) was later included in an exhibit at Howard Wise Gallery in New York on computer-generated pictures. John Whitney, considered the "the father of computer graphics" also produced visuals through

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[234] Elie Siegmeister, Alvin Lucier and Mindy Lee, "Three Points of View," *The Musical Quarterly* 65(2) (1979): 281–295.
[235] Burak Arslan et al., "Biologically-driven Musical Instrument" (Proceedings from *eNTERFACE 05: Summer Workshop on Multimodal Interfaces* in Mons, Belgium, from 17 July to 11 August 2005).
[236] Jud Yalkut, "Electronic Zen. The Alternate Video Generation," (Unpublished manuscript, 1984) 128-130.

mathematical functions by employing outmoded, analogue military computing systems as evidenced in *Catalogue* (1961). A few years later, Charles Cursi experimented with computer-generated animations using an IBM 7094 computer, creating works, like *Hummingbird* (1967).

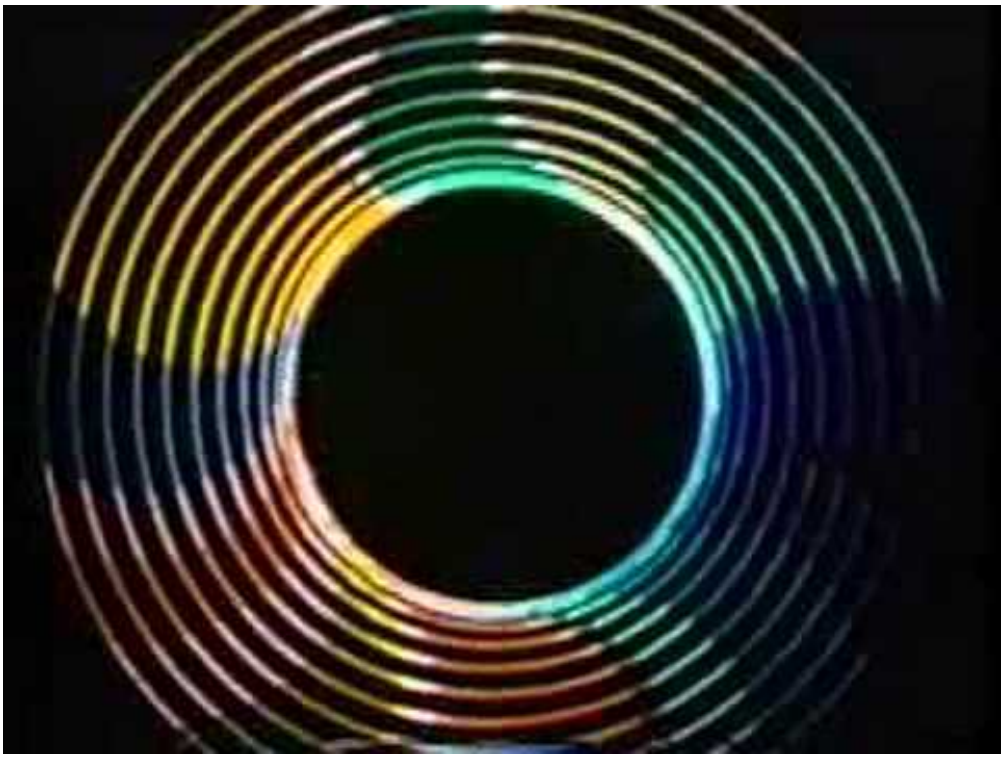

Fig. 4 - Michael Noll, Gaussian Quadratic (1963)

UK-based artist, Roy Ascott, was by far the most overtly preoccupied with applying principles of cybernetics to art. For Ascott, quite possibly influenced by Grey and Pask, the process of making and experiencing art became a cybernetic system—a dynamic field of interacting behaviors comprised of feedback loops between the artist, the audience and the environment that iteratively transformed the system as a whole. Art was only one node within a larger interdependent network of feedback loops that constituted culture, and culture but one node within society. In his 1967 Manifesto, "Behaviorables and Futuribles," he declares, "when art is a form of behavior software predominates over hardware in the creative sphere. Process replaces product in

importance, just as systems supersede structures."[237] His solo exhibition *Diagram Boxes and Analogue Structures* (1963) established cybernetics as the conceptual foundation for his work. He connected Henri Bergson's notion of durée with constructivism and audience interaction along with diagrams and text to maintain a formal element. Of his chosen theoretical underpinnings, Ascott explains:

> Cybernetics has provided me with a starting point from which observations of the world can be made. There are other points of departure: the need to find *patterns of connections* in events and sets of objects; the need to make ideas solid…but interfusable; an *awareness of change as fundamental to our experience of reality*; the intention to *make movement a subtle but essential part of an artifact*.[238]

Ascott's observations are very much in keeping with the second wave of cybernetics, which saw systems as autopoetic instantiating processes. Based on research discoveries by behavioral psychologists Humberto Maturana and Francisco Varela, which suggested that the action of the nervous system was determined by the nervous system itself, rather than external stimuli, they contended that the nervous system was determined by its own organization, the result is a circular, self-reflexive dynamic. Thus, the external world only has a triggering role in the release of the internally determined activity of the nervous system. From here, Marturana and Varela concluded that "it is the circularity that makes the living system a unit of interactions…and it is this circularity that it must maintain in order to remain a living system and to retain its identity through different interactions."[239] One key insight to cybernetics is the belief that it is the living system's self-organization that enables the creation of products or behaviors that characterize the system. Another important concept of second order cybernetics, which departs from the first, is the notion of the observer. The observer is what organizes the stimuli from the outside and then interprets it before sending a message to the rest of the body. Maturana and Varela saw the living system itself as an observer; it is able to observe because it is structurally coupled to the phenomenon one witnesses. An observer becomes an observer by recursively generating representations of our interactions.

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[237] Roy.Ascott, *Telematic Embrace: Visionary Theories of Art, Technology and Consciousness* (Berkeley: University of California Press, 2007), 26.
[238] Ibid, 31.
[239] N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatic*s (Chicago and London: The University of Chicago Press, 1999), 135-137.

For Ascott, artist practice closely parallels autopoesis. The process of recursion can be seen in Ascott's *Change Paintings*, which attempts to reveal the evolving simultaneity of changing states through imprinting of generative processes. Here, the artist is the observer, part of the living system, and so is the audience.

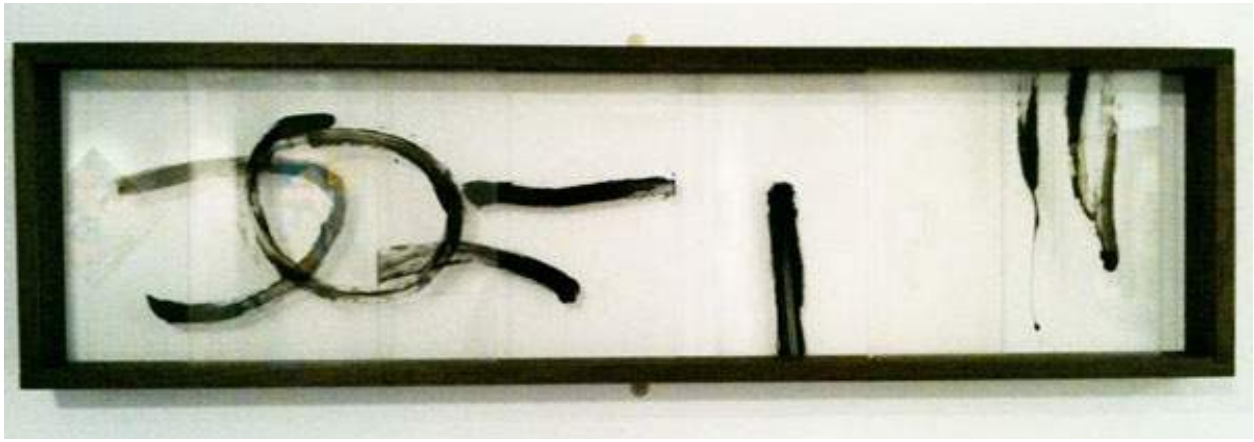

Fig. 5 - Roy Ascott, Change Paintings (1959)

Around the same time period, the exhibition *Cybernetic Serendipity* (1968) at the Institute of Contemporary Arts in London sought to establish a "systems approach to art." Works focused on exploring open systems through experiments with machine aesthetics and poetry generators in an attempt to foster "stable relationships between organic and non-organic systems,"[240] as art critic Jack Burnham described. Burnham went on to curate his own exhibition in 1970 called "Software, Information Technology: Its New Meaning for Art" to further unveil how "information processing was becoming a metaphor for art." The show featured *News* (1969) by Hans Haacke, which connected teletype machines to news bureau services, unfurling a constant stream of printouts onto the gallery floor and Ted Nelson and Ned Woodman hypertext system, *Labyrinth* (1970), which encouraged visitors to interactively construct non-linear narratives through database information.

[240] Christiane Paul, *Digital Art* (London: Thames and Hudson, 2003), 18.

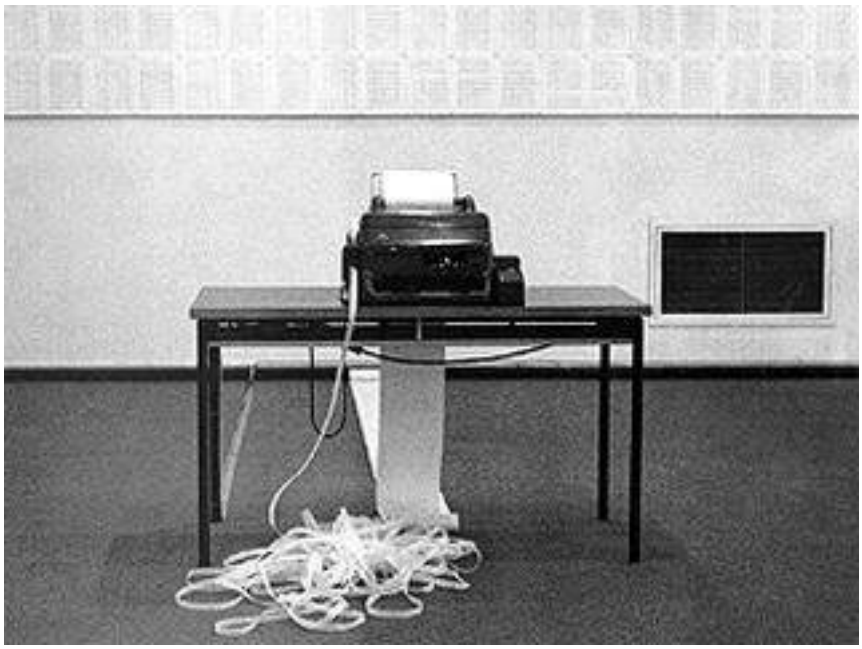

Fig. 6 - Hans Haacke, News (1969)

Another ambitious exhibition at the Armory in New York, *9 Evenings: Theatre and Engineering* (1966), brought together ten artists and thirty engineers and scientists from around the globe to produce pioneering performances that incorporated emerging technology. The group, led by Bell Lab engineers, Billy Kluver and Fred Waldhauer, along with artists Robert Rauschenberg and Robert Whitman became formally known as E.A.T. (Experiments in Art & Technology), a non-profit dedicated to providing the necessary infrastructure and opportunities to encourage further artist-engineer experimentation for events, large-scale projects, like the *Immersive Dome* in Osaka, Japan and also the advancement of software development. Many of their approaches informed the explosion of new media art in the 1990s and continue to dictate digital art production and interdisciplinary collaborations today.

Fig. 7 - E.A.T., 9 Evenings (1966)

Radical experimentation with choreographic techniques and compositional strategies also began during this period as a result of Robert Dunn's dance composition course, which culminated in the infamous concert at Judson Memorial church that inspired 20 concerts over two years. From games and improvisation to task-driven phrases, pedestrian movement and mathematical algorithms, a new generation of female choreographers departed from the traditional constraints of lyrical expression to explore movement itself.

Of the many experiments, Yvonne Rainer, Simone Forti and Tricia Brown most meticulously experimented with game-based strategies. For instance, Rainer's *Room Service* (1964) and *Trio A* (1966) explored literal game structures, such as follow the leader and repetition-based tasks. Forti's "dance constructions" organized play between dancers and various environmental affordances, such as seesaws, wooden ramps, and jungle gyms. Brown's early pieces, *Lightfall* (1963) and *Rulegame 5* (1964) employed rule-bound constraints in an effort to "find the schemes and structures that organize

movement, rather than the invention of movement per se."[241] Although Judson was short-lived, many choreographers continued their formal excavation of procedural systems through the 70-80s. For instance, Brown's algorithmic works, *Accumulation* (1971) and *Locus* (1975), were attempts to make "dance machines that take care of certain aspects of dance-making."[242] Lucinda Child, renowned for her site-specific events, became obsessed with Cartesian geometry. In a series of works, spanning four years, she began choreographing extremely minimal and repetitive set movements in which dancers moved through trajectories comprised of Sol Lewitt-like grids, diagonal and parallel lines. In all of these examples, "movement [was] not pre-selected for its characteristics, but resulting from certain decisions, goals, plans, schemes, rules, concepts or problems."[243]

Although the works referenced above employed "rigorous techniques derived from mathematics or inspired by science [to] yield unexpected possibilities that would not necessarily be under the direct control of a single individual but rather subjected to systematic evolution and control,"[244] few incorporated technology. They consciously maintained very bare bones aesthetics in an effort to both highlight the centrality of the performing body and also to examine the changing nature of the performing body situated within an unfolding techno-scientific environment characterized by procedural machines. However, experiments with emerging technology briefly surfaced in 1966 when a few Judson members (Ranier, Child, Steve Paxton and Alex Hay) participated in *9 Evenings*. Hay's *Grass Field*, was by far the most adventurous (and closest to what I am attempting with ludic performance). He structured the work around three rule-like parameters: 1) sounds would be generated from Hay's inaudible amplified biosignals of alpha signals from brain and muscle sounds from his back, which controlled the timbre and volume of raw data, 2) the performers (Robert Rauschenberg and Steve Paxton) would be given only one task to perform, 3) all the stage elements would be the same color.

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[241] Chris Salter, *Entangled: Technology and the Transformation of Performance* (Cambridge, MA: MIT Press, 2010), 241.
[242] Marianne Goldberg, "Trisha Brown: 'All of the Person's Person Arriving.'" *TDR* 30 (1) (1986),149-170.
[243] Michael Kirby, "Post-Modern Dance Issue: An Introduction," *TDR* 19 (1984): 3-4.
[244] Chris Salter, *Entangled: Technology and the Transformation of Performance* (Cambridge, MA: MIT Press, 2010), 241.

However, while many of these artists and performers were appropriating new information and telecommunication technologies, very few voiced concern or offered critiques of the new technological paradigm, except Charles Harrison, a controversial art critic, who viewed the unity of art and technology in the 60s as "beholder discourse" for modernism. He describes the various experiments as a "flailing about" which only served to reify modernist values of hierarchy and privilege. In contrast, Ascott (perhaps more influenced by the British cyberneticist ethos) argued that cybernetic art undermined these very values by actively involving the audience in interactive encounters that focused on process rather than a product associated with mass standardization.

Towards the end of the period, however, there were some who mocked cybernetics and used "systems" as an "ironic critique of the technocratic ideology of progress."[245] For instance, Terry Atkinson and Michael Baldwin's *22 Predicates: The French Army* (1967) created a litany of acronyms based on a logical "system of gibberish." Others, like Harold Hurrell, challenged the rigid constraints within which interactive participation might transpire. In Hurell's *The Cybernetic Art Work That Nobody Broke* (1969), the visitor encounters a pseudo computer program that generates color through constrained interaction with a user who can only enter binary inputs. If the user puts in anything but a 0 or 1, they received the message: YOU HAVE NOTHING, OBEY INSTRUCTIONS![246]

In addition, more transgressive artists of the late 60s-70s, like Fluxus, Julian Beck's Living Theatre, John Cage, Carolee Schneemann and others were actively countering the bureaucratic segmentation of the senses and emotions through multi-sensory overload and genre-bending experiments in installation and performance intended to re-contextualize the body in space. Around the same time, composer Pierre Henry and scientist Roger Lafosse collaborated on a live performance system, Corticalart (1971), and Manford Eaton published Bio-Music (1973), a manifesto, which sought to preview anticipated electronic systems (GSR and EKG) that used "biological potentials in feedback loops to induce powerful, predictable, repeatable, physiological/psychological states which can be elegantly controlled real time."[247] Eaton forwarded that "electro-

[245] Roy Ascott, *Telematic Embrace: Visionary Theories of Art, Technology and Consciousness* (Berkeley: University of California Press, 2007), 25.
[246] Charles Harrison, *Essays on Art and Language* (London: Wiley-Blackwell, 1991), 58
[247] Manford Eaton, *Bio-Music* (Barton, VT: Something Else Press, 1974).

narcosis" could make the organism as receptive to acoustic and verbal stimuli as she was to a chemical hallucinogen. It was visual artists, James Turrell and Robert Irwin, though who responded most directly and evocatively to the hegemony imposed by modernism. Turrell and Irwin's two year, unrealized project, referred to as *gedankenexperiment*, envisioned for Maurice Tuchman's Art and Technology Program at the Los Angeles Museum of Art in 1968, sought to "enhance the potential cross talk occurring in the brain when it processes image and sound."[248] Unlike McLuhan's assumption that the collaboration between image and sound of the television leads to saturation, overwhelming the senses, Turell and Erwin speculated that a new mode of perception would emerge by acutely reducing the sensory context to a featureless field. The report from 1971 (the only remaining evidence of the work) indicates that they proposed "a combination of an anechoic chamber, a room that absorbs all reflection such that no sound ever bounces away from its point of origin, with the powerful effect of a visual *ganzfeld*, a horizon without depth or size, constructs material conditions for experience."[249] The perceptual act of "grappling with seeing and hearing in a space on the verge of slipping away"[250] constituted the work; the aesthetic event was the performance—the experiencing act—of self-perception itself, not a thing or an object. Free of feedback and external stimuli, as well as an observing self, there would be no release of internally determined activity of the nervous system. Instead, only a calm abiding witness consciousness would reside within the self.

In his article, "The Question of Thresholds: Immersion, Absorption, and Dissolution in the Environment of Audio Vision," Chris Salter states: "In the course of the brief experiment, Turrell and Irwin opened up new directions whose aesthetic and scientific implications are still relevant to our current sociotechnical and cultural moment."[251] While this is certainly true, neuroscience research, for example, has now proven that sound, vision and tactility overlap in the cortical phenomenon of sensory substitution and

[248] Chris.Salter, "The Question of Thresholds: Immersion, Absorption, and Dissolution in the Environments of Audio-Vision," *This Sound – Audiovisuologies 2* (Ludwig Boltzman Institute/Lentos Museum/Ars Electronica: Walter Konig Verlag, 2009), 3.
[249] Maurice Tuchman, "A Report on the Art and Technology Program of the Los Angeles County Museum of Art 1967-1971" (Los Angeles County Museum of Art, 1971), 132.
[250] Chris.Salter, "The Question of Thresholds: Immersion, Absorption, and Dissolution in the Environments of Audio-Vision," *This Sound – Audiovisuologies 2* (Ludwig Boltzman Institute/Lentos Museum/Ars Electronica: Walter Konig Verlag, 2009), 7.
[251] Ibid, 3.

galvanic sensors can measure sensory feedback between an environment and a perceiver. But caught up in the cognitive, Salter overlooks the presence of affect in their envisioned concept, the anticipatory shimmer of the affective turn that would occur during the 1990s. By suspending sound and light on the "threshold of becoming," of intensity, and by situating the body once again as the "center of indeterminacy," the *gedankenexperiment* resonates deeply with Brian Massumi's vector of affect, signifying a critical and dramatic shift from form to experience.[252]

4.2.3. Affective Turn in New Media, Virtual Reality & DanceTech (3rd Order Cybernetics - Virtuality – 1985 - emergent behavior, functionalities, computational universe and enactive model of the brain)

The increasing availability of domestic, pro-sumer computer-based technologies catalyzed an influx of creative research and practice in interactive and immersive arts in the 1990s. Over the initial decade, artists played a vital role in analyzing, envisioning and developing experimental interface technologies and new modalities of engagement. More importantly, many artists directly challenged the liberal humanist regime by bringing the application of technologies "framed as abstract manipulation of information" by the cyberneticists to embodied, material and situated cultural practices. For example, technologies like the intuitive user interface, which is so common and commercially available today, was first explored by Jeffrey Shaw in *Legible City* (1989). He used a simple, universal device—the bicycle—to gather useful input data kinesthetically. The handlebars and pedals gave the viewer interactive control over both speed and direction as they traveled through a word-based simulation of a city using ground plans from actual cities.

[252] It is interesting to note that this is precisely why McLuhan condemned electronic media: "With electronic media every place is the center. No place is the margin," (*Understanding Media*, 48).

Fig. 8 - Jeffrey Shaw, Legible City (1989)

David Rokeby's *Very Nervous System* (1988) solved real-time machine vision by capturing live camera data into a highly reduced dataflow processed through an Apple IIe. Using video camera, image processors, computers, synthesizers and a sound system, he attempted to orchestrate a scenario in which one's movements create sound and improvisational music. Rokeby says he made the work as a

> Simple *impulse towards contrariness*…because the computer is purely logical, the language of the interaction should strive to be intuitive. Because the computer removes you from the body, the body should be strongly engaged…*because the computer is objective and disinterested, the experiences should be intimate*"[253] (*emphasis mine*).

[253] "David Rokeby," accessed January 4, 2012, http://homepage.mac.com/davidrokeby/home.html.

Fig. 9 - David Rokeby, Very Nervous System in Potsdam (1993)

The late 1980s also witnessed another surge of interest in biosignals as a result of the evolution of signal processing systems and the increasing availability of personal computers. This made it possible to design real-time signal analysis applications. Scientists Benjamin Knapp and Hugh Lusted were first to design a signal-capturing unit that sampled eight channels of biosignals, which were then amplified, conditioned and translated into midi messages, much like the Xth Sense, the technology I employ in *[radical] signs of life* and *Beware of the Dandelions*. Their BioMuse system (which captured EMG, EEG, EOG, ECG and GSR) introduced the concept of "biocontrol," a shift from the biofeedback approach that dominated the 1970s experimentation. As Atau Tanaka, who wrote the first piece for the BioMuse, *Kagami*, which was premiered at Stanford in 1989 noted,

> whilst biofeedback allowed for physiological states to be monitored passively and translated into media by means of signification, biocontrol *proposed the idea and means to create reproducible, volitional interaction using physiological data as input*."[254] (emphasis mine)

[254] Atau Tanaka, "Sensor based Musical Instruments and Interactive Music," in *The Oxford Handbook of Computer Music*, ed. Roger T. Dean (Oxford, UK: Oxford University Press, 2009), 233–257.

Tanaka continued his corporeal explorations with Sensorband where he was able to refine his control of synthesis parameters transmitted to the computer by electromyogram (EMG) worn on his arms by playing with muscle tension and relaxation. As he notes, his performances were intended to "push both his own and the audience's threshold, mapping muscle contraction and expansion to amplitude and frequency limits in the listener's body."[255]

Simon Penny underscores this sentiment when he acknowledges,

> There was a strong desire among artists to *make that which is truly virtual--the immateriality of computational data and processes--amenable to lived sensory-motoric reality*. Perhaps that is why the work of the period was not just technically but also intellectually challenging, to the makers as well as to its audience -- it collapses the Cartesian Dualism which structures both the technology and our general cultural paradigm.[256]

Diane Gromala and Yacov Sharir's very personal and tech intensive *Dancing with the Whirling Dervish: Virtual Bodies* (1994-99) project, which explores what Elaine Scarry describes as the "inexpressibility of pain," certainly attest to this twin negotiation. In the simulated experience the user enters a human body of enormous proportions wrapped in words and letters. The body is in a continual state of decay. As you travel through the bones and viscera, an artificial intelligence (the whirling dervish) layered over the body imagery interacts with the user by mimicking their actions or provoking them to follow her. As Gromala speaks openly about the impetus that drove the work:

> My first intention in the Art and Virtual Environments Project dealt with exploring experiential issues as they relate to notions of the body, not only as a culturally constructed notion and text but also as lived experience and material form. The aspect of materiality was especially important since discussions of the experiences attendant on virtual environments, such as disembodiment, tend to underscore an underlying subscription to the well-worn Cartesian mind/body split.[257]

[255] Chris Salter, *Entangled: Technology and the Transformation of Performance* (Cambridge, MA: MIT Press), 219.
[256] Simon Penny, "Desire for Virtual Space. The Technological Imaginary in 1990s Media Art," *Space and Desire Anthology*, ed. Thea Brezjek (Zurich: ZHDK, 2011), 8.
[257] Diana J. Gromala, "Dancing with the Whirling Dervish; Virtual Bodies," in *Immersed in Technology: Art and Virtual Environments*, ed. Mary Ann Moser (Cambridge, Ma and London: MIT Press, 1996), 281.

Fig. 10 - Diane Gromala & Yacov Sharir, Dancing with the Whirling Dervish (1994-99)

The emergence of a new genre of performance, "dance tech," also emerged at the end of the 1990s, which Chris Salter claims "reinvented the perceptual and ontological role of dance in the context of the digital zeitgeist."[258] In addition to curiosity about 3D modeling and software control systems, computer vision and data analysis, there was a growing interest by choreographers to use biophysical sensor-based technology. Robert Wechseler's Palindrome Performance Group was probably the most inventive. With the computer engineer, Friederick Weiss, he began using computers in dance performances "not as a choreographic tool, but rather for their ability to facilitate [performer-driven] interaction between media."[259] In the *Heartbeat Duett* (1997), dancers' heart beats are experienced as separate musical notes transmitted through chest-worn electrodes and transmitters. *Elektroden* (1998) enabled the audience to hear the electrical sounds generated from the muscle contraction of each dancer, creating a "body symphony," from the tensing and relaxing muscles. In 1994, Troika Ranch, was the first to develop their own hardware and software system for translating real-time movement data into a sonic and visual composition. For *MIDIDancer*, programmer and musician, Mark Coniglio worked with choreographer Dawn Stoppiello to experiment with a wearable hardware-sensing system comprised of an encoding and transmission unit align with a series of wired bend sensors affixed to joints, which controlled the note values of synthesizers and

[258] Chris Salter, *Entangled: Technology and the Transformation of Performance* (Cambridge, MA: MIT Press), 261.
[259] Robert Wechsler, "O, body swayed to music…(and vice versa)," *Leonardo Magazine* (Fall 1997).

the color parameters of projected images. Like Wechseler, Troika Ranch eventually moved away from sensors to camera-based motion tracking, which later morphed into Isadora, with the intent of giving dancers more "jazz-like autonomy," a balance between play and precision.

These experiments soon garnered interest from the scientific community, too, who were looking for physical environments to test hypotheses outside the lab, which brought in lots of government funding for studies employing emotional interfaces, movement data and multi-modal interactive systems. For instance, computer scientist, Flavia Sparacino, a researcher at MIT's Spatial Imaging Group, experimented with one-to-one mappings between human movement and triggered music with her Dance Space project (1996). Joseph Paradiso, who originally worked at CERN designing precision alignment sensors, found his way into developing hardware-based sensing systems that could form a local body-based network using a combination of sensor-augmented sneakers and wearable wireless accelerometers. Confluence between cultural sectors and academia also created spaces for knowledge sharing. For instance, the research conducted by the Affective Computing Lab at MIT In 1998, headed by Rosalind Picard, coupled with the Music, Sensors and Emotion team at SARC has greatly advanced the technical aspects of biosignal monitoring in terms of both technical sophistication and artistic affordances. Piccard developed *The Conductor's Jacket* (1996), a wearable computing device that measured and recorded the physiological and kinematic signals from the orchestra conductors. Picard's collaborator, artist Teresa Marrin-Nakra, took advantage of the real-time data stream to apply to her own musical performance contexts. STEIM in Amsterdam, too, has also contributed to the early development of gesture-based controllers.

In many ways, biosignal art, dancetech and new media arts, which community grew out of a "murky confluence" between disparate disciplines[260] served as a think-do tank in which the deep cultural implications of the "information revolution" were finally debated and modeled. I would also venture that these artist, most notably Shaw, Rokeby, Gromala

[260] List the disciplines: 1) cinema and media studies, built largely around the cultural imaginary of virtual reality (VR), fueled by sci-fi literature and media; 2) computer graphic and Human Computer Interface (HCI) professionals, focused on the trials of real R + D work; 3) artists, whose motivations and goals were often incomprehensible to the technical community.

and Sharir sought to articulate Donald MacKay's alternative theory of information;[261] they transformed the instruments of computer technologies into meta-communication imbued with meaning and reflexivity, since the subject matter in these works consist of the user's subjective experience with their own bodily and affective engagement with the system itself.

For example, Penny's own practice consciously focused on "the bodily experience of the user and the construction of a fluid relation between bodily dynamics and technological effects." Two other works, *Fugitive Project* (1996-7) and *Traces* (1999), both real time machine vision, motion controlled installations were created to provoke certain types of perceptual explorations in the context of an aesthetic environment in which the technological systems were ubiquitous, "presenting an experience of technological immanence."[262]

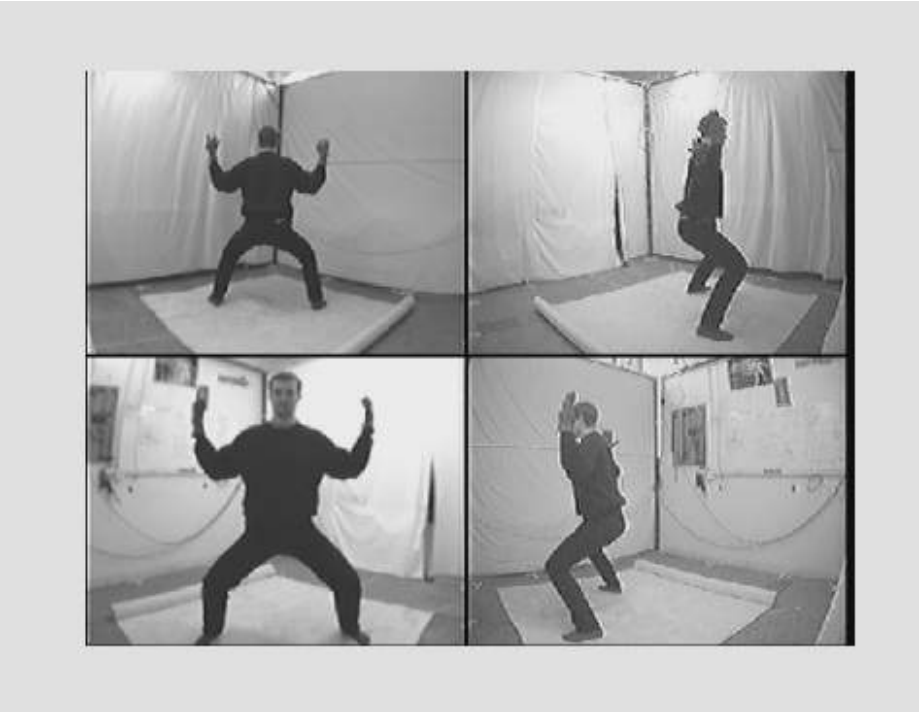

Fig. 11 - Simon Penny, Fugitive in Progress (1996-7)

[261] As mentioned in Chapter 2, MacKay's forwarded a theory during the first Macy Conference, which incorporated a message into Weiner-Shannon's theory of information, but it was rejected due to a message opening their neat formulations to subjective interpretation.
[262] Simon Penny, "Desire for Virtual Space. The Technological Imaginary in 1990s Media Art," in *Space and Desire Anthology*, ed. Thea Brezjek (Zurich: ZHDK, 2011), 17.

Fugitive is a single-user interactive artwork that places the user inside a 10-meter diameter space onto which a constantly rotating video is projected coupled with the user's gross bodily movements through an infrared camera. By repositioning the embodied viewer-participant into a "dynamic coupling" with the image, Mark Hansen contends that new media installations and environments, like Penny's, expand the "body's margin of indeterminacy" and "function as laboratories for the conversion of information into corporeally apprehensible images."[263] In this way, the user comes to "enframe"[264] (and regain control over) technology. For Hansen, the "framing function" of the human body (versus the "revealing function" of biosignal art) resides within what he calls *active affection*; "the body's capacity to experience its own intensity, its own margin of indeterminacy, which cannot be assimilated to the habit-driven, associational logic governing perception."[265] In *Fugitive*, Hansen suggests Penny's use of VR creates the necessary indistinguishability between perception and image required to "expose the affective basis of perception—and indeed the priority of affection over perception."[266] Drawing on French philosopher, Gilbert Simondon, Hansen situates affect between the individual image and the "preindividual reality." Briefly, Simondon views preindividual reality as a heterogeneous manifold of potential differences left over from temporal sequences of any given system. It's a critique of cybernetic autopoesis. Individuation, therefore, is an always-incomplete transformation of these tensions into structures and series, "transduction in a metastable environment."[267] Hansen sees affect, therefore, as a core driver of differentiation, which transduces preindividual reality's "pregnant intensity" for kinetic individuation. Thus, affective action generated through the interaction with the work simultaneously triggers the actualizing potential of the image and the virtualizing of the body. Perception serves to resolve the conflict.

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[263] Mark B.N. Hanson, *New Philosophy for New Media* (Cambridge, Ma and London: MIT Press, 2006), 10-11.
[264] *Gestell*, literally framing, was first employed by the German philosopher, Martin Heidegger, to describe what lies beneath—the essence of—modern technology, which he perceived as not only all-encompassing and pervasive, but as a barrier to a more primordial encounter with *poeisis* (that which transforms, and continues the world). In the "Question Concerning Technology" (1954), originally called "Framework," Heidegger defines *Gestell* rather obliquely as "the gathering together of that setting upon which sets upon man, and challenges him to reveal the real, in the mode of ordering, as standing reserve."[264] In short, enframing refers to a vital, unseen force that impels humans to unconceal the "actual" (aletheia/veritas/truth) as ever-present and on call, "standing reserve" (*Bestand*), stockpile.

[265] Mark B.N. Hanson, *New Philosophy for New Media* (Cambridge, Ma and London: MIT Press, 2006), 7.
[266] Ibid.
[267] Gilbert Simondon, "The Genesis of the Individual," in *Incorporation*s, ed. Jonathan Crary et al. (New York: Zone Books, 1992), 316.

On the other hand, Munster examines how the virtual interpenetrates the material in the everyday. She sees bodies in many states of becoming virtual. Virtual reality is only one among many countless organizations of virtual reality. As she explains,

> What we feel as our ordinary everyday embodiment is only one actualization of intersecting sensory and proprioceptive virtuality, concretized over a period of time into habits and recognizable rhythms. Virtual reality environments, therefore, can *affect those habits by disrupting* speed, rhythm, and direction of movement and stasis. This *disturbance* can make *feel as though* we have *moved outside of or beyond the boundedness of our bodies*.[268] (emphasis mine)

The work of Catherine Richards resonates with both Munster and Hansen's observations. In particular, The Virtual Body (1993) invokes the necessary "disturbance"—cognitive dissonance—required to disrupt habit, extend perception and catalyze the "production of new affective relations."[269] As the user inserts their hand inside a miniature box, an image is triggered, and

> The floor pattern on the monitor begins to scroll. In a few moments the spectator begins to sense a body illusion: a displacement of the body, an illusion of motion. One's hand appears to be infinitely traveling away from the body. Then the arm begins to take the body with it. It is as if the miniature space is folded into infinite space, as if stillness is folded into motion. The body loses all reference: inside/outside, giant miniature, spectator/object, part/whole."[270]

[268] Anna Muster, *Materializing New Media: Embodiment in Information Aesthetics* (Lebanon, NH: Dartmouth College Press, 2006), 115.
[269] Mark B.N. Hanson, *New Philosophy for New Media* (Cambridge, Ma and London: MIT Press, 2006), 147.
[270] "Catherine.Richards," accessed December 18, 2014, http://www.catherinerichards.ca/artwork/virtual_statement.html.

Fig. 12 - Catherine Richards, Virtual Body (1993)

Richard's piece anticipates the mirror box experiments invented by the neuroscientist V.S. Ramachadran to help alleviate phantom limb pain by retraining the brain to eliminate the learned paralysis.[271] This is not surprising. My sense is that new media artists anticipated and perhaps even coaxed the emergence of post-cognitivist theories of mind as the field of Human Computer Interface (HCI), AI and robotics quickly advanced as the decade came to an end. New modes of cognitive science began to flourish, grappling with embodied, situated and social dimensions of cognition (See Varela, Thompson and Rosch (1992), Barsalou (1993), (Hutchins (1995), Lakoff and Johnson (1999) et al). By 2000, neuroscience and neurobiology were beginning to explore new relationships between the mind, body and the environment (Ramachadran, Damasio, Sacks, Noe and Clark).

[271] V.S. Ramachadran and Sandra Blakeslee, *Phantoms in the Brain: Probing the Mysteries of the Human Mind* (New York: William Morrow & Company, 1998).

By problematizing the easy binary logic between technic/embodiment that typically sustains technological determinism through affective experimentation with virtuality, synesthetic disruptions and an emphasis upon non-linear complexity of bodily capacities, new media aesthetics of the 1990s along with biosignal experimentation in music and performance, and dance tech, fulfilled the purpose of autonomous art as an "opposition" to prevailing societal mores popularized by Alvin Toffler, cyberpunk and Hollywood movies. *But was their counter cultural shadow felt by the status quo?* While these artists were grappling with an emerging and rapidly advancing field and producing what Penny calls an almost "Pre-Cambrian explosion" of innovative work examining the changing relationships between bodies, technologies and society, and while they were invoking a provocative reclamation of the body's materiality from the cybernetic fold of disembodiment, the works became conversations amongst artists, rather than experiences to awaken mass audiences. Audiences were often scant. Simon Penny notes that an art-specific disciplinary discourse did not form around the central structuring concepts of the period; "art historians were notably absent…their professional paradigms tended to render the concerns of such [digital] artists trivial or incomprehensible."[272] *If autonomous art does not establish a countervailing discourse, instigate a Culture or consciousness shift, what then is its impact? Does it even matter?*

In an effort to consider these questions, I will establish a discourse that informs my own art practice, an art practice that can more directly confront the surfacing fourth order, a Cybernetic Renaissance coinciding with our recent entrance into the sixth wave of innovation. Here, we are witnessing a movement away from information and back towards the body as a site of colonization. We are also witnessing an explosion of biosensing technologies, moving beyond music and dance into other interactive art practices due to commercially available medical equipment and to open source hardware and software movements. To fully comprehend the current shifts underway, it is important to first grasp the prevailing trends in cognitive science theories and how they may inform the design of future intelligent technologies.

[272] Simon Penny, "Desire for Virtual Space. The Technological Imaginary in 1990s Media Art," in *Space and Desire Anthology*, ed. Thea Brezjek (Zurich: ZHDK, 2011), 10.

4.3. Theories of Mind, Technological Innovation & Emerging Artistic Intervention

While science historians, like Howard Gardner, suggest that cognitive science emerged as a discipline out of the Cognitive Revolution ignited by cybernetics in the 1950s, a backlash against behavioral psychology, one might argue that it is still not exactly a mature science, but rather a loose agglomeration of disciplines, including linguistics, neuroscience, psychology, anthropology, computer science, artificial intelligence and the philosophy of mind, all of which are attempting to answer two fundamental questions: *what is the mind (or cognition) and how does work (so we can optimize and control it)?*

Currently, neither a unifying theory or even an agreed upon direction for how the field should proceed in answering these questions exists. That said, the cognitivist vision (a computer model of the brain) and by extension artificial intelligence as its most literal articulation continues to occupy a dominant pole. Military and government funding has driven research in this particular area. Still, there are some emerging patterns of overlapping thought, which loosely fall within four main, non-linear trajectories, working in tandem trajectories: computational/cognitivist, connectionist/emergent, enactive/embodied, and more recently extended cognition. One can visualize a radial movement from a the core brain-bound model of cognition (computational and connectionist) outward to a model that subscribes to a more holistic understanding of the relationship between the mind, body and the environment (enactive and embodied), then moving towards non-biological integration (extended). Each model unfolded alongside the evolution of the cybernetic orders and their corresponding artistic interventions, noted in the last section.

Perhaps another way to classify these research tendencies might be by parsing the theories into either the amodal or modal representational camp, that is, those who believe in the symbolic representation of knowledge in the semantic memory, or those who believe in mental imagery representation, respectively. From a historical stance, amodal representation, which has been favored since the Cognitive Revolution (because it provides “elegant and powerful formalisms" that render phenomena easier to grasp) has more recently been overshadowed by modal views as increasing behavioral and neural evidence for mental imagery surfaces. To date, little empirical evidence supports the presence of amodal symbols of cognition or explains where the brain actually stores these

symbols, but numerous studies have been conducted to support modal representations, showcasing how neural imagery interfaces with perception and action.

Grounded cognition, put forth by Lawrence Barsalou, serves as a quasi umbrella for various theories of cognition, including enactive, embodied and extended cognitive theories, that reject the standard, amodal view and instead espouse the modal view as a shared representational theory central to knowledge production and emotion regulation. This is the approach I find most useful for informing my creative practice, because cognition, Barsalou contends, is grounded in multiple ways: through bodily states, through simulation and through situated action (which involves social interaction, the environment, affect and emotion). Because grounded approaches are still relatively new, and not yet specified computationally or formally, however, theorists tend to diverge significantly on how, when and why mental imagery forms, what terms they use to describe it, and the role imagery plays in emotion, constructions of self, and consciousness or not. Thus, often dismissed, as too subjective, and therefore, like MacKay's proposition during the Macy conference, not quantifiable.

As a result, grounded theories are commonly viewed as solely empiricist, where experience, especially of the senses, is the only source of knowledge. This view suggests that our senses are basically recording systems that only capture images and are unable to interpret these images conceptually. Critics of this approach falsely presume that there is an over-reliance on sensory-motor representations of the external world to represent knowledge, which are necessarily dependent upon bodily states (kinesthesia) and/or full-blown simulations for the recreation of experience. While the notion of simulation is a central underpinning of grounded theory, it is by no means the only guiding construct. Although we know that sensory-motor activation plays a large part in reproducing the aforementioned simulated state, in fact, all states of body and emotion affect how one thinks and perceives, the environment and non-biological objects, too, contribute to this perception. Grounded theorists claim that cognition is a distributive system with no central meaner. To comprehend its complexity, we, therefore, cannot study these facets independently of one another; we must examine the meshwork of interrelationships between and within these different systems (as I attempt to do with *[radical]*), so we can comprehend how not only the brain but also the fully embodied mind work. Andy Clark

underscores such an imperative:

> Human minds are not old-fashioned CPUs trapped in immutable and increasingly feeble corporeal shells. Instead, they are the surprisingly plastic minds of profoundly embodied agents: agents whose boundaries and components are forever negotiable and for whom body, sensing, thinking and reasoning are all woven flexibly and repeatedly from the accommodating weave of situated, intentional action.[273]

Thus, my turning away from the amodal view is not a binary denial, but rather a holistic movement towards the integration of the biological and the phenomenological, the physical and the experiential, the inside and the outside, in an attempt to create a critical bridge between cognitive science and daily lived experience. An understanding of this integrative approach informs my art practice.

However, a new unifying theory, based on the modal view, has recently been forwarded—the predictive coding model (henceforth PCM). Like early cybernetics, this model, a seeming backlash against embodied cognition, attempts once again to apply neural function to other domains. The objective of PCM is to increase the prediction and error-correction cycles within the hierarchical distribution of processing. It is assumes that errors in predicting lower-level sensory inputs cause the higher-level models to adjust in order to reduce the disparity. Andy Clark further extrapolates:

> What matters is that the predictive coding approach, given only the statistical properties of the signals derived from the natural images, was able to induce a kind of generative model of the structure of the input data: it learnt about the presence and importance of features in a way that enable better predictions concerning what to expect next in space or time. The cascade of processing induced by the progressive reduction of prediction error in the hierarchy reveals the world outside the black box.

PCM offers a framework to correct "feed forward residual errors" that migrate from multi-level cascading through feedback connections. Detecting errors in multi-layered prediction of input enables "higher-level systems to predict lower-levels ones on the basis of their models of the causal structure of the world (signal source)."[274] *But why not the inverse?* For instance, low-level peptides can equally control thoughts. As Candice Pert's research has shown, neuropeptide receptors communicate more efficiently to various interdependent systems, such as the immune and endocrine, through a chain of amino

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[273] Andy Clark, *Supersizing the Mind: Embodiment, Action and Cognition* (New York: Oxford University Press, 2008), 43.
[274] Andy Clark, "Whatever Next? Predictive brains, situated agents, and the future of cognitive science," *Behavioral and Brain Sciences* 36 (2013), 181-253.

acids in the blood stream. I suggest that such a body-centric and non-hierarchical approach might too directly challenge the underpinnings of the field of cognitive science. The field, regardless of theories of embodied cognition, therefore, still holds to a staunch cognitivist view not too dissimilar from first order cyberneticist and psychiatrist W. Ross Ashby's reductive assertion: "The whole function of the brain is summed up in: error correction."[275]

The implicit assumption here is that the body, emotions and senses are the source of error and considered lower-level functions, which must be overridden by optimizing high-level processing in the brain. PCM promises just this. One of the stated goals of the model is to rid the embodied agent of the uncertainty possible at each stage of processing which adversely affects perceptual judgment and motor behavior by "minimizing informational surprise" and optimizing the brain's capacity for inference. A PCM-based intervention would do this by matching incoming driving signals with a cascade of top-down predictions that aim to cancel out error. However, active sensing coupled with motor intentions performs the same function, enabling the individual to respond adaptively to environmental cues. As Clark notes, "we often use action and perception to probe the world in ways that fit with our expectations. Action tries to reduce that error by moving body and sense organs in ways that yield predicted states."[276] Furthermore, attention through movement increases efficiency as dopamine rises to encourage the encoding of precision. The predictive coding model focuses on improving "performance" by minimizing free energy (the measure of the difference between the energy and the entropy of a system), which minimizes informational surprise (environmental stimuli), and therefore entropy, the tendency towards disorder and disintegration—Norbert Weiner's personal preoccupation.

My concern is that by minimizing free energy and informational surprise through abstract neural computation translated into intelligent technologies to regulate our neurobiological processes, we will eventually begin to act in ways that yield sensations that conform to inbuilt expectations. Once we improve inference through top-down predictive coding models and processes that get embedded as "correct" scripts through

[275] W. Ross Ashby, "Adaptiveness and equilibrium," *The British Journal of Psychiatry*, 86 (1940): 478–83.
[276] Andy Clark, *Supersizing the Mind: Embodiment, Action and Cognition* (New York: Oxford University Press, 2008), 13.

our devices, such interventions will disallow serendipitous encounters with "unfiltered" information, reducing curiosity, spontaneity and a sense of wonder.

Intelligent technology, as I have argued elsewhere, is already designed with the express purpose of increasing cognitive efficiency to eradicate human fallibility through the reduction of "free energy" and "informational surprise." Historically, cognitive science designs models, which computer science then renders in simulations, which later bioengineering realize in the form of technologies for neurobiologists to test on human specimens. The cochlear implant and the defibrillator offer positive examples of such symbiosis. But the above pipeline also makes possible the insertion of nanobots into the body to "correct" lower-level processing, such as regulating the internal milieu (sympathetic and parasympathetic nervous system) to reduce error so higher brain functions can be enhanced. The predictive coding model could soon isomorph into everyday bio-adaptive technologies to optimize our operating systems. For instance, embedding nanobots with algorithms that "strip away the visual stream of predictable, and therefore, less news worthy signals" for us to process might also create a "filter bubble"[277] on our perceptual experience, narrowing (and perhaps standardizing) our worldview. We see evidence of such bioengineering efforts already underway in the recent Swiss Federal Institute of Technology experiment with "thought-controlling genes" referenced above. Martin Fussenegger, the lead author of the study, "envisions therapeutic implants that one day produce chemicals to correct a wide variety of dysfunctions: neurotransmitters to regulate mood or anxiety, natural painkillers for chronic or acute pain, blood-clotting factors for hemophiliacs and so on."[278] This, of course, sounds promising, but the more efficient and error-free we become, the less subjective our perceptions, the less open to serendipity and surprise and the less adaptive and responsive to the changing circumstances wrought by liquid modernity.

As these models are applied across disciplines and soon inform the design of future, more mainstream technologies, as artists we must prepare for this molecular turn, and be ready to insert "experiences to think with" that counter attempts to improve the process of

[277] A term coined by Move On founder, Eli Pariser, to describe how web algorithms choose what users want based on the user's past search habits, thus narrowing the scope of what becomes viewable content.
[278] Stuart Briers, "Thought Controlled Genes Could Someday Help Us Heal," *Scientific America*, accessed February 12, 2015, http://www.scientificamerican.com/article/thought-controlled-genes-could-someday-help-us-heal/.

inference meant to stabilize the organism by reducing "informational surprise" and "free energy." To this end, contemporary artistic interventions must move towards unpredictability, surprise and unquantifiable subjective experiences, which encourage human error, maximize free energy, and perhaps even catalyze "positive disintegration" through spontaneous expression. The New Aesthetic[279], glitch art, in particular offers one such response and Applied Media Theory offers another. Both emphasize hacking or consciously breaking ready-made systems and functional tools that seem to provide ease of access to and control over other people and things by transforming them into "malfunctioning apparatuses"[280] that confound the user and instigate contemplation. I propose ludic performance as yet another. If, however, we are to radically transform our reigning epistemic structures—the cybernetic paradigm—we must intervene at the level of technological production. As Don Ihde persuasively argues in *Bodies in Technology*,

> If critics of technology expect to produce more than a retroactive and impotent response to technology's manifold implication on human beings, then they must enter into *technological 'situations,'* not just through the *production of reactionary critical discourse*, but *at the research and development stages* as well as the later applied ethics stages."[281] (emphasis mine)

For Idhe, technological situations stem from "contemplative engagement." It is here "things become clear" and a space for a new episteme can be formulated. Idhe sees interaction and performance as a site ripe for contemplative engagement whenever the ensuing confluence between human-technology emerges. Performance disrupts epistemology through an active, in the moment, reshaping of the materiality of being; it is constantly changing, lacks precision and it is prone to and driven by human error. It is a direct assault on the cybernetic ethos. Performance allows us to render visible, to expose that "all technologies display ambiguous, multi-stable possibilities…they cannot be reduced to designed functions."[282] The performing body is an active, mutually participating *lived* body filled with responsive, actional experience, as Marcel Merleau-Ponty describes, rather than the culturally determined and passively acted upon *corporeal* body of Michel Foucault. Performance, my chosen medium of expression, therefore, has

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[279] The New Aesthetic is a contemporary art movement focused on processes derived from machine vision and computer processing. Spearhead by James Bridle's not with a manifesto, but through a Tumblr that showcases work supposedly defining the form.
[280] Marcel O'Gorman, "Broken Tools and Misfit Toys: Adventures in Applied Media Theory," *Canadian Journal of Communication*, 37(1) (2012): 27-47.
[281] Don Ihde, *Bodies in Technology* (Minneapolis: University of Minnesota Press, 2002), 52.
[282] Ibid, 106.

presented a way for me to embody my philosophical understanding of technology, much in the way British cyberneticists enacted cybernetics as "ontological theatre."

Having established a structural framework from which to evaluate the various grounded theorists' arguments against the backdrop of co-existing artistic interventions and emerging technologies, I am now able to anticipate the emerging trends that might come to define mind, experience and agency. I am also able to suggest another model, the model seen in my own artistic practice, one I have named *ludic performance*. Bruno Latour might describe it as an "alternative to the myth of progress."[283]

4.4 Disrupting the Sixth Wave of Innovation & the Cybernetic Counter Renaissance

In an article outlining a new theory on the "long waves," Czech economist Daniel Smilhula predicted that the economic crisis in 2008 signified the beginning of the end of the information and telecommunications revolution and the glimmerings of the biomedical-hydrogen revolution. He suggests that future emphasis will be placed on pharmaceutical biotechnology and the biomedical sciences necessitated by increasing numbers of baby boomers. In addition, other forms of biological mitigation, such as genetic engineering, cloning, new pharmaceuticals and a more direct integration between machines and living organisms will be made possible by advances in nanotechnology and biotechnology. Human enhancements and extensions as well as robotics will facilitate immense changes in production processes. While he believes that the sixth wave will begin this year and peak rather quickly by 2020 Smilhula also notes that as a result of legal and political conflict[284] it might initially be slowed down because the areas of scientific and technological progress will be in areas that are morally and politically sensitive.[285] There are, he says, intense fears specifically surrounding transhumanism procedures and methodologies and argues that these interventions "could open a range of possibilities for social and economic exploitation that are hard for us to fully imagine at the present."[286]

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[283] Bruno Latour, *We Have Never Been Modern* (Cambridge, Ma: Harvard University Press, 1993), 198.
[284] The FDA's initial rejection of 21 and me, the first DIY DNA kit, attests to this.
[285] Daniel Smilhula, "Waves of technological innovations and the end of the information revolution." *Journal of Economics and International Finance* 2(4) (2010): 58-67.
[286] Daniel Smilhula, "The waves of technological innovation of the modern age and the present crisis," *Studia Politica Slovaca*, 1 (2009): 32-47.

Anders Sandberg and Nick Bostrom observe similar preoccupations and reluctance but focus instead on the psychological and social implications of adopting said technologies on our identities and point out that to an individual's sense of identity they "are serious threats and often evoke strong reactions,"[287] regardless of the multiple identities we already accommodate. In one study, Sandberg and Bostrom discovered that participants were actually unwilling to enhance traits that were central to their sense of self. While improvements to memory or language skills were acceptable, identity enhancements, which targeted at the core of who the person perceived himself or herself to be, alterations to embedded traits such as kindness and compassion were met with resistance.[288] Nevertheless, as the Internet of things becomes like electricity, less visible and more deeply embedded into our lives and bodies through sensor fusion, data-driven identities might slowly and quietly redefine our selves through pervasive, augmented experiences and automatic life logging; individuals would "never be alone, never be lost, never forget."[289]

Caroline Jones, however, believes that such anxieties will be abated once machine-like prosthesis gives way to the interpenetration of nanoscale biomimesis. She argues that biomimesis is "biological engineering that aims to function within that seamless fantasy of control we like to call human will."[290] The major problem as I see it is that biomimesis not only replicates will, but also replaces it. This, apparently, was Norbert Wiener's intent. In *Human Use of Humans* he carefully outlines a universal "learning machine" to take over the role his father played as a motivator for his thought processes and emotion regulation. But Jones suggests that the machine metaphor is outmoded, and that sub-sensorial informatics, such as internal defibrillators[291] are pushing us closer towards bio-adaptive symbiosis where a two-way communication path will be possible between the machinic and the organic.

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[287] Nick Bostrom and Anders Sandberg, "The Future of Identity," (2011) Report Commissioned by the UK's Government Office for Science. Future of Humanity Institute. Faculty of Philosophy & Oxford Martin School, Oxford University.
[288] Jacob Riis, Joseph P. Simmons and Geoffrey P. Goodwin, "Preferences for enhancement pharmaceuticals: the reluctance to enhance fundamental traits," *Journal of Consumer Research* 35 (2008): 495-508.
[289] Charles Stross, "Gaming in the world of 2030," (keynote speech presented at LOGIN: 2009 in Seattle, Washington. May 2009), accessed March, 17, 2015, http://www.antipope.org/charlie/blog-static/2009/05/login-2009-keynotegaming-in-t.html.
[290] Caroline Jones, *Sensorium: Embodied Experience, Technology and Contemporary Art* (Cambridge, Ma and London: MIT Press, 2006), 116.
[291] This is the same device that malfunctioned inside my aunt, leading to her death.

Here, the machinic will be informed by the organic, which will automatically reset the program "to reflect the host body's autonomic certainty that its heart rate is normally rather than abnormally heightened."[292] As she concludes "when the autonomous nervous system, with its alternating dynamics of sympathetic and parasympathetic response, can be put 'in touch' with the subcutaneous machine, we may finally feel in control of our biomimetics"[293]—and, I would argue, of our unpredictable selves and others. Since the nervous system, which is our internal architecture, forms our perception of the world, it is at this level, within the sub-sensorial, that our contemporary artistic interventions must now occur—a biomimetic, better yet, a molecular turn. As artists, we, too, can design experiences to mirror complex, natural systems, the internal milieu, to render visible the impacts of such co-optation or to return autonomy to the autonomic system.

The anxieties brought on by a consideration of bioengineering as envisioned in *Transcendence* are not new. Stelarc's performances anticipated this "evolutionary crisis point." When Stelarc wrote the word "EVOLUTION" on a glass panel at the Maki gallery in Tokyo in 1982 simultaneously using both his hands and his third arm (triggered by abdominal and leg muscle signals) Jane Goodall interpreted the gesture as a statement implying that "prosthetic extension requires harmonization and synchrony if it is to lead to a new evolutionary, or post-evolutionary phase."[294] In a 1983 interview about his work, Stelarc remarks: "Technology, symbiotically attached and implanted into the body, creates a new evolutionary synthesis, creates a new hybrid human--the organic and synthetic coming together to create a sort of new evolutionary energy."[295]

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[292] Caroline Jones, *Sensorium: Embodied Experience, Technology and Contemporary Art* (Cambridge, Ma and London: MIT Press, 2006), 118.
[293] Ibid.
[294] Jane Goodall, "The Will to Evolve," *Stelarc: the monograph (Electronic Culture: History, Theory and Practice)*, ed. Marquard Smith (Cambridge, Ma and London: MIT Press, 2005), 11.
[295] James D. Paffrath and Stelarc, eds. "Obsolete Body/Suspensions/Stelarc" (Davis, CA: JP Publications, 1984), 17.

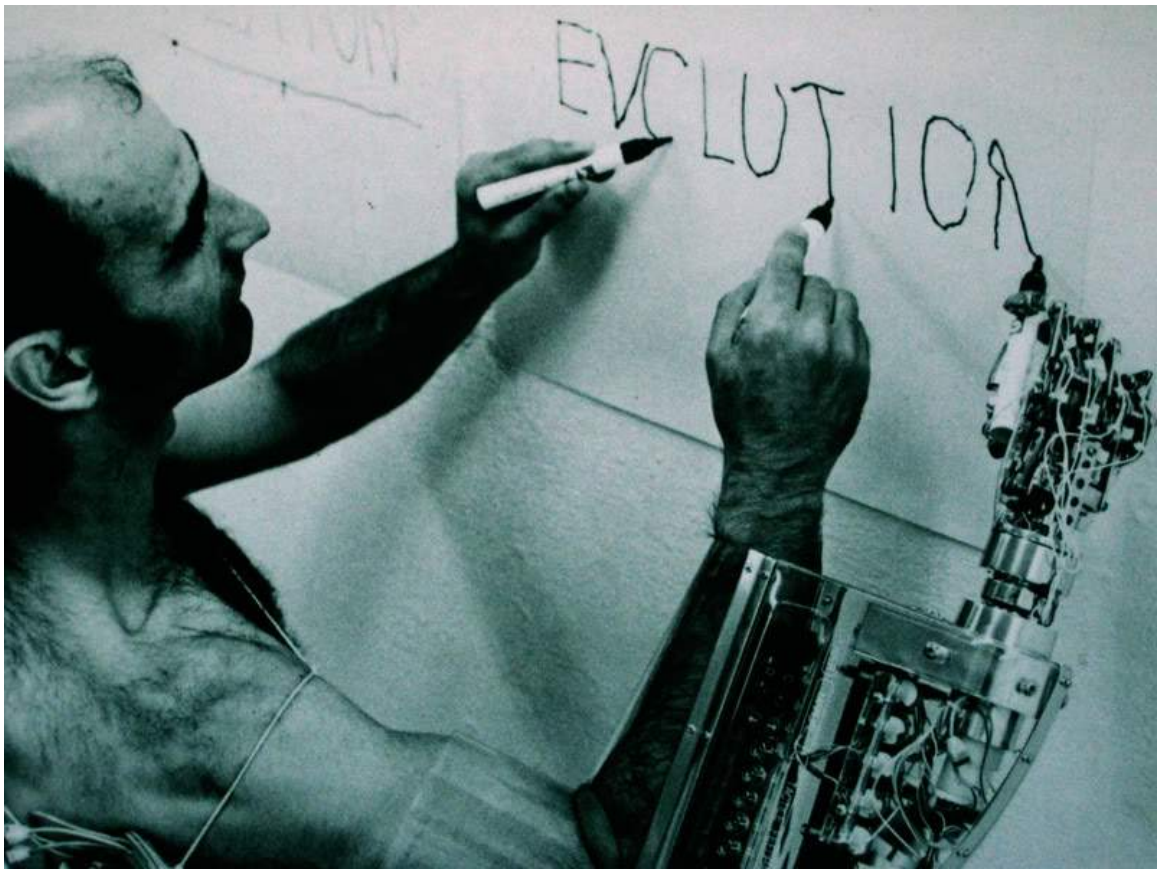

Fig. 13 - Stelarc, EVOLUTION (1982)

Though Stelarc is often accused by critics of denying the body, propagating technophilic fantasies and indulging in macho narcissism, Goodall claims instead that his performances, particularly during the 1980s and 90s, which grew out of experiments with feedback loops between human and technology and "emphasized the fleshiness of the body,"[296] play with notions of distributed and displaced subjectivity. For Stelarc, the body is obsolete because human beings have generated a technological environment to which they cannot effectively adapt as a purely biological species. Because of this, Stelarc has declared, "information is the prosthesis that props up the obsolete body...information gathering satisfies the body's outmoded Pleistocene program."[297] Yet, his work seems to defy such extinction by engaging in adaptation experiments with multi-lateral organic and synthetic fusion, which rest outside the parameters of Darwinian

[296] Jane Goodall, "The Will to Evolve," *Stelarc: the monograph (Electronic Culture: History, Theory and Practice)*, ed. Marquard Smith (Cambridge, Ma and London: MIT Press, 2005), 8.
[297] "Stelarc," accessed January 2, 2012, http://stelarc.org/.

selection. Each new work beginning with *Obsolete Body* (1980) and going forward, push the feedback loops progressively closer to a point where the biological and non-biological are effectively one operational system. On the surface, no parasitic struggle or dualism exists between the body and the robot. However, in the mid-1990s, a shift occurs, whereby both human agency and artificial intelligence become lifelessly extended into the system itself, creating a kind of psychic split. Goodall incorporates notes by Stelarc on *Psycho/Cyber* (1996) to underscore this shift: "Plugged into and arrayed in circuitry, *the body becomes remote from its psycho-chemistry and hollow*, with its *internal processes emptied into the electronics*."[298] Although the body appears to be transformed into a black box, emptied of meaning,[299] the pain that registers through Stelarc's musculature during performance denies the complete erasure of bodily presence.

In contrast to Stelarc's external, cosmetic changes, Marco Donnarumma, plays with externalizing the internal changes resulting from body-technology symbiosis to re-integrate the split self through stimulating sub-sensorial individuation. In *Nigredo* (2013), Donnarumma, in collaboration with engineer Marije Baalman, creates a private experience of altered self-perception through the use of biophysical technology. Donnarumma describes the eight-minute time-based installation as such:

> By repurposing biofeedback methods, whole-body vibration and wearable bioacoustic technology, the visitor is first induced in a state of perceptual deprivation, and then subjected to diverse stimulations designed and temporally composed so to provoke physiological, physical and neural alterations. The work aims to unlock latent qualities of the human body through its coupling with the technological system.

[298] Jane Goodall, "The Will to Evolve," *Stelarc: the monograph (Electronic Culture: History, Theory and Practice),* ed. Marquard Smith (Cambridge, Ma and London: MIT Press, 2005), 14. I would agree, but argue that the body is not yet obsolete, only imbalanced.

[299] Much like Shannon and Weiner's original theory of information, outlined at the first Macy Conference.

Fig. 14 - Marco Donnarumma, Nigredo (2014)

Echoing Chris Salter's *Just Noticeable Differences* (2010-11), which sought to "explore the phenomenological shifts occurring in the embodied experience of the self and environment,"[300] Donnarumma, too, attempts to over-saturate the participant with low frequency audio, light and vibrational stimuli to provoke a state of perceptual deprivation from stimulus confusion. In *Nigredo*, however, the sensory intensity is generated from the participant's own heartbeat, blood flow and muscle contractions. By feeding back the participant's own inner body sounds in the opposite direction in the form of mechanical vibration patterns, Donnarumma attempted to produce "standing waves"—a stationary wave that is catalyzed by two opposing waves colliding and causing a forceful sonic resonance. When the waves vibrate the internal milieu—the bones and connective tissues—the intensity carries the ability to displace one's organs,[301] and the participant becomes uncertain about what lies within and without her body. Combined, the sonic, visual and sensory elements disrupt the neurophysiological processes associated with the autonomic nervous system, which in turn shape our perception of the external world and ourselves.

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[300] Chris Salter, "JND: Artistic Experiment in Bodily Experience as Research. Bodily Expression," in *Electronic Music: Perspective on a Reclaimed Performativity* (New York and London: Routledge, 2011), 1.
[301] M.J. Griffin and H. Seidel. "Whole-Body Vibration" (2011), accessed March 15, 2015, http://www.ilo.org/oschenc/part-vi/vibration.

Fig. 15 - Chris Salter, Just Noticeable Difference (2009-10)

Both works point towards the hidden dangers inherent in employing technologies to alter sub-sensorial systems and the promise of biophysical technologies to re-script the nervous system, potentially restoring gray matter volume to the hippocampus and amygdala. Nonetheless, such cross-modal substitution requires goal-driven sensorimotor engagement for adaptation to be successful. As a proponent of the enactive view of cognition, Alva Noe, observes the "sensorimotor model of perception suggests that an important role is played by embodied action in terms of information pick up and initially tuning circuitry which supports perceptual awareness."[302] For Noe, sensory perception is not just something that unfolds in the brain, but rather a mode of active and motivated exploration of the environment, which draws upon an implicit understanding of sensorimotor regularities. He believes, for example, that to model vision correctly, "we must model it not as something that takes place inside the brain, but as something that

[302] Alva Noe, *Action in Perception: Representation and Mind* (Cambridge: Cambridge University Press, 2005). 87.

directly involves not only the brain, but also the animate body and the world."[303] Andy Clark, however, thinks Noe's sensorimotor theory of perceptual experience falls short because it foregrounds embodied skills and motivated tasks at the expense of *qualia* (the raw feeling of conscious experience). In doing so, he fears Noe "fail[s] to do justice to the many firewalls, fragmentations, and divisions of cognitive labor that characterize our engagements with the world our senses reveal."[304] Thus, bio-adaptive feedback alone cannot combat the slow violence enacted through our dependence upon intelligent technology, but combined with kinesthesia and goal-directed play, ludic performance suggests a microcosmic sandbox in which to experiment with re-scripting "whole new agent-world circuits" with the hope of quietly transforming Culture.

4.5 Ludic Performance: A Response to the Molecular Biomimetic Turn

What I have termed the Molecular Biomimetic Turn is somewhat like the Affective Turn in new media aesthetics in the 1990s in that it is emerging from an equally "murky confluence" between various disciplines, spanning the digital arts, cognitive and biological sciences, engineering and computer science. It, too, can play a vital role in re-embracing the lived body through new configurations and relationships of bodies, technology and matter. Its specificity, however, arises from origins in the intermediality of bioart—art that involves the appropriation of living systems or techno-scientific methodologies. Whereas new media artists of the 1990s responded to cybernetic principles in keeping with the 3rd order, such as autopoesis and connectionism, and the repurposing of the Internet and VR, contemporary new media artists are experimenting with biotechnologies and their accompanying protocols to design experiences that provoke a counter discourse intended to spark a theoretical, cultural and ethical debate. Still, uncertainty about art that explicitly sets agendas without transforming the process into an emotional form, some voice concern. Representative is curator and media studies scholar, Jens Hauser. In his essay, "Towards a Phenomenological Approach to Art Involving Biotechnology," Hauser observes "the use of biotechnology as a means of expression is currently addressed less as art and more as a discursive and often

[303] Ibid, 30.
[304] Andy Clark, *Supersizing the Mind: Embodiment, Action and Cognition*. (New York: Oxford University Press, 2008), 146.

instrumentalized form of contributing to ongoing public debates beyond the aesthetic realm."[305] Some of the themes Hauser sees artists experimenting with are: 1) the phenomenon of re-materialization, 2) biomedia and their mediation, 3) The relation between presence and representation, 4) performativity and co-corporeal projection, 5) the role of documents, physical traces, and paratexts, 6) context dependency and its consequences. He urges artists to maintain a balance between "meaning effects" and "presence effects,"[306] and biological processes and representation.

While *ludic performance* touches upon many of these themes, responding to the Biomimetic Molecular Turn, it does not rest comfortably or solely within bioart, but moves between disciplines and genres, offering another orientation. Ludic performance is equally informed by cognitive neuroscience, game design, data-driven storytelling, immersive theatre, complex science and even alternative spirituality. However, it grows most directly out of two different, but interrelated streams: the sixty-year history of experimentation with biosignals for interactive music and performance practices, and game-based strategies in post-modern dance, many examples of which were discussed above in Section 4.2. Ludic performance is an attempt to further integrate and accentuate the relationship between these two streams.

4.5.1. What is Ludic Performance?

Standing alone as a term, *ludic* means anything characterized by play or the display of undirected, spontaneous playfulness. *Performance* simply is an event in which an embodied performer or a group of performers deliberatively behave for an audience who can also actively participate in the event. Both terms, however, possess an inherent duality informed by the cybernetic paradigm. Ludic acts can also be about guided, simple rule-based behavior that can lead to complex forms of emergence. Performance equally serves as an evaluation mechanism for collecting, measuring, analyzing data based upon tasks completed by a human actor. When combined and moved beyond false binaries and

[305] Jens Hauser, "Observations on an Art of Growing Interest: Toward a Phenomenological Approach to Art Involving Biotechnology," in *Tactical Biopolitics: Art, Activism and Technoscience*, ed. Beatriz DeCosta et al. (Cambridge: MIT Press, 2008), 83.
[306] A distinction initially made by Hans Ulrich Gumbrecht in *Productions of Presence: What Meaning Cannot Convey*.

categorical sedimentation, "ludic performance" suggests embodied, data-driven, game-based experiences involving performers and an audience with an emergent outcome.

By forging this new genre, my intent is to simultaneously challenge the legacy of cybernetics (and current theories in cognitive science, such a predictive coding model) and offer an alternative technological paradigm based upon principles of complexity, contingency and relational becoming, opposing quantification, computationality and control through the reinsertion of the body, affect and the senses into technology. This approach is an attempt to extend N. Katherine Hayles reframing of the post-human[307] into situated cultural practice by similarly supplanting teleology with emergence, objectivism with reflective epistemology, autonomous will with distributed cognition and the body as a mere support system for the mind with an embodied agent driving the experience. [308] Hayles appears to neglect both the critical value of affect and the senses as unquantifiable catalysts shaping behavior and perception and the role performance can play in recuperating the technologically mediated body. I contend that through the unique combination of biomedia, performative gesture and socio-collaborative play, both the performer and the audience as an expressive medium and a technology, can once again experience the body. Furthermore, the subjective, *lived* body[309] can become a site of resistance and re-inscription.

In the following chapters, I examine two case studies, *[radical] signs of life* and *Beware of the Dandelions* (henceforth BOTD), to offer diverse stylistic approaches that advance these ideas. Both works integrate the three defining features, which form the foundation upon which the six characteristics rest. Together, these core elements are what distinguish *ludic performance* from other types of performance experiences, as well as current art, technology and science collaborations. The characteristics also establish the scaffolding upon which a new technological paradigm can emerge; one that not only reasserts the centrality of the body, but also re-animates affect and the senses through the re-stimulation of the peripheral nervous system in an attempt to recuperate "critical

[307] The post-human is a de-centering of the human as a result of our interpenetration with technology and informatic networks.
[308] N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago and London: The University of Chicago Press, 1999), 288.
[309] As outlined in the Introduction, I see the lived body as the subjective, pre-semiotic body, comprised of felt bodily sensations and the corporeal body as the objective physiological body.

feeling." My aim is to investigate opportunities for thickening the gray matter of both the amygdala and hippocampus currently being eroded by intelligent technology through creating an immersive environment (an environment and practice recreating the absorption of mindfulness) in which emotion-feeling cycles and knowledge-schemas can be reactivated. *Ludic performance* is, thus, the perfect counterpoint to the unfolding sixth wave of innovation; it offers a safe space, an immersive sandbox of resistance and re-inscription, which repurposes biotechnologies to enable us to not only explore new modes of expression but also become more fully human through shared experience and a reconnection with our bodies, emotions and senses. Because biosignals from both the somatic and autonomic nervous system generate spontaneous, unpredictable excitable signals, which can be monitored and amplified by various sensors, surrendering to free, unguided bodily expression through play can serve as an opposition to the values espoused by the Cybernetic Renaissance. Below I briefly explore each foundational element of ludic performance, biomedia, performative gesture and socio-collaborative play, which were each chosen based on the following theoretical assumptions:

1) The body is an ambivalent and "expressive technology," which can invite spontaneity and unpredictability.
2) Performative gesture can "reproduce culture" by stimulating the interoceptive and nervous systems, thereby enhancing memory consolidation.
3) Socio-collaborative play can "activate mirror neurons" and thereby increase empathy, and by extension restore critical feeling.

4.5.2. Biomedia

Eugene Thacker coined the term *biomedia* to show how biology is becoming the new media, wherein the body is the medium and the molecule the message. He examines how bioinformatics and biocomputing both use DNA and perform computational work in relation to DNA. Echoing the cybernetic easy slippage, he sees a confluence between genetic and computer codes, between informatics and biological substrates. However, Thacker is careful not to fall into binary logic; he views the goal of biomedia as a way to restore material instantiation. He suggests that we do not use the computer technology in

the service of biology, but rather as "an emphasis on the ways in which an intersection between genetic and computer codes can facilitate a qualitatively different notion of the biological body—one that is "technically articulated, and *yet still fully biological*." [310]

I wish to extend Thacker's theory of biomedia or perhaps draw a more literal connection between biology and media to look at the body's viscera as base material for the creation of real-time, dynamic media. Both *[radical]* and *BOTD* employ the Xth Sense (henceforth XS), an open-source biophysical sensor that reads and amplifies muscle sounds and blood flow, which my collaborator, the performer and sound artist, Marco Donnarumma, invented and which I developed further (with the help of MJ Caselden, an engineer from littleBits) into a wireless prototype and network. Donnarumma and I are currently collaborating on the design and development of the latest version, a market-ready stand-alone instrument with added spatial and body temperature functionality. The new version now possesses an API that interfaces with the web, gaming platforms and mobile applications. In contrast to the current wearable market hype, which views the corporeal body as pure informatics, wherein data is tracked, measured, and analyzed, we describe the XS as an "expressive technology" that reveals the lived body as more than data; it's vibration, it's physical. For us, the XS amplifies sonic resonance stemming from the lived body in an attempt to re-establish our intimate connection with ourselves and with one another through shared human experience. As Thacker notes, biomedia, like the XS, offer "novel configurations of biologies and technologies that take us beyond familiar tropes of technology-as-tool, the cyborg or the human computer interface." Because of this, biomedia "describes an *ambivalence* that is not reducible to either the technophilia (the rhetoric of enabling technology) or technophobia (the ideologies of technological determinism)."[311]

Both *[radical]* and *BOTD* extract biophysical information and map the sound data to larger technical ensembles through a diverse set of players performing technological actions to trigger content that generates deeper meaning. For instance, *[radical]* uses the interplay of call and response patterns between the dancers' choreographed trajectories, which generate sound and imagery, and the composer and audiences' improvisational

[310] Eugene Thacker, "What is Biomedia?" The John Hopkins University Press and Society for Literature and Science, *Configurations* 11.1 (2003): 47-79.
[311] Ibid.

sculpting as sites of technological action invested with complex, contradictory and constantly changing meaning. *BOTD* uses the biophysical and spatial data from the audience to instead trigger narrative fragments in the form of clues and puzzles to create a real-time unraveling of a story world controlled entirely through social interaction. In both works, the raw sonic data from the Xth Sense becomes both meaningful and present only once it is amplified and given life through gesture and translated through code into a composition or a visual representation. The act of transport over Open Sound Control (OSC) and the mapping into Max/MSP (for sound) and Processing (for imagery) serves to physicalize—to corporealize abstract data.

For Thacker, the technology of biomedia is also not strictly instrumental; the body is both a means of communication and an object of communication. Biology, simply put, *is* a technology infused with source code—"informatic materiality."[312] Thus, the body is understood as both a molecular, species body, and as a compiled body through which we can process information and from which we can extract data, as well as render models and run simulations. Here there is no "body-anxiety." The body-technology relationship is mutually inhering; "the biological informs the digital, the digital corporealizes the biological."[313] But subjectivity, the lived body, is still absent. Incorporating performative gesture into biomedia, thus, enables one to inscribe social and cultural meaning into data extracted from the prosthetic amplification of body-technology.

4.5.3. Performative Gesture

Gesture can be communicative, instrumental and/or aesthetic. Kendon defines "performative gesture" as a "learned shape or sequence that not only indicates, but instantiates, embodies a request, a plea, an offer, an invitation, a refusal."[314] It is, therefore, hypothetically possible to bring new awareness to the body through new routine gestures, disrupting social conventions and dislodging painful embedded memories. In *Agency and Embodiment*, Carrie Noland supports this assertion. She sees the body as "a sensorium extending itself prosthetically through gesture into the world."

[312] Thacker is playing off of N. Katherine Hayles' crossing between information and materiality. He sees this as a missing part of her argument.
[313] Eugene Thacker, "What is Biomedia?" The John Hopkins University Press and Society for Literature and Science, *Configurations* 11.1 (2003): 47-79.
[314] Adam Kendon, *Gesture: Visible Action as Utterance* (Cambridge: Cambridge University Press, 2004), 109.

For her, gesture functions as a "nodal point where culture (the imposition of bodily techniques), neurobiology (the given mechanics of a human sensorimotor apparatus) and embodied experience (the kinesthetic experience specific to an individual body) overlap and inform one another."[315] Specifically, Noland interrogates the interoceptive system, which entails the physiological condition of the body; "it is the 'material me' that enables visceral afferent information to surface in awareness and affect our behavior, our moods, emotions and general well-being."[316]

The Xth Sense relies on a particular type of performative gesture, what Donnarumma conceived of as a "sound-gesture (SG);"

> A SG is a compounded interpretation model that bonds a given feature mapping to the designated performer's gesture. It is both a gesture dictated by a neural impulse, that generates a given muscular excitement (a specific MMG sound), and also SG relies on specific mapping definitions that live inside the circuits of the computer to achieve effectiveness and expressiveness. Hence, the SG can be seen as a *techno-epistemic enactment of a dormant sonic capability of the body system*.[317]

Because the XS does not rely upon an external object as an instrument, but instead the performers own muscle fiber, her own body, it moves beyond instrumental gesture, acting only upon the external environment. Instead the performer acts within and responds to her own intimate, bodily milieu. Operating on the level of the body's viscera, the performer's conscious sculpting of muscular tension and heightened articulatory sensitivity creates, in a sense, a direct pathway to the interoceptive system itself.

The interoceptive system is part of the autonomic nervous system and also consists of small fibers, which tie directly to our homeostatic impulse. Changes to our bodily states when the "feeling of an emotion"—affect—surfaces, which today, is largely set to a default flight or fight response as a result of heightened cortisol spikes caused by techno-stress (as I have argued elsewhere), adversely impacts this system. The body's interoceptive sensations mediate its interaction with external stimuli in a process called "self-affection," which provides the basis for the subjective image of the material self as a feeling, sentient entity that possesses emotional awareness, presumably located in the

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[315] Carrie Noland, *Agency & Embodiment: Performing Gestures/Producing Culture* (Cambridge: Harvard University Press. 2009), 8.
[316] , Oliver G..Cameron, *Visceral Sensory Neuroscience: Interoception*, (Oxford: Oxford University Press, 2002).
[317] Marco Donnarumma, "Music for Flesh II: informing interactive music performance with viscerality of the body system" (paper presented at NIME Conference in Ann Arbor, Michigan, May 21-23, 2012).

right anterior insular. Therefore, our biologically and culturally informed use of the body establishes "agentic" awareness. Noland contends that when "gestures interact with other information-gathering processes of the mind and body, they become organs of 'distributed agency,' mobilizing sensory surfaces to engage the dynamic mentality of one's neuromusculature in decision-making processes on multiple planes."[318] Continuing this line of inquiry, Andre Leroi-Gourhan claims that from an evolutionary viewpoint that "gesture is that which involves the body in a double process of active displacement (through contraction of muscles) and information-gathering (through the neuro-receptors located along the muscles)."[319]

Kinesthesia—the body's "sensations of [its own] movements transmitted to the mind from the nerves of muscular, tendinous and articular systems"[320]—is essential to the process of decision-making and learning. Kinesthesia, Noland contends, offers "autonomous resistance to sedimentation by revealing affect's reliance on habitual *and socially generated* muscular articulation,"[321] which Marcel Merleau-Ponty refers to as "I cans" and William Reich coined "social armor." In short, changing our movement patterns, which alters our muscular articulation, changes the mind. The kinesthetically engaged body in dance and theatre performance, therefore, is a site rife with potency and the power to transform Culture through culturally determined gestural re-inscription. For Noland, and myself, the body, the connective tissue, specifically, is also a site of active resistance. Because the Xth Sense amplifies musculature contraction within the interoceptive system, which vibrates through kinesthesia, placing them on performers and audience members carries the potential to "disrupt" and "re-inscribe" deeply embedded social conventions, painful memories and/or behavioral patterns through embodying new performative gestures. For example, holding yin yoga postures (discussed in the last Chapter), which map organ-pairings to emotional states along the meridian channels located within the interoceptive system can dislodge memories stored as samskaras inside the neuro-musculature. Kinesthesia, therefore, suggests a vehicle for re-animating the numbed biological self, reconnecting the *corporeal* with the *lived* body. Thusly, I forward

[318] Carrie Noland, *Agency & Embodiment: Performing Gestures/Producing Culture* (Cambridge: Harvard University Press. 2009), 16.
[319] Ibid, 15.
[320] Ibid.
[321] Ibid, 67.

that the combination of the Xth Sense with performative gesture (responsive choreography in *[radical]* and embodied mini-games in *BOTD*) offers a way to restore agency and critical feeling. By restoring bodily attunement through real-time amplification of our internal viscera, by coupling spontaneous expressive and biomimetic gestures with XS technology, we can strive to uproot social conditioning and to transform the slow violence of technological control. As Elizabeth Grolz reinforces: the "lived body is a potential area of resistance to patriarchal norms and a surface of inscriptions."[322]

Further support comes from Susan Goldin-Meadows's 2003 study in which she asked two matched groups of children to memorize a list, and then carry out some mathematical problem solving before trying to recall the list, the potential for embodied learning technologies clearly emerge. In the study, one group could freely gesture during an intervening math task, while the other group was asked not to move while conducting the same task. The results showed that the group that was not allowed to gesture performed significantly lower in the memory recall test than the group that was able to move around during the intervening math task. As Goldin-Meadow concluded, "the physical act of gesturing plays an active (not merely expressive) role in learning, reasoning, and cognitive change by providing an alternative (analog, motoric, visio-spatial) representational format."[323] Thus, it would appear that gesture continuously informs and alters verbal thinking, which continuously informs and alters gesture, forming a coupled system, in which the act of gesturing is not simply a motor act expressive of some fully neurally realized process of thought, but instead "a coupled neural-bodily unfolding that is itself usefully seen as an organismically extended process of thought."[324] Movement, in essence, is a form of thinking and feeling. And thinking and feeling, as we shall discover, is enhanced through play.

During my early research prior to *[radical]*, I came across Victorio Gallese's 1990s studies of mirror neurons. As mentioned earlier, Gallese explored a neural basis for "the human propensity to feel what another feels," not only emotionally but also

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[322] Elizabeth Grolz, *Volatile Bodies: Toward a Corporeal Feminism* (Bloomington: Indiana University Press, 1994), 94.
[323] Dedre Gertner and Susan Goldin-Meadow, *Language in Mind: Advances in Language and Thought* (Cambridge, Ma: Bradford Book 2003), 186.
[324] Andy Clark, *Supersizing the Mind: Embodiment, Action and Cognition* (New York: Oxford University Press, 2008), 126.

physically, which confirms the relationship between empathy and kinesthesia. Gallese argues, "Mirror neuron networking provides a functional mechanism—embodied simulation—that sponsors our capacity to share "actions, intentions, feelings, and emotions with others."[325] He also discovered that both sight and sound trigger the same brain region. J.J. Gibson, who was also fascinated by kinesthesia, conceptualized it as both our muscular connection to our deepest emotions and the originator of our senses and sense of self.

The potential for movement to retrain mirror neurons and calm the nervous system enabling the optimal condition for memory consolidation is supported by a yet to be released documentary by choreographer Tamar Rogoff. In the film "Enter the Faun"[326] Rogoff works with Gregg Mozgala, a young man with cerebral palsy whom she casts to play the lead in her next performance. Not trained as a physiotherapist, but a highly attuned dancer aware of her own anatomy, she proceeds to help Gregg create an alternative nervous system through "body work." In only six months, Gregg is able to feel the earth under his feet, his body alignment is re-routed, the pain associated with massive tension throughout his body is released, and his almost constant state of fight and flight and constrained breathing patterns are transformed. As the doctor who exams him states, "if CP made him walk on tip toes and now he doesn't clearly the nerves have still been damaged, but the functional eventuality of the nervous problem does not exist. The nervous system is not fixed and immutable, but educable."

Like Gregg, the audience is educable; they, too, can build new circuits step-by-step to mitigate the neural misfiring caused by intelligent technology through sensory substitution. Kinesthesia might be able to re-callibrate the ecological assembly process. In the much cited, seminal Tactile-Visual Substitution System study conducted over the course of several years by Bach y Rita (1972, 83, 84, 96), a blind subject is rigged into a head-mounted camera with sensors attached to their thigh. When visual stimulation enters the camera, the images are transduced to trigger an array of vibrations on the subject's thigh, which stimulate "quasi seeing" without using the parts of the body and brain normally dedicated to seeing. As neuroscientist Andy Clark acknowledged of the study,

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[325] Susan Leigh Foster, *Choreographing Empathy: Kinesthesia in Performance* (New York: Routledge, 2011), 140.
[326] "Enter the Faun," accessed February 25, 2015, http://www.enterthefaun.com. The film was sent to me privately by the Producer; it will be released during the summer of 2015. But the trailer can be seen online for further context.

such sensory substitution reveals that "even without penetrating the existing surface of the skin and skull, sensory enhancement and bodily extension are pervasive possibilities"[327] for inducing new agent-world circuits. But cross-modal substitution requires both goal-driven sensorimotor engagement and repetition for adaptation to be successful. This is where connecting movement to games is so powerful.

4.5.4. Socio-Collaborative Play

Eric Zimmerman's "Manifesto for a Ludic Century" suggests that the 20th Century was the century of information, but in our Ludic Century, "information has been put at play."[328] While game design involves system logic, social psychology and culture hacking, characteristics of the cybernetic paradigm, games also offer a counterpoint. They can serve as autonomous art, transforming culture, like kinesthesia, through recursive actions. Players can modify, break apart and entirely redesign the game to change the mechanics of the world and restore their own agency. Zimmerman reminds us that games are just playful systems, and that "a playful system is a human system, a social system rife with contradictions and with possibility."[329] As a result, games can be beautiful and appreciated for their aesthetic value alone. The pioneering play theorist, Johan Huizinga also thought play, more broadly, was beautiful because it is characterized by the urge to orchestrate an orderly form. Summarizing his formal observations on play, he states,

> [W]e might call it a free activity standing quite consciously outside "ordinary" life as being 'not serious' but at the same time absorbing the player intensely and utterly. It is an activity connected with no material interest, and no profit can be gained by it. It proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner.[330]

Similarly, art historian, Katja Kwastek, in Chapter 3 of *Aesthetics of Interaction in Digital Art* identifies play as one of the many aesthetic aspects that define interactive experience. She sees "the free nature of play as comparable to the concept of autonomy in art, [which] vacillates between poles of cognitive and material independence."[331] Synthesizing Huizinga, Roger Callois, Hans Scheuerl and Frederik Buytendijk, she

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[327] Andy Clark, *Supersizing the Mind: Embodiment, Action and Cognition* (New York: Oxford University Press, 2008), 36.
[328] Eric Zimmerman and Heather Chaplin, "Manifesto for a Ludic Century," *Kotaku*, September 9, 2013, accessed September 9, 2013, http://kotaku.com/manifestor-the-21st-century-will-be-defined-by-games-1275355204.
[329] Ibid.
[330] Johan Huizinga, *Homo Ludens: A Study of Play Elements in Culture* (New York: Routledge, 1949), 13.
[331] Katja Kwastek, *Aesthetics of Interaction in Digital Art* (Cambridge, MA: MIT Press, 2013). 74.

outlines the core characteristics of play: 1) freedom of activity, 2) unproductiveness, 3) self-containedness 4) no predictable outcome, 5) inner infinitude 6) based in rules 7) exists in the artificial realm, and 8) ambivalence. All can be found within both *[radical]* and *BOTD*. Although bound by time and space, the endless repetition and variation render both works indeterminable and lacking in material productivity. Both works are always in the process of becoming. Relational and contingent, they are verbs subject to both chance and control. Thus, ludic performance establishes dynamic interactive systems that intend to inspire both beauty and meaning. Here, art-making and play are indistinguishable. Combined they serve as "unscripted" ontological opposition to epistemic social formations.

Socio-collaborative play also creates opportunities for embodied learning and the restoration of critical feeling. As the first year learning outcomes from the Institute of Play, a charter school in NYC founded by Katie Salen confirm "cooperative problem-solving through games generates significantly higher achievement outcomes, higher-level reasoning, better retention, improved motivation, and better social skills"[332] than traditional pedagogy due to increased social cohesion, and peer-to-peer support. Another study conducted by Mina C. Johnson-Glenberg et al at Arizona State University revealed similar findings when combining multi-modal immersion with cooperative game-based learning experiences. The study also noted that dopamine was activated in response to the novel stimuli and in built reward mechanisms. Because dopamine induces our "rapid orienting response," it forces us to attend to incoming information, while simultaneously stimulating our limbic system, which cues the brain for reward, thereby motivating players to continue exploring the open environment. As Carr pointed out dopamine is also a key chemical for "system consolidation." Socio-collaborative play, therefore, can re-activate synaptic connections to enhance the formation of critical knowledge-schemas as well as ignite the self-stimulating feedback loops necessary for the healthy maintenance of the emotion-feeling cycle. The emotion-feeling cycle relies on multi-modal coupling acquired through simulation to activate and regulate emotions. Our emotional experience and our ability to understand another's emotional experience are

[332] David Johnson and Roger Johnson, *Learning Together and Alone, Cooperation, Competition and Individualization* (Needham Heights: Prentice-Hall, 1994), 91.

deeply rooted in our physical body. Emotions, Antonio Damasio explains are "complex, largely automated program of 'actions' carried out by our bodies"[333] but the feeling of emotions, affect, are images of actions, rather than actions themselves. The emotion-feeling cycle begins in the brain with the perception of stimulus (image or event), which triggers emotion, sending a chemical signal from the brain through the body wherein the emotion accrues, and then feedback is sent back to the brain for the feeling part. Embodied simulation, therefore, through recursive play, can aid in memory consolidation, planning and emotion regulation, which I contend is currently imbalanced as a result of constant screen time within the "ecosystem of interruptions." It can also increase mirror neuronal engagement, the physiological basis for our experience of empathy, as discussed in the previous sub-section.

Studies have also shown that embodied socio-collaborative play encourages more frequent and open emoting and intensity than those who play on their own in front of screens. As Buytendijk contends "we play only what is pathic in our presence, what addresses our feeling life."[334] Group play, therefore, has the ability to generate new behaviors, attitudes and emotions. Nicole Lazarro's four keys[335] emphasize the importance of socio-collaborative play in the process of unlocking emotions in games and increasing player's bodily sensations and awareness of others:

1) Hard Fun: Emotions from meaningful challenges, strategies and puzzles

2) Easy Fun: Grab attention with ambiguity, incompleteness and detail

3) Altered States: Generate emotion with perception, thought, behavior and other people

4) The People Factor: Create opportunities for player competition, cooperation, performance & spectacle

Both case studies, *[radical]* and *BOTD,* incorporate all four.

Free and unguided embodied play are also important for fostering social-emotional competence; it teaches us to subordinate our desires to social rules, readily cooperate with

[333] Antonio Damasio, *Self Comes to Mind: Constructing the Conscious Brain* (New York: Pantheon, 2010), 114.
[334] Frederik J.J. Buytendijk, *Wesen und Sinn des Spiels. Das Spielen des Menschen und der Tiere als Erscheinungsform der Lebenstriebe* (Berlin: Kurt Wolff Verlag, 1933), 129.
[335] Nicole Lazzaro, "Why We Play Games: Four Keys to More Emotion Without Story," (paper sent to me by email via Nicole).

others and engage in socially appropriate behaviors. While it is critical during early childhood, the erosion of the amygdala and hippocampus (the limbic regions of the brain dedicated to memory consolidation and emotion regulation) resulting from our dependence upon intelligent technology, makes spontaneous play for adults equally essential for coping with the increasingly stressful challenges of modern life.

4.5.5. Defining Characteristics of Ludic Performance

Building upon the three core ingredients, which views the body as a technology, gesture as non-linguistic language and game as an open-system, the following integration of characteristics appear across both works discussed in the Chapters 6 and 7, offering hints of an emerging genre. The characteristics seek to distinguish *ludic performance* from the seminal new media works of the 1990s, which also attempted to recover the body and affect from the computational hype favoring the pattern over material instantiation and the more recent interdisciplinary collaborations among performers, technologists and scientists. It expands upon and differently applies the rich sixty-year history of biosensor performance experimentation across music and dance, as well as the game-based choreographic strategies explored in post-modern dance outlined above. The six defining characteristics of ludic performance are as follows:

1) Meta-Data-Driven Experience

Multiple types of data sets (biological and non-biological) are integrated to trigger multi-media events, shape narrative arc and generate co-creative expressivity.

2) Game-Based Design Framework

Both game rules and mechanics drawn from various genres are employed to structure the work.

3) Embodying Principles of Complex Science

Abstract concepts of emergence, complexity and self-organization are learned and externalized through embodied social interaction.

4) Interplay of Real-Time and Pre-Determined Performance

Performances are expanded to include both: live and pre-recorded, emergent and pre-determined rules, and linear and non-linear content triggering.

5) Audience as Co-Creator-Player-Performer

Audience gains agency through the multiplicity of roles they simultaneously navigate as well as serving as the generator of the experience triggered through their own biophysical processes.

6) Large-Scale Networked Sentient Immersion Environments

A diverse entanglement of inputs and outputs from performer, audience and interactive systems intersect to create an all-encompassing sentient entity.

In *Performance, Technology and Science*, Johannes Birringer delineates various types of environments in which interactive systems appear, including derived, responsive, immersive, networked and mixed reality. Alternately, ludic performance integrates and remixes all types into one environment,[336] plus adds the sub-sensorial.

This combination of characteristics and resolution suggests the optimal conditions for balancing the ecological assembly process. Together, biomedia, performative gesture and socio-collaborative play form a foundation upon which to build the necessary simulated framework for the fostering of memory consolidation and the reinvigoration of critical feeling.

[336] Johannes Birringer, *Performance, Technology and Science* (New York: PAJ Publications, 2008), 119.

5. Presence of Being

> *"I went into the woods because I wished to live deliberately, to front only the essential facts of life, and see if I could not learn what it had to teach, and not, when I came to die, discover that I had not lived. I did not wish to live what was not life, living is so dear; nor did I wish to practice resignation, unless it was quite necessary."*[337] *Henry-David Thoreau*

To write this dissertation, I did as Thoreau admonished; I went [off the grid], albeit not to the Massachusetts woods, but to the Maine coast to disconnect from society, most technology, and social media. I, too, no longer "wish[ed] to live what was not life." My intent was to examine through experience whether my theory that intelligent technologies—the Internet, mobile devices, immersive displays and wearables—are numbing our biological selves was more than conjecture. I would explore whether a return to my own body, emotion and the senses could offer an antidote. Through a self-imposed de-toxification, a removal from the digital realm, I wanted to observe what would happen to me. *Would I go through withdrawal symptoms? How would my sense of reason, perception, memory and emotions change? Would my memory consolidation processes strengthen, and thereby re-activate and better regulate my emotion-feeling cycle and knowledge-schema production?* Additionally, I wanted to understand why it appeared that we so readily give over our cognitive and affective faculties to intelligent technology, and what might become of us as a culture and a species if we continued along the trajectory predicated by the Singularity. More importantly, I wanted to determine how I, as a creative technologist and experience designer, could intervene in this ostensibly seamless merging between the "born and the made" to redirect society by exposure of what I felt we are losing, and to envision another pathway forward as we move towards greater complexity.

My disconnect from intelligent technology to reconnect with nature was both an intentional choice, as well as a survival tactic to counter the autonomic nervous system shutdown. However, what I call the "third strand" also provided me with an unexpected gift—an embodied understanding and acceptance of myself as a human being whose feelings and thoughts are not separate from the whole, but are part of an interdependent system bound by time and space.

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[337] Henry David Thoreau, *Three Complete Books: The Maine Woods, Walden, Cape Cod* (New York: Gramercy Books, 1993).

I experienced the sudden disconnect from all digital life (including my partner) like any loss, as grief. My sense of self was left unanchored and shaken by a lack of narcissistic supply. My former numbed, hyper-other-directed biological self was in shock. I was left feeling rudderless for days without technology, no clear sense of purpose, thoughts and feelings—no identity. Then out of the haze, and uncertainty, emerged an onslaught of unpredictable emotions associated with withdrawal from any addictive drug that suppresses unwanted memories and emotions—anger, rage, sadness et al. As Silvan Tomkins observed, "affect breaks down the cognitive sedimentation holding our spirits hostage,"[338] and brings forth conscious awareness.

But I was neither ready to listen, nor open to feel bare reality. To replace technology, I began to run daily, do yoga and go for long walks on the beach. I thought kinesthetic engagement would help me work through the uncomfortable well of emotion, but movement disconnected from conscious awareness is another way of avoiding unprocessed pain. As a former gymnast, I had always viewed my body as a disciplined machine that quietly runs in the background. It was something to manage, control and master in order to perform with perfection, not to fully inhabit. Because of such practiced management, I ignored the signs that my body was running on fumes until the engine finally ceased. I was overcome with exhaustion: I went down to 98 pounds, was unable to eat or sleep, could not concentrate, or write coherently. An onslaught of rashes attacked my face and body, and I could not get out of bed or refrain from sobbing. One night, I felt my heart suddenly stop, and a voice inside my head said, "I am not sure if you're going to make it." The next morning, as if guided by an innate intelligence, I made an appointment with an acupuncturist. I had never been to one before, but I somehow sensed my life force was stagnant and this approach alone would magically re-stimulate my peripheral nervous system. It was the beginning of a transformative journey to restore my mental and physical well-being by bringing my mind and body back together in stillness.

During my first visit to the acupuncturist, he examined my tongue, and the pulse in my wrists. From these two simple measures, he discerned that though my Chi was present, it was almost imperceptible, existing in all the wrong places. My yellowed tongue indicated that blockages in my spleen, gall bladder and liver were causing the

[338] Silvan Tomkins, *Affect Imagery Consciousness* (New York: Springer Publishing Company, 2008).

imbalance. After a first attempt to redirect my Chi, he sent me on my way with some herbal sleeping pills, and instructions not to exercise. For a few days, I felt like a former self that I had not sensed since my twenties, more spontaneous and less rigid. It was as if the constant unconscious muscular tension that I had born much of my life had released, and as if a protective social armor fell away.

Like an alternate reality game, one breadcrumb mysteriously led to the next, allowing me to connect the dots between the various systems that govern the complex interrelationship between our body, mind and emotions. Through subsequent encounters with the acupuncturist conjoined with the patient teachings of a yoga and meditation teacher, an integrative medicine doctor, and a cognitive behavioral therapist, I was brought closer to a personal understanding of the theoretical assumptions underpinning my creative research: re-scripting, calming, the nervous system can heal the body-mind.

Since I was advised to stop running for a time, I decided to check out a yin yoga class, a style previously unknown to me. Yin yoga is considered a restorative practice. It focuses on cleansing the five organ pairings through particular postures that stimulate sixteen meridians. In Chinese psychology, each organ relates to a particular emotion. The day I attended the class, the organ pairing for the month was the liver and gall bladder, which were the very same organs the acupuncturist had identified as imbalanced, and depleted in my system. The liver aligns with the emotional expression of anger and frustration. Waves of emotions swept through me the entire class. I could not contain the tears.

Perhaps sensing my pain, the teacher invited me to a meditation session the following day. I decided to attend. After the session, a participant shared that she had recently been diagnosed with thyroid cancer. Her symptoms sounded astonishingly similar to what I had experienced during the past six months. I pressed her for more details, and asked if she could recommend a doctor in the area. The following week I had an appointment at the Southern Maine Integrated Medicine center where I was sent for an ultrasound, and a dozen blood tests. The results revealed, that I, too, had a lump on my right thyroid, and blood results confirmed that it was hyperthyroidism. In addition, my adrenal glands were severely burned out, and I had an auto-immune disorder caused by food allergies, along with hypoglycemia and a double red blood cell count. All of the

issues were stress induced, and tied to the endocrine system, which regulates metabolism, and emotions. The doctor explained that the adrenal glands function as a buffer for cortisol spiking. When our sympathetic nervous system is set to a constant stress-induced state of fight or flight, the adrenals cannot perform their function properly, causing the three neurotransmitters activated by cortisol—serotonin, dopamine and norepinephrine—to become unregulated, thereby causing bipolar-like features, which in my case, presented as a depressive episode. Interestingly, the treatment was the same as the acupuncturist. Conserve energy, and reduce stress. Conjunctively, herbal supplements which adjusted my metabolic system, vitamins which boosted my immune system, and a change in diet intended to reduce inflammation, worked to restore my levels back to normal range within eight weeks.

Coincidentally, my yoga teacher invited me to participate in a Mindfulness-Based Stress Reduction (MBSR) workshop. MBSR is an eight-week program designed by Jon Kabat-Zinn. Participants in the program typically meet for two to three hours a week in a group setting. Mindfulness training, which involves cultivating our capacity for being aware in the present moment with a compassionate and non-judgmental stance, includes body scanning, yoga, and sitting meditation. Daily exercises are also incorporated during non-class time, which seek to bring mindfulness and the principles into everyday activities.

During this weekly practice, I discovered that I had been breathing incorrectly. Under stress, muscle tension constrains our breathing, which disallows us from taking a longer breath with our full abdominal region. When breath is inhibited, we become cut off from our internal emotional experiences, what we feel, and the increased reliance on chest breathing to supply the body's oxygen requirements produces chronic muscle tension in the chest and abdomen. As a result, we put more pressure on our heart, which increases cardiopulmonary stress, blood sugar and lactate levels—and important to this study, our perception of pain. This decrease of oxygen to the heart serves to block the transfer of oxygen from hemoglobin to tissues, leading to fatigue. The strain on the nervous system is equally detrimental, since breath also supports the health of body tissue and metabolic function. Therefore, disturbed breathing alone can perpetuate a state of

sympathetic nervous system arousal, causing anxiety, panic and fear reactions that cause cortisol to release, which eventually wears down the adrenal glands.

The doctor informed me that when one grows up in a volatile, unpredictable home environment, or has a traumatic experience resulting in PTSD, like I did, even as an adult, our cortisol levels tend to be typically higher, and breathing continues to be more quick and shallow because constant muscle tension results from the muscle-clenching state of self-protection. He directed me to a few studies, which confirmed that prolonged exposure to stress increases the risk of mental and physical illnesses, because heightened cortisol levels lead to dysynchronization of the Hypothalamus-Pituitary-Adrenal (HPA) axis, causing imbalances in stress hormone levels, as well as structural and functional changes to the brain. Chronically high glucocorticoid levels damage and destroy neurons in the region of the hypothalamus, an area responsible for regulating corticotropin-releasing hormone (CRH) release—a peptide and neurotransmitter. This rise causes erratic or insufficient HPA axis activation, which often leads to various mood disorders.[339]

The amygdala also plays a crucial role during stress response. It detects stressful and threatening stimuli and initiates adaptive coping responses. The brain area of individuals exposed to chronic stress, therefore, is often enlarged; various fMRI studies show consistent increases in dendritic length and aborization within the basolateral complex of the amygdala (Vyas et al., 2002-3). Such maladaptive activation in the amygdala, which reveals a decrease of the gray matter density, has been correlated with anxiety (Stein et al, 2007), post-traumatic stress disorder (Rauch et al, 2000, Shin et al, 2004-5), social phobia (Birbaumer et al, 1998, Evans 2008), depression (Drevets et al 1992; Abercrombie et al, 1998, Sheline et al, 2001; Siegle et al 2002; Dougherty et al, 2004), and impulsive aggression (Coccaro et al, 2007).

Throughout the MBSR program, the teacher shared numerous articles espousing the positive psychological and physiological benefits of meditation, and yoga. I was particularly interested in two clinical studies performed at Massachusetts General

[339] The most relevant studies I encountered: Amanda R Tarullo and Megan R. Gunnar, "Child maltreatment and the developing HPA axis.," *Hormones and Behavior* 50 (2006): 632-639. Daniela Kaufer, and Sundari Chetty and Aaron Freidman, "Stress and glucocorticoids promote oligodendrogenisis in the adult hippocampus," *Molecular Psychiatry* 19 (2014): 1275-1283.

Hospital. The studies examined the same two regions of the brain—the amygdala and hippocampus—that the neurobiological research on technology, and stress focused upon. Both studies used pre and post neuroimaging to show the increased activation of select brain regions as a result of mindfulness training.

The first study (employing voxel-based morphomgery) confirmed, "there were increases in gray matter concentration in the left hippocampus"[340] in the MBSR group compared to the control group. The hippocampus has been identified as the brain area that controls cortical arousal and responsiveness (Newberg and Iverson, 2003) as well as the regulation of emotion (Concoran and Maren, 2001). A full brain analysis also revealed changes to unexpected areas, including an increase in the posterior cingulate cortex, the temporo-parietal junction, and the cerebellum, the same areas the virtual reality research had highlighted. But unfortunately, the insula was not altered, the region known for interoceptive/visceral awareness (Critchley et al, 2004) and empathic responses (Singer et al., 2004). Britta K. Holzel et al concluded, "the results suggest that participation in MBSR is associated with changes in gray matter concentration in brain regions involved in learning and memory processes, emotion regulation, self-referential processing, and perspective taking."[341] These are all vital skills for fostering social-emotional competence.

The second study focused on stress reduction, and the structural changes to the amygdala. It was the first attempt to conduct a longitudinal MRI study in humans to investigate the correlation between changes in perceived stress and effects upon the size of amygdala gray matter density as a result of participating in a stress-reduction program. The results of the study confirmed that there is an association between changes in stress levels and structural changes in the right, but not in the left amygdala. The right automatically responds quickly to incoming stimuli, whereas the left serves a slower, more evaluative purpose. MBSR, therefore, alters participants' initial reaction to stimuli; one learns to be less reactive and attached to storylines, even amidst "present shock" which requires hyper-pattern-recognition processing to keep up with the increasing information fragmentation. While the researchers were not successful in capturing gray

[340] Britta K. Holzel et al., "Mindfulness practice leads to increases in regional brain gray matter density," in *Psychiatry Research: Neuroimaging* 191(1) (2011): 36-43.
[341] Ibid.

matter changes, they, nonetheless, believed the results were promising, and surmised that "ameliorating the subjective experience of stress through behavioral intervention may actually decrease amygdala gray matter density in humans."[342] Thus, active re-learning of emotional responses to stress (through immersive art experiences, even) can lead to beneficial changes in neural structure and overall well-being even when there is no change in person's external environment.

Interestingly, these are the exact two regions of the brain, which intelligent technology inversely impacts, as indicated by the structural changes to gray matter volume determined by Yuan et al in Chapter 2. This led me to investigate whether anyone had conducted longitudinal MRI studies on the rise of cortisol levels and their relationship to the Internet and mobile use. At first, I came up short. I was only able to find a pre-Internet book from the 1980s on the physiological implications of "techno-stress,"[343] and two more current, but polarized sociological inquiries. A doctoral student from the University of Gothenburg Sweden, Sara Thomee, examined how intensive mobile phone and computer use affects young people's stress levels and sleep, leading to depressive disorders. The longitudinal study targeted 4,100 20-24 year olds, and relied solely on a qualitative and quantitative questionnaire. Based on the data, her analysis asserted that the constant accessibility and "intensive use of ICT can have an impact on mental health among young adults"[344] due to heightened stress tied to altered biorhythms and fatigue. However, a more recent Pew study, which focused less on platforms and more on social media applications, claims that for women, stress was reduced through their online participation.[345] Neither study employed neuro-imaging or looked specifically at the neurobiological implications, relying instead upon an outdated "perceived stress scale" measurement tool. My hunch, based on my own compromised health and a serendipitous encounter with Candace Pert's interdisciplinary,

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[342] Britta K. Holzel et al., "Stress reduction correlates with structural changes in the amygdala," *Social Cognitive and Affective Neuroscience Journal* (2009): nsp034.
[343] Michelle Weil, PhD and Larry Rosen, PhD coined the term technostress in their book of the same name. Technostres refers to not only our physiological response to technology, but also our perception of technology as an added stress in our daily lives.
[344] Sara Thomee, "ICT use and mental health in young adults. Effects of computer and mobile phone use on stress, sleep disturbances, and symptoms of depression" (Ph.D. diss, University of Gothenburg, Sweden, 2012).
[345] Keith Hampton et al., "Social Media and the Cost of Caring," *Pew Research Center*, Internet, Science and Tech Report, January 15, 2015, accessed January 15, 2015, http://www.pewinternet.org/2015/01/15/social-media-and-stress/.

psychoneuroimmunology research[346] is that there is likely a neuropeptide receptor for cortisol, which functions much like the endorphin receptor, as a messenger signaling behavior between the endocrine, immune, nervous system and the brain. Thus, constant cognitive strain induced by intelligent technology would over-activate the sympathetic nervous system, releasing cortisol sent as a message through a string of amino acids—neuropeptides—to my immune and endocrine system—causing them to collapse.

Finally, I found a few promising neurobiological studies that confirmed my hunch. Riedl et al conducted a lab experiment to examine cortisol levels of end users. They saw significant increase of cortisol as a consequence of system breakdown in a human-computer interaction task. Using biometric data—Silicon-controlled rectifier (SCR), blood pressure and eye movement—combined with human resource files, Maier et al explored the physiological and psychological strain of human-computer interactions, and how these stressors influenced the physiological and psychological behavior of the end users. While the relationship between psychological (PSS) and physiological (PSI) strain remain unclear, the researchers aptly acknowledge, "future research investigating human-machine interactions should consider the neurobiological perspective as a valuable complement to traditional concepts."[347]

What I found most compelling was that the frustration with the computer resulted in similar behavioral response and cortisol spiking that an autistic child experiences when attempting a communication task with a human being. My sense is that if our behavior is more closely aligning with our computers, and our physiological health indicates heightened cortisol levels, large numbers of society are suffering, like me, from adrenal burn out, and other stress-related health conditions, which increase our risk for heart-failure and cancer.

As my physical and mental health began to improve following my withdrawal from technology, and participation in the MBSR program, I wondered if the epigenetic structure of my brain had changed. Although I did not have the foresight to conduct a pre and post scan of my brain, the discernible changes to my metabolic system—deeper

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[346] Candice Pert, *Molecules of Emotion: The Science Behind Mind-Body Medicine* (New York: Simon & Schuster), 1999.

[347] René Riedl, "Technostress from a Neurobiological Perspective - System Breakdown Increases the Stress Hormone Cortisol in Computer Users," *Business & Information Systems Engineering*: 4(2) (2012): 61-69.

breathing, slower heart rate, more equanimity, reduced inflammation and improved psychological well-being—support the veracity of the clinical studies above. In only eight weeks, my body and mind began to heal through a combination of practices: acupuncture, mediation, yoga, in person social interaction unmediated by a screen, therapy, contact with nature and a change in lifestyle. Medical test results began to indicate normal levels and functioning of cortisol, adrenal, blood count and thyroid. In addition, I noticed that my emotion-feeling cycle had balanced and the brain fog evaporated, enabling knowledge-schemas to once again form, enabling a more satisfying writing experience.

Through direct experience, I was beginning to apprehend the complex interrelationship between our physiological, psychological and emotional states. I personally witnessed how the same brain regions affected by what I perceive to be slow violence wrought by intelligent technology—the amygdala and hippocampus—were restored through mindfulness, yoga and play. Even without an fMRI to scan the gray matter of my pre-frontal cortex, I chart the felt symptoms associated with chronic neurological dysfunction described in the various studies I came across: interrupted memory consolidation processes, eroded knowledge schemas and emotion-feeling cycles, an imbalance in emotion activation and regulation, a decrease in social-emotional competence, and the ability to read social cues, a result of less face-to-face time, and neurons suffering from cognitive dissonance during telematic intimacy.

I can also chart the felt symptoms of the opposite—homeostasis—as a result of meditation and yoga, genuine human connection and an immersion with nature. Bringing conscious awareness to abdominal breathing, compassion, kinesthetic engagement and social interaction strengthens memory consolidation, increases social emotional competence—emotion regulation, empathy—all requiring slower processing, inspires a greater sense of embodied subjectivity, and psychological well-being. In short, my return to my own body, emotions and the senses enabled me to recuperate my biological self, to stabilize my nervous system and to restore critical feeling—to re-become human.

6. Case Study – [radical] signs of life

"Artists are people driven by the tension between the desire to communicate and the desire to hide."[348]
D.W. Winnicott

6.1. Overview

I view art practice as both a creative process and an object of experience, which embodies situated knowledge revealed and articulated by means of experimentation and interpretation. Following Ronald Jones who suggests that the purpose of experience design is to "persuade, stimulate, inform, envision, entertain, and forecast events, influencing meaning and modifying behavior,"[349] I see my role as an experience designer as someone who invents and organically shapes novel immersive, multi-modal experiences for interactive participants. I do so through the integration of concepts, methods and theories from diverse disciplines articulated across multiple genres and platforms with the intent of transforming perception—reality[350]—from moment to moment.

This chapter and the following chapter use a case study format to explore two wildly diverse multi-media experiences, which demonstrate *ludic performance*. I will examine works both past (*[radical] signs of life*) and pending (*Beware of the Dandelions*), as instances of this aesthetic phenomenon. Both comment upon and seek to disrupt what I see as the resurgent rhetoric of the Cybernetic Renaissance; the former does so through what Theodore Adorno calls autonomous art, and latter through a more committed approach.[351] Using a case study format as a methodology to examine and document my practice enables me to show how experience design itself is a mode of inquiry.[352] Case studies typically combine descriptive, exploratory and explanatory

[348] D.W. Winicott, *Playing with Reality* (New York: Routledge, 2005).
[349] "Ronald Jones- Experience Design Group," accessed December 22, 2014, http://www.Konstfack2008.se.
[350] Fortun and Bernstein, 32. In Muddling Through: Pursuing Science and Truths in the 21st Century, they recast reality as realitty to denote that it is "neither discovered or constructed, but instead...pursued and performed." Thus, generative in nature, not sedimented in form.
[351] For Adorno autonomous art is art for arts sake, whereas committed art is created with the conscious intent to persuade for social or political reasons.
[352] Experience Design (XD) "is the practice of designing products, processes, services, events, and environments with a focus placed on the quality of the user experience and culturally relevant solutions. An emerging discipline, it draws from many disciplines including cognitive psychology and perceptual psychology, linguistics, cognitive science, architecture, and environmental design, haptics, hazard analysis, product design, theatre, information design, information architecture, ethnography, brand strategy, interaction design, service design, storytelling, heuristics,

analyses of a subject or project to create a holistic framework for making sense of underlying principles. For the purpose of my research, these two studies will, additionally, define characteristics of what I perceive as an emerging genre—*ludic performance*.

I have chosen a four-part structure for each case. The first part (inspiration) offers a brief overview of the main conceptual idea and themes at play. The second (ideation) explores the core experience design features of each work to provide context for thematic considerations. The third (implementation) details the design process and technical specifications needed to realize each work. Finally, the fourth (insight) uses interviews with performers, surveys solicited from audience members and a personal reassessment of my original intent for producing the work to better understand the embodied learning and/or social change outcomes of each work. The collected data comes from phenomenological, empirical and ethnographic inquiry into the experience design process of each work.

Chapter 7 specifically applies the insights derived from the distinctive "thought experiment," *[radical]*, to inform a more thorough exploration of the defining characteristics of *ludic performance* shared by both works. Integrating insights and exploration, I will then apply what has been learned from the creation of *[radical]* to a more committed art piece. There, I conduct a socio-cultural analysis of the potential for art to create frameworks within which alternate more human-centric technological paradigms can be envisioned. There, I will aim to formulate a new theory for social change through a close discussion of *Beware of the Dandelions*, an immersive theatre performance that attempts to teach social justice building through complex science. Based on a set of assumptions derived from using my creative practice as a microcosmic sandbox for the investigation of "social situations."[353] I offer what Jack Burnham in another context refers to as a "psychic dress rehearsal"[354] for the future.

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technical communication, and design thinking." "Experience Design," *Wikipedia*, accessed December 22, 2014, https://en.m.wikipedia.org/wiki/Experience_design.

[353] In "On the Social Situation of Music," Adorno delineates between social functions and social situations. Social functions "serve the immediate needs of a society," whereas social situations possess a "genuine social-polemic impact" and look towards to the future while influencing the present. Theodor W. Adorno, Richard D. Leppert and Susan H. Gillespie, *Essays on Music* (Berkley: University of California Press, 2012), 425.

[354] Jack Burnham, *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century* (New York: George Braziller, 1968).

6.2 [radical] signs of life

Situated within a rich 60-year history of biosignal appropriation for performance, *[radical] signs of life*, is one of the first large-scale game-based experiences to use wearable biotechnology to integrate networked bodies and interactive dance. Through responsive dance, the work attempts to externalize the mind's non-hierarchical distribution of thought and its relationship to other biomimetic structuring principles. Music is generated from the dancers' muscles and blood flow via biophysical sensors that capture sound waves from the performers' bodies. This data triggers generative, neurobiological algorithms to be projected onto multiple screens as 3D imagery. As the audience interacts with the images produced, they enter into a dialogue with the dancers. Conceptually, the piece is an embodied examination of self-organizing systems and the increasing disparity between bio-data and bio-memory. The work reveals a dangerous legacy of cybernetics and awakens an urgent need for inserting the body, affect and the senses into the design of technology before technology further embeds itself into us.

6.2.1. Inspiration

During a month-long residency at Vermont Studio Center during the winter of 2013, I made use of the time and space to work on two projects. On the one hand, I drafted my original dissertation proposal examining why there was a need to foster social emotional competence in 3-7 year olds and how to do so through kinesthetic play and biophysical feedback. On the other hand, I conceptualized *[radical]*. Only later did I discover that the questions I was posing and the issues I was attempting to address in my theoretical research unconsciously found their way into the creative work. Specifically, my theoretical research was examining the impacts of contemporary cybernetic rhetoric on socio-cultural behavior, the neurobiological ramifications of intelligent technology on the construction of memory consolidation, and how the truncation of this process was dissolving key regions in the brain responsible for knowledge-schema production and emotion-feeling activation and regulation—the amygdala and hippocampus. Through game design informed by theories of embodied cognition, I sought to re-stimulate the peripheral nervous system in order to re-activate these particular brain areas. My hypothesis was that if humans are provided a cognitive niche construction, an iterative

play space in which physical structures transform problem spaces to enhance thinking and reasoning, one in the form of an immersive, embodied virtual environment, where gesture plays an integral role, the tendency would be to shift or reduce aspects of the overall neural cognitive load. By displacing processing onto the extended tool, in this case, the immersive environment generated through Microsoft Kinects, the mind frees up resources for the memory task, and enables higher assembly processes, such as memory consolidation and empathy, to take place.

Thus, *[radical]* evolved into a thought experiment, and the Experimental Media and Performing Arts Center (EMPAC) became a laboratory for testing out my theoretical assumptions on live bodies in a controlled environment. The process of creating and experiencing the work allowed me to explore three interrelated questions:

1) Can we re-stimulate the peripheral nervous system through kinesthetic play, performative gesture and biophysical feedback?
2) Can the stimulation of the peripheral nervous system activate memory consolidation processes necessary for sustaining emotion-feeling cycle and knowledge-schema production?
3) Once activated, can audiences' experience of the work restore critical feeling, what I believe necessary to social change?

Because I did not have access to fMRI or EEG machines, I developed my own artistic protocols (i.e. initial conditions and game rules) and open-source biotechnologies to run experiments, hoping that through direct observation I could better understand the socio-cultural and neurobiological impacts of technology on our brain-wiring diagrams.[355] Eventually, I would come to employ not only game design but also choreography and biophysical sensors to amplify somatic data from the dancers' bodies as the base medium of articulation—sonic and visual evidence. The work, therefore, created a material instantiation of abstract concepts.

During this gestation period of *[radical]*, I had begun to take dance classes with the Ellen Sinopoli Company at the Egg in Albany. Through my body's experience I came to comprehend the transformative (and healing) potential of performative gesture upon

[355] To remind the reader, a brain-wiring diagram is the structural map of our neural connectivity in the brain, including the detailed activity of synapses and neurons at the cortical and sub-cortical level within an organism's nervous system.

our interoceptive system.[356] I learned how the body stores emotional information in our muscle memory, which in turn enables the body to shape the mind, our perceptual reality. I experienced the dislodging of painful memories through the release of muscle tension and abdominal breathing when my body explored unfamiliar movement patterns which de-sedimented the social armor protecting my ego. As a result of this embodied understanding, I reasoned that by placing biophysical sensors on my body to amplify the inaudible sounds of my own somatic system through speakers or headphones, I could externalize the vibration of internal viscera and restore homeostasis through biofeedback. Intrigued by Seth Horowitz's observation that the attention brought through listening to music creates a state of absorption strengthening memory consolidation, I ventured that careful placement of subwoofers around a black box space, might enable me to stimulate the peripheral nervous system of an audience through an immersive sculpture of densely layered sonic texture, and perhaps even catalyze a change in consciousness or behavior. Next, combining biophysical feedback with unstructured movement, and play, the experience might offer a simulated condition for reclaiming a more direct connection to the self—to the live body, emotions and senses—and thereby restore critical feeling.[357] As Stephen Copes contends "our false self is typically shaped in an environment that inhibits an authentic self to be as it is moves away from a visceral, grounded, kinesthetic base to an abstracted idealized base."[358] He continues to argue that while the false self initially emerges as a coping mechanism, it eventually becomes a liability because as Copes explains "it requires us to shutdown our connection with the direct feedback of our bodies, or biocomputers, and hampers a person's ability to take in information about reality."[359] Through conditioned resistance, we lose touch not only with ourselves, but also with one another and the environment, and therefore, our "capacity to feel the 'realness' of ourselves and the world is gravely impaired."[360]

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[356] Interoception consists of the "material me" and entails visceral sensations that relate to how we perceive feelings from our body. These feelings determine our mood, sense of well-being and emotions. The visceral information stemming from the interoceptive system are comprised of small fibers considered to be an "afferent limb of the autonomic nervous system," which run along neuronal pathways to higher centers of the brain, specifically the insular cortex.

[357] Critical feeling emerges when memory consolidation is properly functioning, enabling both emotion-feeling cycle and knowledge-schema production to occur. I contend that critical feeling is a requirement of large-scale social change.

[358] Stephen Copes, *Yoga The Quest for the True Self* (New York; Bantam Books, 2000), 96. In yoga, the false self is perceived to be a "defense against energy."

[359] Ibid.

[360] Ibid, 97.

Intelligent technology, as I have argued in Chapter 2, is a form of slow violence which I believe reinforces a false self, disconnects us from kinesthetic engagement with life, and pushes us further into the disembodied, virtual at-a-distance realm as we enter the sixth wave of innovation. In this wave of post-biological technocracy, I have observed four main cultural trends beginning to surface in the mainstream, reminiscent of the cybernetic emphasis upon absence, hyper-real, pattern and information (as seen in FIG. 38 towards the end of this chapter).

1) Utopia of Cognitive Efficiency – the increased emphasis upon hyper-computationality and quantification at the expense of bodily engagement and affective attunement with the world.

3) Over-reliance upon Intelligent Technology – the rise of cognitive and affective co-optation through self-tracking masked as self-knowledge and self-managed and community monitored identities; limited expression achieved through the social norming of narcissism.

2) Reduction of Material Culture – the mainstream fascination with ocular-centric, mixed/augmented reality 3D reproduction of real world for engagement in the virtual world.

4) Diffusion of Gamification Strategies across Sectors – the pervasive invasion of game mechanics into everyday activities, which forces people to play, indiscriminately places rewards on things, leaves no choice when confronted with a system for utilitarian measurement, and allows the system to essentially play the individual.

For me, *[radical]* served as a space of productive tension—a quiet backlash—a vehicle through which to expose, contest, and ultimately transform these observed trends. The work became an opportunity to ask: *how can I harness bio-adaptive, data-driven, game-based experiences and future emerging technology to instead "re-stimulate" what I assert as the numbed biological self?* By externalizing the subtle body, by reconnecting the dancers and audience with themselves and one another, I sought to bring participants, even if temporarily, to a state of presence, mutation, randomness and materiality.

Like the new media artists of the 1990s surveyed in Chapter 4, I appropriated the very technologies and strategies I was critiquing in an attempt to instigate a state of

"positive disintegration" in the audience with the intent to induce the "shudder"—the liquidation of the I—required for breaking down the ego.[361] I desired the audiences' internal experience arc to travel from stimulus confusion to positive disintegration and to end in presence of being—a place of absorption where one is not grasping for meaning through pattern-recognition, but viscerally embodying the experience—raw energy and matter—beyond the self. I believed that designing a viscerally immersive experience could somehow uproot the underlying mechanisms driving the cybernetic impulse towards prediction, control and quantification. I wanted to instead suspend the audience in a balance of clear seeing and calm abiding[362] in the hopes of transmuting what I perceived to be fear-based separation caused by our unhealthy dependence upon intelligent technology into an awareness of love-oriented interdependence. In essence, my intent was to re-script, to quiet, the audiences' nervous system to neutralize techno-stress and to rebalance the ecological assembly process, thereby creating an optimal environment for system consolidation.

To create this experience, I needed to orchestrate internal conflict. The work, therefore, layers in a few key themes or areas of concern resulting from our imbalanced dependence upon current intelligent technologies. Within each theme a productive tension is established through performing an alternative framework, which embodies principles from complex science. The areas of concern, discussed in the previous chapters, are: the cultural and neurobiological effects of intelligent technology, the rejection of the body, regulation of emotion and canalization of the senses, the emptying out of our cognitive and affective faculties and the loss of human connection, passional engagement, with one another and our environment. In setting up these tensions, *[radical]* aimed to move beyond fixed false binaries toward dynamic contingencies that coexist, albeit steeped in contradictions.

[361] Not too dissimilar from Teitelbaun's intent for Spacecraft (1967) referenced in Chapter 5.
[362] In yoga, the balance between clear seeing and calm abiding signifies the beginning of contemplative development, and the cultivation of a witness consciousness, which is a fundamental to the emergence of a fully alive human being.

6.2.2. Ideation

Experience Design

As an experience designer, I am concerned with how audiences embody and are changed by the interactive systems and the immersive environments I invent. I see the process as both transactive and transformative. I am an experiencer situated within the work as it and I evolve, I am the designer of the experience who shapes perceptions. My process is often both very abstract and very subjective and affective. It requires multi-dimensional thinking. Initially, I typically create a rough sketch of the experience architecture and the technical infrastructure needed to drive the audiences' journey through the work.

For *[radical]*, I decided that I wanted the audience to experience what it's like to live inside my body-mind as it interacts with the world. I often feel like an exposed nerve; I live with a hypersensitivity to sight, sound, texture, and sensation. I easily sense and internalize the moods of others. Lacking a strong filtering system, which might reduce the onslaught of information, my autonomic nervous system receptors are indiscriminately subjected to external stimuli, therefore, I am always in a constant state of fight or flight. While this attunes me to the world in a positive way, this same susceptibility sometimes creates challenges for me in what I perceive to be an increasingly affectless society. Still, this sensitivity is a gift that has drawn me to design experiences, which I create with the hope that they will heighten sensitive awareness in others.

Therefore, I established that the aim of the work would be to stimulate the nervous system to restore "critical feeling" in both the performers and in the audience. First, I created a baseline for the audience's experience. I began from a place of the numbness and disconnection to which overuse of technologies may have brought the audience members and performers. I sought to transport them from stimulus confusion to positive disintegration to presence of being—a place of complete absorption where their body, emotions and senses were fully present and alive again. *But what vehicle would facilitate this transportation?*

Because the Xth Sense (described in extensive detail below) captures sound at the moment of musculature contraction, and amplifies low frequency vibrations externally, it could facilitate the performer's connection to their deepest emotions, as J.J. Gibson

surmised and enable audience to experience another's amplified internal experience. It could be the vehicle for transportation from numbness and disconnection to critical feeling. I wondered what the Xth Sense could communicate about our emotions and the social armor used to protect the self, as conveyed through an accumulation of muscle tension. Furthermore, because dance offers the most direct conduit for inner mimicry, placing the Xth Sense on dancers became the medium through which I felt I could invoke empathy in the audience and establish a surrogate vehicle for catalyzing critical feeling. But it was also vital to connect the audience to their own bodies through free and unguided kinesthetic expression. As a result of my dance experience with the Ellen Sinopoli Company and the ensuing research prompted by those sessions, I sensed that spontaneous movement carries the capacity to soften muscle tension and strengthen abdominal breathing, which breaks down the social armor reinforcing the ego, the script in charge of maintaining homeostasis and self-preservation. Movement, therefore, holds the promise of not only retraining the mirror neurons lost during screen time but also expanding social cohesion.

What I desired to establish in the experience was the transference of emotions through sensory substitution; an audience experiences changes to the dancers viscera and internal milieu as their own via sonic vibration and embodied visual interaction. True, a one-off performance may not be able to override the "bully in the brain,"[363] but my intent was to synesthetically disrupt the senses (temporarily at least) through repetitive actions (database phrases, musical motifs, and imagery) over 60-90 minutes. To intervene in the latest techno-utopian efforts forwarded by the digital Maoists outlined in Chapter 2 to de-corporealize the body, I intended for *[radical]* to become an "enem[y] of abstract, visual and mechanical order, [by placing] a stress on synesthesia and wholeness and tactility."[364] My goal was to plant a seed without the audience's awareness; the audience may not know what shifted for a couple of days.

Each rehearsal and performance served as an "assay" to test out my original hypothesis on human specimens. I wanted the experience to have the feel of "an investigative procedure for qualitatively assessing the functional activity of a target

[363] A term Oliver Sack popularized.
[364] Marshall McLuhan, "Inside the Five Sense Sensorium," in *Empire of the Senses: The Sensual Culture Reader,* ed. David Howes (New York: Berg, 2005), 48.

entity."[365] In this case, the target entity would observe the interplay between technological constraints set up by the "protocols" of the API-like rules and spontaneous, kinesthetic engagement, both of which carry the capacity to re-scripts the dancers bodies (and by extension their nervous system) and rewires their brains. Kinesthetic engagement and play can recuperate the same areas—the hippocampus and the amygdala—in the brain that intelligent technology erodes. Both also alter the ecological assembly process, which helps foster memory consolidation. My hypothesis: we can mitigate the effects of current intelligent technology by creating the optimal environmental conditions for re-scripting, calming, the nervous system, thereby encouraging memory consolidation, which in turn rewires the brain through a combination of biomedia, performative gesture and socio-collaborative play--*ludic performance*.

Experience Architecture

Having planted thematic seeds, I next devised relational systems for communicating the flow of content. For *[radical]*, I established an open framework with rule-based design constraints that encouraged emergence and unpredictability, a direct response to the predictive coding model. The first treatment is described below:

The audience enters an open black box theatre with multiple moving screens configured around a reflecting pool, behind which five dancers perform. Each dancer wears two wireless Xth Sense (henceforth XS) sensors on their body. The XS is an open-source biophysical technology that detects and captures mechanical sound waves produced at the onset of muscular contraction. As the dancers begin to move, the corporeal sounds produced by their muscular activity are processed by the XS software in PureData (PD), then sent over Open Sound Protocol (OSC) and composed into real-time music. Data extracted from the body is also used to drive generative 3D imagery projected on the moving screens created in Processing. A motion-capture system consisting of four Microsoft Kinects rigged above enables the audience to interact with the 3D imagery through their own bodily gestures. A feedback loop is established between the dancers and the audience. Data accumulation thresholds from this exchange signals Isadora to

[365] "Assay," *Wikipedia*, accessed January 28, 2015, https://en.m.wikipedia.org/wiki/Experience_design.http://en.m.wikipedia.org/wiki/Assay.

disperse pre-rendered video loops of memory engrams embedded inside matrix-like data bodies created with the RGBD Toolkit on the back wall.

Technical Infrastructure

Once the basic architecture is in place, I then create a schematic of the technological infrastructure required to support the complex networked flows of data. *[radical]* resembled a Turing machine with numerous inputs and outputs, as explained in the following two diagrams below.

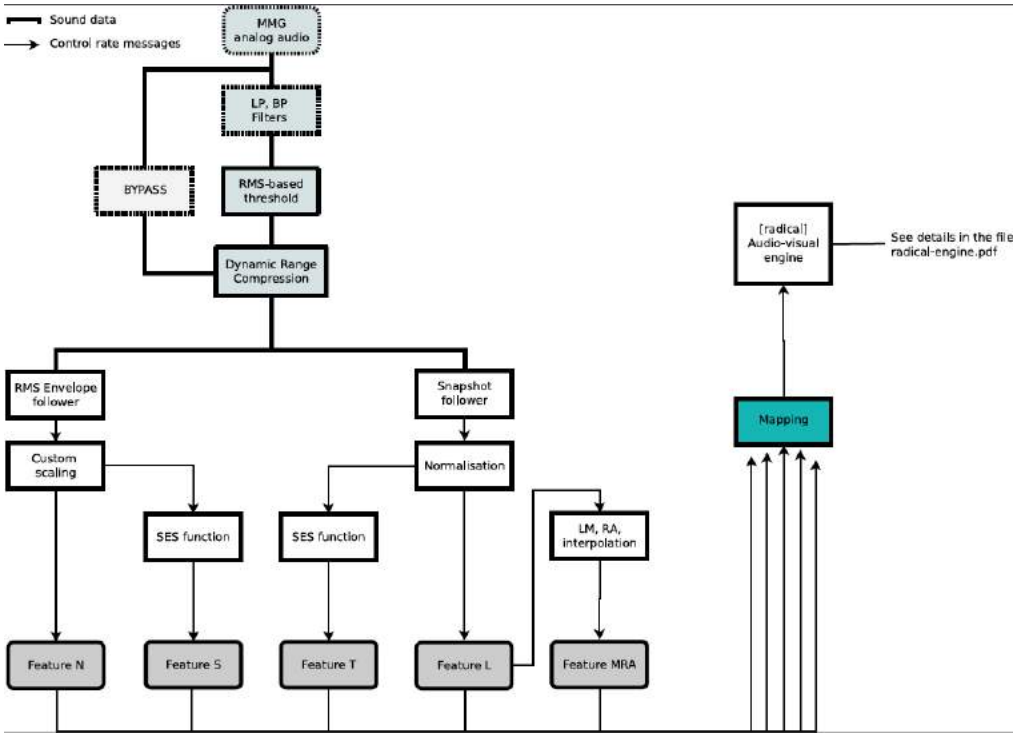

Fig. 16 - Xth Sense Schematic for [radical] integration (2013)

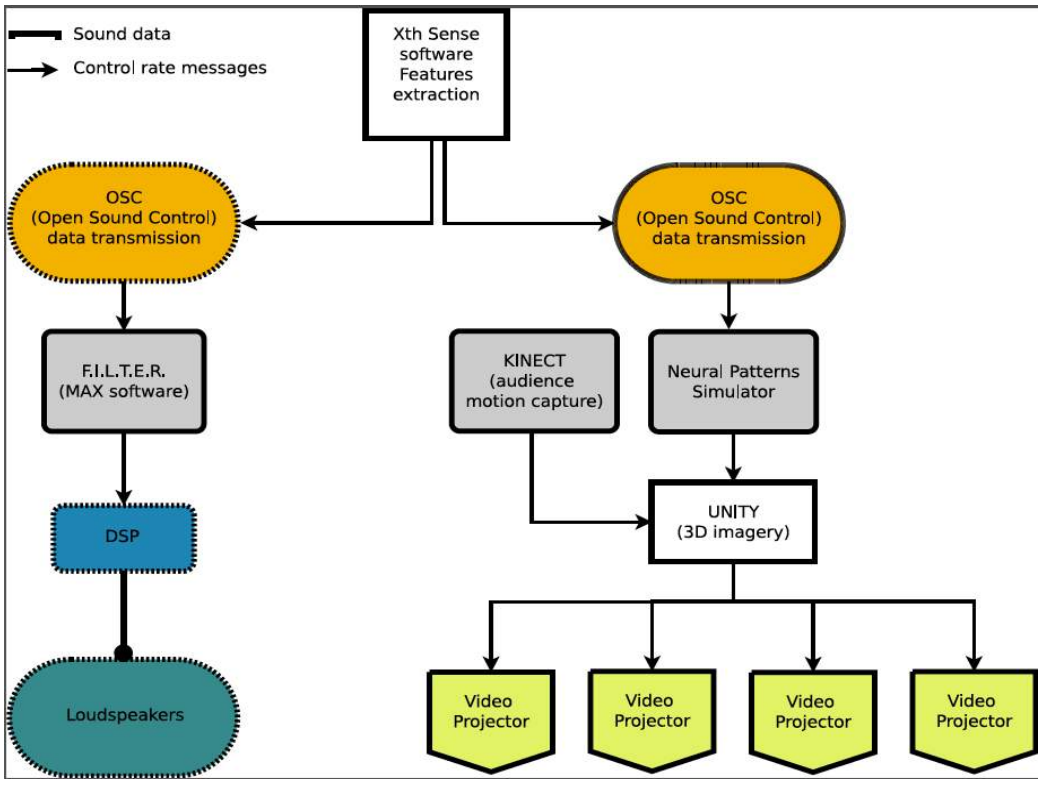

Fig. 17 - [radical] feature extraction mapping to visual and audio systems (2103)

Core Features

The core components of the complex architecture consist of a confluence of live performance and interactive media. Each feature embodies principles of self-organization, and employs algorithms to generate the aesthetic content. Together, the features function like a database; they form "relational and non-hierarchical" collaborative systems (much like the human brain) with an initial condition, which as Victoria Vesna contends, possess a "structure that persists while its content evolves and is displaced."[366] In *[radical]*, the technical infrastructure that supports the flow of data between various systems is constant, but the content activated by the dancers' bodies grows and decays. From this "field of coherence and contradiction," a dialogic space unfolds between and within each feature. Simple game-based rules determined by the architectural constraints I established for the coherence of the work served as the initial condition within each genre. Each artist's varied interpretation of these initial conditions,

[366] Victoria Vesna, *Database Aesthetics: Art in the Age of Information Overflow* (Minneapolis: University of Minnesota Press, 2007), 150.

however, enabled individual autonomy to co-exist non-hierarchically within the web of networked interdependence. As Susan Sgorbati aptly observes of communication within ensemble work: "a significant part of agency is the willingness to participate in the process of co-creation."[367] Below is a description of each feature, and how it respectively contributes to both the experience design and the self-organizing whole.

Biophysical Sensors:

Inaudible sounds generated from dancers' muscles and blood flow serve as the base material of *[radical]*. The work features the Xth Sense (XS), an open-source biophysical sensor that detects and captures mechanical sound waves produced at the onset of musculature contraction. The sensor was created by UK-based sound artist and performer, Marco Donnarumma. For *[radical],* I worked with engineer MJ Caselden, and industrial designer, Krystal Persaud from littleBits to convert Donnarumma's original schematic into a custom wireless network and stand-alone armband to enable the dancers to wear the sensor anywhere on the body to explore a wider range of sonic texture. The Xth Sense consists of both hardware and software. The wireless prototype required a transmitter (worn by the dancers) and a receiver, which patches into an external sound card, or audio interface. The audio interface then connects to the computer via firewire and feeds the data real-time into a software app run in PureData. The software does a couple of critical things. It amplifies the inaudible sounds captured by the microphone built into the transmitter, filters the noise of blood, and extracts five features from the muscle sounds to map to musical parameters. Donnarumma explains the process in more depth:

> The computer learns about the emergent physiology of my body by extracting discrete and continuous features from the MMG signal. Each sensor produces one analog signal output; this is digitalized and passed through an array of algorithmic functions designed to meaningfully shape the incoming biosignal into diverse control features, namely: Natural (N), Soft (S), Linear (L), Tanh (T) and Maximum Run-ning Average (MRA).[368]

It detects even the subtlest articulation of the fingers. One can compose patches for musical performances directly in the XS software, but for *[radical]*, we only used it to

[367] Susan Sgorbati, "Emergent Improvisation: on the nature of spontaneous composition where dance meets science," *Contact Quarterly Dance and Improvisation Journal* 38(2): 38.

[368] Marco Donnarumma, "Music for Flesh II: informing interactive music performance with viscerality of the body system" (paper presented at NIME Conference in Ann Arbor, Michigan, May 21-23, 2012)

process the data, and then sent the extracted features over OSC simultaneously to Max/MSP and Processing (as seen the diagrams above). Because the XS creates music through the body's physiological processes, and each body is unique, these sounds are both highly personalized, and improvisatory.

Fig. 18 – Wireless Xth Sense Transmitters & Receivers developed by MJ Caselden (2013)

Responsive Choreography:

Outfitted with two wireless sensors each, the dancers create patterns that dissolve from autonomous polyrhythms to intersecting lines as they slip through generative video and light. The unpredictable patterns evolve through responsive choreography, which consists of visual, auditory and environmental cues that trigger a behavioral response, a decision and an action from the dancer. The technique is similar to Susan Sgorbati's "emergent improvisation," which applies "concepts of complex system dynamics" to the "process of

composing in the moment."[369] Although the choreography for *[radical]* is also composed in real-time by five dancers, the dancers draw from a shared movement database in accordance with pre-determined rules based on computer-generated algorithms. The cues serve as game mechanics instigating the choices and trajectories determined by the dancer-player. Whereas for Sgorbati, each dancer first develops her own solo practice, which consists of a "dynamic process of exploring movement as a way to build a kinetic philosophy and technical base unique to the individual,"[370] the movement vocabulary for *[radical]* was based on the solo practice of the choreographer, Pauline Jennings, and the dyadic transference of her unique body signature (shape, gesture, rhythm)—her encoded script—to the dancers. Jennings choices, too, were constrained by both the needs of the technology, which relied on isolating and accentuating particular muscles, and the initial conditions I established through game rules. In this sense, Jennings becomes a programmer working within the protocols of a network, and the dancers, like player-characters in a game, only "responding" to the environmental conditions based on their field of view with limited animation pre-sets. But eventually, they learn how to co-create, and to lead within these constraints of the API-like software program by internalizing the language and challenging the system.

Sgorbati also plays with the tension between autonomy and control in her ensemble practice. She applies the principle of "order for free" from complexity science "to develop the skills required to embody and recognize patterns of natural living systems that arise in the present moment."[371] Cultivating these communication skills attunes dancers to the balance between chaos and openness, between integration and differentiation. For *[radical]*, however, I was more interested in "technologies of emergence;" I wanted to reveal instead how humans adapt within artificial, auto-poetic systems and become part of technological ensembles to create what Anne Munster calls an "interfolding" that traverses "the gaps between corporeality and information."[372] Reduced to cellular automata, the dancers appear affectless and "informationally closed,"

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[369] Susan Sgorbati, "Emergent Improvisation: on the nature of spontaneous composition where dance meets science," *Contact Quarterly Dance and Improvisation Journal* 38(2): 6.
[370] Ibid, 20.
[371] Ibid, 33.
[372] Anna Munster, *Materializing New Media: Embodiment in Information Aesthetics* (Lebanon, NH: Dartmouth College Press, 2006),140.

but they are nonetheless responsive to environmental stimuli based on their own internal self-organization. [373] In turn, the environment is responsive to the autonomy of their unpredictable internal milieu.

The externalization of their internal self-organization through the Xth Sense becomes their unique body signature. Stripped of cognitive and affective faculties, code translates their invisible autonomic and somatic processes. Code remaps them real-time both sonically and visually into "spectral reminder[s] of affect," of the human, under the regime of information aesthetics.

Game Design:
The dance performance evolves choreographically through three game levels based on self-organizing systems, which are also mirrored visually and sonically:

1. Conway

   In the first game level, dancers can be seen participating in an adaption of Conway's Game of Life, which dictates survival between states of loneliness and starvation. As individual movement triggers fellow dancers to move throughout the space, dancers collide within territories marked by tape. These collisions may result in the starvation of fellow dancers. The game level ends when one dancer survives.

2. Hebb

   Each dancer begins level two with an individual goal and trajectory through the space. As dancers begin to meet fellow dancers along their trajectories, unions—adaption—begin to form, much like a neural network. As these bonds strengthen, dancers begin navigating their trajectories as partners and eventually as a group. To win the level, a community of five dancers must be formed.

[373] Victoria Vesna, *Database Aesthetics: Art in the Age of Information Overflow* (Minneapolis: University of Minnesota Press, 2007), 146.

3. Markov

The dancers begin level three building upon the cohesion developed during level two, but with the challenge of not being permitted to travel outside of their level one territories. The group explores dynamics of leadership until a clear director temporarily emerges, resulting in the degradation back into the power struggles of level one.

Total run time is between 60-90 minutes, depending upon how the rules play out. The piece is different every time, based on dancer choices and the random database of phrases established at the outset of the performance. The emerging music and generative imagery also fluctuates based on movement patterns and gestures of the dancers.

The game design was a delicate balance between informatics protocols and free, unguided play. I envisioned the entire logic of the piece as an API running protocols—"a set of rules for establishing how a network operates in a range of contexts."[374] Because protocols are so adaptable, I designed simple rules based on well-known simulations that could function as initial conditions requiring no further input. These rules or conditions were then applied across the various mediums of articulation. The audience was, in a sense, trapped inside a Skinner box.

Integrating opportunities for social connection and emergent play were also fundamental to the experience. All the games I had previously designed for NGOs, cultural and educational institutions had been "zero-sum"—unwinnable. I felt constrained by the false free will built in to ensure pre-determined learning or behavior change outcomes, and this predictability only served to reinforce the cybernetic ethos of social control—even if for social good. Reducing the strength of a game to its ability to mount an argument or to teach titration, disregards other productive social affordances unique to games. Tired of balancing message with engagement, I regarded *[radical]* as an opportunity for me to experiment with creating an open-ended game that conveyed complex ideas through non-verbal formal aesthetics. Agreeing with Eric Zimmerman's

[374] Eugene Thacker, "What is Biomedia?" The John Hopkins University Press and Society for Literature and Science, *Configurations* 11.1 (2003): 47-79.

assertion in a *Manifesto for a Ludic Century* that games can be beautiful, I wanted the piece to demonstrate how "dynamic interactive systems create beauty and meaning."[375]

Understanding the embodied mind to be the most complex, interactive system, I designed simple rules that could emerge into complex, aesthetically sublime neurobiological patterns across the movement, sound and visual landscape. My intent was to have all the elements of *[radical]*—the dancers, the generative images, the improvisational music, the dynamic lighting etc.—mirror the "principles of ecological assembly," the cognitive distribution between mind, body and world whereby the embodied agent employs a variety of problem-solving resources and opportunities, consisting of dynamic loops of perceptual and motor routines, combined with neural processing and storage, active sensing, and scaffolding onto environmental affordances.

I needed to create an "assay" to observe a simulation of the brain's assembly process in an attempt to reflect the socio-cultural and neurobiological impacts of intelligent technology. Theories of grounded cognition state that simulation exists as a naturally occurring phenomenon, forming a core computation in the brain itself. For Lawrence Barsalou, simulation is the re-enactment of perceptual, sensory motor and introspective states acquired during our daily experience with the world, body and mind. As experience occurs, he contends:

> The brain captures states across the modalities and integrates them with a multi-modal representation stored in memory. Later when knowledge is needed to represent a category, multi-modal representations captured during experiences with its instances are re-activated to simulate how the brain represented perception, action and introspection associated with it.[376]

It only seemed natural to employ cellular automaton simulations as protocols for responsive choreography to reflect the self-stimulated and sustained activation of soft assembly neural saccading brought about through multi-modal social and environmental interaction. By sequentially employing Conway's Game of Life, Hebb's Law and Markov's Stochastic patterning, I intended to reveal the evolution and adaptation of non-hierarchical, self-organizing systems attributed to brain patterns (and just as easily as to human biology, animal behavior, natural environments or planetary activity). Dr. Gerald Edelman underscores that "the brain's most significant challenge is that it must operate in

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[375] Eric Zimmerman and Heather Chaplin, "Manifesto for a Ludic Century," *Kotaku*, September 9, 2013, accessed September 9, 2013, http://kotaku.com/manifestor-the-21st-century-will-be-defined-by-games-1275355204.
[376] Barsalou, Lawrence. "Grounded Cognition," *Annual Review of Psychology*, 59 (2008), 617-645.

a complex, open-ended environment teeming with novelty, unanticipated events and circumstances."[377] Therefore, I recreated the "open-ended" conditions by shaping the immersive environment to serve as a cognitive niche construction—an iterative play space for problem solving—onto which the dancers cognitively scaffold. The audience, as well as the composer-performer and the artificial intelligence creatures on the front screen make up the environmental conditions. The cues for the responsive choreography resemble the "unanticipated events" that trigger synaptic connections represented through bodily gestures, movement trajectories and social interaction. Together, the dynamic interplay between responsive choreography, the improvisational music and generative imagery catalyzed by the initial protocols powerfully communicate the neurobiological processes as an active negotiation of mind-body-environment.

In addition, the game play combined with biomedia offers an opportunity to witness how the prosthetic integration of intelligent technology hypothetically (and simultaneously) changes both our brain-wiring diagram and our socio-cultural interactions through the dancers simulation. They function as both neurons and humans. The very act of en-coding body data—translating it from one format (pureData to OSC) or material substrate to another (analogue to digital)—alters the original pattern. Once encoded, the data was re-coded—programmed into music (Max/MSP) and imagery (Processing) and then played back to be de-coded (Kinect)—by the audience, who in a way hacked it, ultimately transforming the original environmental conditions, and by extension re-wiring the neural pathways—dancer trajectories. The decoded body is then re-materialized, "re-bodied."[378] Thus, *[radical]* enables the audience to simultaneously witness human behavior and interior processes in a way that an fMRI and EEG could never show.

Improvisational Electronic Music:

Original multi-channel electroacoustic music was performed live with interactive sound instruments developed in Max/MSP by Doug Van Nort and based on the Xth Sense

[377] Susan Sgorbati, "Emergent Improvisation: on the nature of spontaneous composition where dance meets science," *Contact Quarterly Dance and Improvisation Journal* 38 (2): 41.

[378] Eugene Thacker identifies three different bodily states as the body interfolds with technology: encoding, decoding and recoding. Encoding is the process of capturing body data, decoding is transmitting, and recoding is transformation of the biological substrate by code into whatever new form it takes.

technology to surround the audience in a dense web of complex texture and emotion. I wanted the sound to reflect the organic and responsive choreography, as well as the game-based constraints set up as the initial condition for co-creation. Musical improvisation is by its very nature an emergent phenomenon; it stems from some sort of inner subjectivity and gestural engagement in a way that crosses music and movement. Because of the emergent property of the choreography, specifically the unpredictability of where and when the database of phrases would be performed, anticipating larger structures was difficult. We decided, then, that Van Nort would hone in on the phrase level to aesthetically align with the kind of phrases that Pauline Jennings was working with, and to better map to the instruments he designed the distinct kinesthetic gestures she was exploring.

I initially reached out to Van Nort after working together on a genetic algorithm composition with the students from Deep Listening, a course for which I was teaching with Pauline Oliveros. I thought that this system, which freely generates sound, and assigns fitness interactively, conceptually fed into the game-rules I was designing for the choreography. But the more I shared ideas about the back-wall and how memory engrams form, the more we began to see that the act of capturing gestures and sonically feeding them back out could be a kind of imprinting of all the dancers movements upon the performance space. This is when Van Nort realized FILTER was the way to go.

FILTER (freely improvising, learning and transforming evolutionary recombination system) is "a system that listens to sound, and understands it as a bunch of sonic gestures, a bunch of phrase level contours."[379] As an instrument, FILTER rests between sound and movement. Interfacing it with the Xth Sense, however, greatly enhanced this relationship. Van Nort re-tuned FILTER for phrases. He programmed it to remember patterned action over the course of the performance with the intent of being able to identify each dancer's motion through the medium of sound to later reconstruct it to reveal in the end an invisible cohesion that could not have been known before the performance, a cohesion which became apparent only as a product of learning these sequences. This process dovetailed nicely with the choreographic game play in level two,

[379] "Doug Van Nort," accessed November 25, 2014. http://www.dvntsea.weebly.com.

which was based on Hebb's law. When the movement stills at the end of the piece, Van Nort then improvised over the structures that FILTER captured in the first part, a variation on Markov chains, which both the choreography and the visuals also underscore in level three. More than a cognitive scaffold, artifacts of the dancers viscera—their subjectivity—are extended, and re-animated through sound.

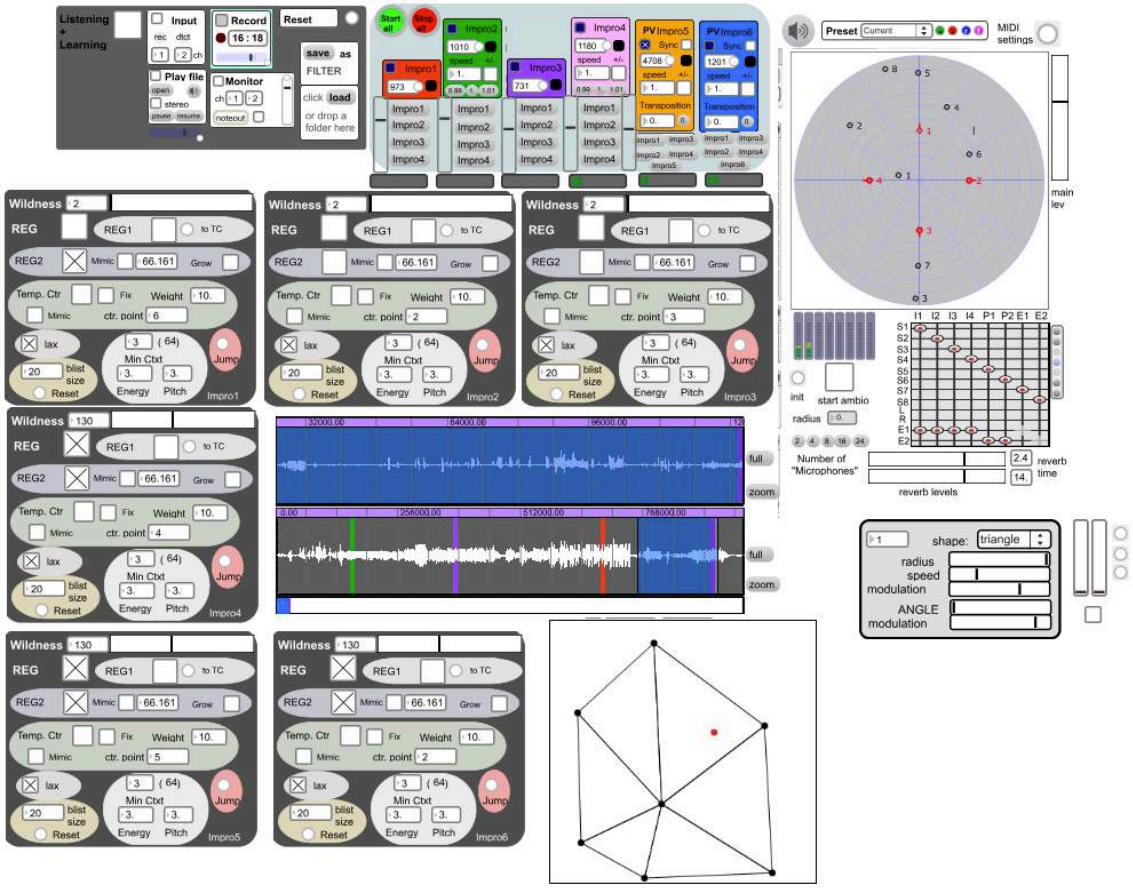

Fig. 19 – FILTER interfacing with Xth Sense designed by Doug Van Nort (2013)

In addition to FILTER, which was processing and storing sound data from the dancers' bodies, Van Nort designed another custom module in Max/MSP, GREIS, to freely improvise the ten channels of source material real-time through a searching process. GREIS (granular-feedback expanded instrument system):

> Focuses on sculpting incoming sounds through spectral and textual transformations, largely performed with hand gestures on a Wacom tablet (right hand) while modulating the sound or the nature of the control/mapping in some way (left hand). The unit of a 'grain' – which may be a

> temporal fragment, a single partial or a transient component – is dispersed to different processes and fed-back through the system.[380]

The system includes granular and spectral analysis, complex mapping techniques and generative processes that often surprise Van Nort with machine-based decisions, forcing him, like the dancers, to react in the moment. For *[radical]*, Van Nort wanted to extend this idiosyncratic system to the collective. Because it moves through different surfaces and territories of sound, and then tries to find points of resonance within source material through freezing, collapsing or expanding at certain moments, we thought it might be interesting, instead, to find resonance between the dancers' subtle tunings and to transform that resonance into a product of space. Similar to Van Nort's co-creational partnership with GREIS, the system became an extension of the dancers' practice. Mapping musical actions on the Wacom tablet—sculpting, moving, scrubbing, traversing—to a combination of structured motions, the choices which the dancers made in trajectories and autonomy of phrase interpretation, Van Nort found that there were "these nodes and points of action that the dancers would fall into that are much more salient sonically, almost like a cloud of sonic action that the dancers were falling in and out of."[381] Their bodies (as instruments) had different tunings, so they could fall into points of harmony sonically by their motions periodically coming together. Thus, "sculpting became the physical act of finding that harmony"[382] to produce sonic resonance.

[380] Ibid.
[381] Doug Van Nort, audio transcript from Skype conversation with author, November 12, 2014.
[382] Ibid.

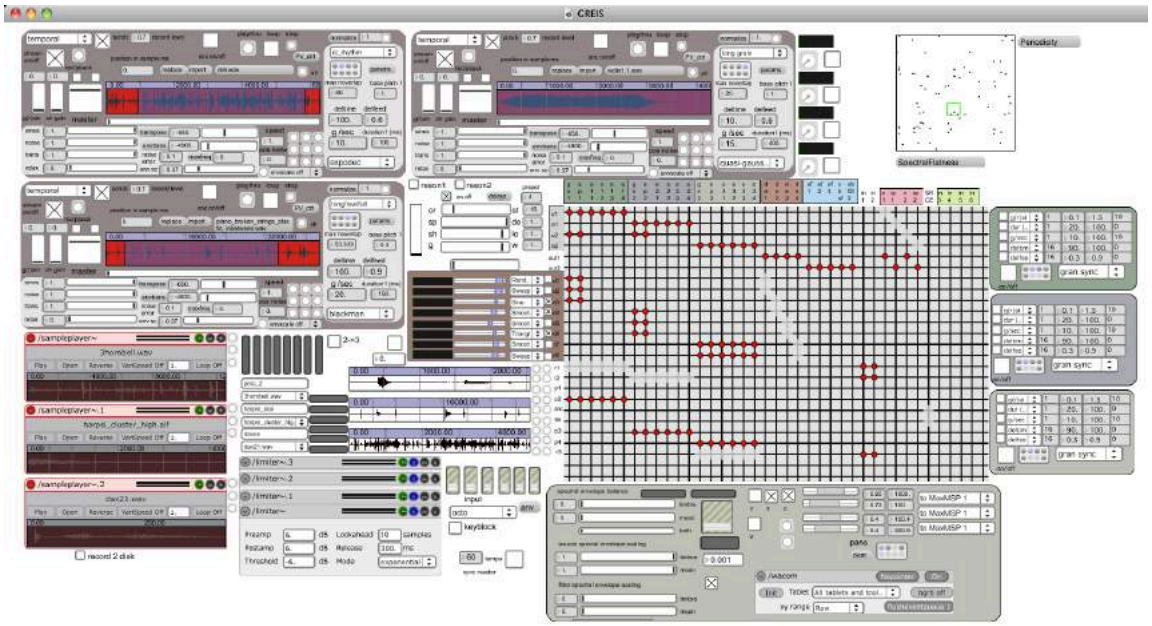

Fig. 20 – GREIS interfacing with Xth Sense designed by Doug Van Nort (2013)

Generative Imagery:

The same data extracted from the body was also used to drive two different types of generative imagery; the front moving screens signify bio-data, and the back wall simulates bio-memory. The front pulled source data to feed the initial condition coded in Processing to run the neurobiological algorithms, which projected black and white imagery of artificial microorganisms. The back responded to recursive data from FILTER to trigger memory engrams through pre-sets scrubbing in Isadora.

Generative art is typically defined by its use of an autonomous system. The system can be ordered, disordered or complex. While neither the code for the front wall nor playback from the back wall possess the ability to think and learn, they are like the choreography, "responsive" to environmental stimuli, and they employ a mixture of order and disorder. Through a combination of data mapping and golden section[383] along with stochastics and randomization, the front and back imagery contribute to a complex system to underscore the co-existence of logic and emergence, pattern and randomness. Drawing upon the theories of Christopher Langton who created computational models based on the properties of physics to identify critical points—"phase transitions"—

[383] The golden section is based on a Fibonacci sequence that defines a "divine proportion" found in humans as well as many other natural systems that is aesthetically pleasing. In mathematical terms it equates to ratio of two quantities being the same as their sum.

separating order from disorder in cellular automata, I intended the visual imagery to convey moments of threshold that transform our internal neurobiology, perception and memory, as well as our outward actions and behaviors. In addition, the juxtaposition between the front (bio-data) and back (bio-memory) walls offered a subtle critique of the "quantization" of our physical entity through emerging technology by translating the discrete packets of information sent over OSC back into a visible, though ghosted, life force. The generative imagery, therefore, needed to be open enough to reflect a host of different complex systems from cellular automata to neural networks, and the emergence of artificial life. Simultaneously, the imagery had to address my concern that our dependence upon intelligent technology to mediate both our understanding of the world and our intimate relationships was rendering our innate biological intelligence artificial.

To communicate these nested ideas, I decided to parse out and suspend the dancers' bodies simultaneously in four different representational and dimensional forms: live 3D body in the center, polygonal-memory 2D-3D body on the back wall, extended-data 3D body on the front wall and 4D sonic-affective body dispersed throughout the space. In doing so, I sought to displace the post-humanist privileging of disembodiment and abstraction to recover the "embodied features of digital media"[384] left out of N. Katherine Hayle's argument established in Chapter 2. Using biomedia as source material defuses body anxiety. It is an approach which reveres the body because it consists of both the material and the immaterial, both the biological and the informatic.[385] The suspended multiplicity and materiality of informatics rendered possible through biophysical technology supports the emergence of a "meta-body,"[386] one that highlights what Jaime del Val terms *embodied differentials*; "the irreducible and changing differences of bodies and contexts that foreground unpredictability and emergence [in an attempt] to resist social control and quantification."[387] Moreover, I was attempting to convey that the technology-mediated body encourages a further disconnection between our mind and body. I wondered: *When we are emptied of our cognitive and affective faculties as they*

[384] Eugene Thacker, "What is Biomedia?" The John Hopkins University Press and Society for Literature and Science, *Configurations* 11 (1) (2003) 47-79.
[385] For a more thorough discussion of this approach, see page 21 of Eugene Thacker's "What is Biomedia?"
[386] In the 2013 Meta-Body Conference programme, Jaime del Val defined meta-body as "emergent fields of affective and kinetic relations of incipient and relational movement, which challenge the platonic-Cartesian tradition of transcendent forms by proposing an immanent ontology of movement and becoming." From.
[387] Ibid.

are transferred onto extended devices, surrogate selves, when technology overrides our biological systems, does this ubiquitous dispersion," distributed agency," render us more powerful, or does it render us more easily controllable? Do the benefits outweigh the loss of kinesthetic engagement with the world, and one another? Or can expressive technology serve as a bridge to heighten our attunement?

Front Wall – Bio-Data

In *What Technology Wants* Kevin Kelly insists that the only choice we have in steering the inevitable march forward towards the *technium*[388] is in how "we treat our creations, where we place them, and how we train them with our values."[389] He views humans as parents guiding technological children. For the front wall, therefore, I extended Kelly's metaphor further. The projected white and black artificial agents literally spawned from the dancers viscera to take on their own life form as they responded to and were shaped by the environment—the audience. To enhance the connection, it was important that the morphing would resemble the pace of contracting muscles and breathing patterns of a fetus incubating inside a womb. Since the dancers were essentially providing life support, and giving birth to new cells through their gestural expression, the AI needed to appear as if they were feeding from each dancer's motion—their life force. When the dancer was still, the cells associated with that dancers began to disappear. Also, when the audience interacted with the growing organism-child, the artificial agent recoiled and expanded as if responding to the sensation of touch across the reflecting pool. This "interference" of the system by environmental forces altered the organisms' form and direction. Based on these themes and some illustrations I sent on mapping complex patterns of information, Raven Kwok, who created the front wall visuals, then experimented in Processing with different ways to visually represent the three evolutionary stages of self-organization as neurobiological patterning. We extracted the primary features of the rules for running Conway, Hebb and Markov simulations, and then blended them with ideas stemming from our discussions about artificial life. We talked about how to communicate their life

[388] Technium is a term Kelley coins to "designate the greater, global, massively interconnected system of technology vibrating around us; the whole system of acceleration beyond hardware, includes culture, art, social institutions, and intellectual creations, as well as software, law and philosophical concepts that drive the engine of progress forward."
[389] Kevin Kelly, *What Technology Wants* (New York: Viking, 2010), 257.

force and how to make the artificial agents feel more alive than the human forms, which the audience experienced as affectless and at–a-distance through responsive game mechanics tied to Xth Sense and Kinect data inputs. As a result, Kwok interpreted the initial constraints and underlying themes in his own unique way. He shares his approach in detail below:

> The key features of Conway's Game of Life are life, death, and motion. The most interesting one is motion because it is in fact an illusion produced by life and death, or black and white. The reason we see these animated patterns in this static grid is because the changing from black to white or vice versa through sequential cells is fast enough to cause persistence of vision. So for the first corresponding stage of my visual system, I separated the "life and death" and the "motion" into two independent "threads." The life or death of a cell (or an agent in my system) doesn't lead to the motion of the agent itself. A new agent will be born when the first parameter from related sensor reaches a certain threshold value, and its life span depends on the mapping value of that parameter. Each agent will die "naturally" according to its life span. The least life it has, the more it blends itself into the background. For the motion part, each agent has a constantly changing self-tension, giving its neighbors either a pull or push on a certain direction. Both the state and the direction are influenced by the Kinect data, which is actually provided by the audience who take part in the interaction. At that time, the final visual outcome once again reminded me of a microorganism, so I constrained all agents' revival in a circular range, making it look like an abstract culture dish.[390]

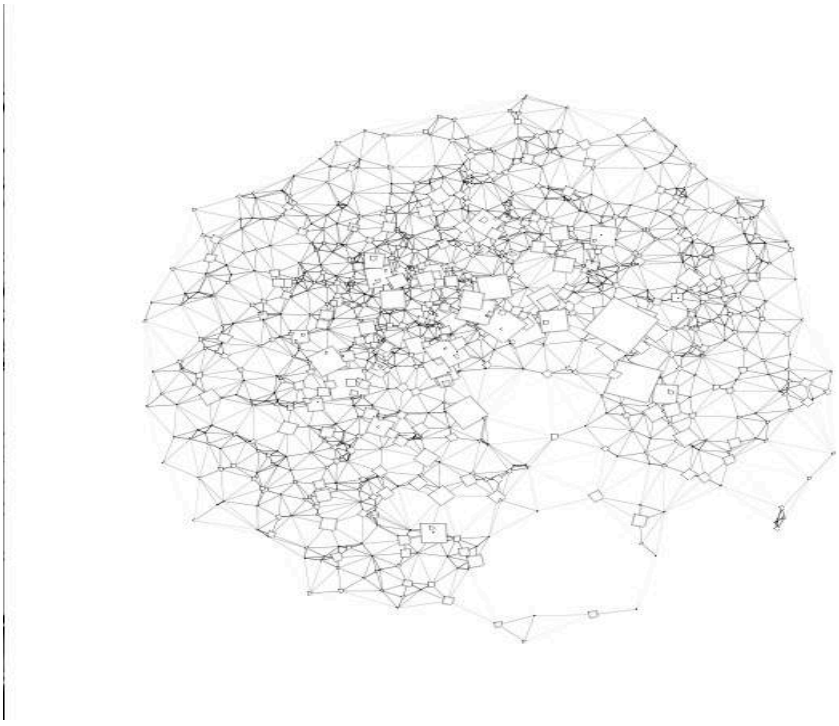

Fig. 21 – Level 2 AI creature tests replicating neural network behavior designed by Raven Kwok (2013)

[390] Raven Kwok, email message to author, April 4th, 2013.

The multiple projections of the data-generated microorganisms reflecting neurobiological processes occurring inside a petri dish (signified by the pools in front of the screens) underscored the notion of performance as a laboratory in which we were testing our assay. However, the stochastic patterning of level 3 revealed agents breaking free of the circular constraints. Diffused across all the screens, the imagery resembled genetic drift, signifying the restoration of autonomy to the agent.

Fig. 22 – Projection of Level 3 AI creatures based on Markov's Stochastic Patterning designed by Raven Kwok (2013)

Back Wall – Bio-Memory

I first envisioned memories as blurry snapshots randomly triggered by noise thresholds directly from the Xth Sense and mapped symmetrically to each gridded panel like an fMRI X-ray. But when I loaded the footage I had shot in Isadora to test the concept at EMPAC, the images—though blurry—somehow felt too exposing and disrupted the minimalist abstract aesthetics. Also, the more I investigated how memories were

imprinted, stored and re-triggered, I began to see them as a biological neural network. They were not localized in the brain. Instead, traces form in cell assemblies through engrams as biophysical or biochemical changes in both the brain and other neural tissue spread throughout the body in response to external stimuli. This made me think of connective tissue and of how trauma is embedded into the body, re-scripting our nervous system.

Fig. 23 – Sketch Up rendering of set mocked up by Allen Hahn to visualize relationship between the front & back projections (2013)

Connective tissue is the most widely distributed of all the body's tissue; it is "the tough, uninterrupted 3D network from head to foot, knitting the body together like one huge sweater, and connecting the viscera, the musculature, and the outer layer of the skin."[391] This distribution enables direct communication between the nerve cells and chemicals, which carry both emotional and physical trauma as they to travel through the body. Often memories end up far away from their point of origin. When neuromuscular patterns become chronic and unconscious they are patterned into the whole myofascial system: the original reaction—fight or flight—becomes locked into the cells as a body

[391] Stephen Copes, *Yoga The Quest for the True Self* (New York; Bantam Books, 2000), 238.

memory. Our fascia, which is originally plastic and flexible, then becomes increasingly frozen and rigid as the body-mind becomes chronically set in certain defensive postures. William Reich calls the resulting postures—social armor—unconsciously held patterns of physical contractions and defense that store memories.[392]

The Xth Sense, which captures and amplifies muscle sounds at the onset of contraction and generates music through gestural release, transforming the interoceptive system, the sounds metaphorically externalize the subjective experience of each dancer. Because the improvisational music metaphorically articulates the affective body of each dancer, I chose to use sound to trigger the memory engram in a manner that accurately reflected theories of emotion-feeling coupling that contend that memories which provoke and sustain emotions are processed as an image.[393] To mirror the firing of memory engrams from cell assembly clusters expressed through Hebb's law, I had Van Nort set thresholds in FILTER mapped to the accumulated density of sound for each dancer. Once the threshold was reached, a signal was sent over OSC to Isadora to scrub through non-linear footage of dancers generated by rigging a DSLR camera to a calibrated Kinect. Each time a cluster of dancers-neurons hit the threshold value, the first loop was overridden and projected another random loop in a different location on the back wall. As the movement in level 3 becomes more frenetic and the dancers' choices more autonomous, the figures in the background grow in both dimension and frequency. Through performative gesture memories are ostensibly released and healed.

Thus, the polygonal representation of the dancers' bodies signify both the knitting of connective tissue, as well as the imprisoning armor of the ego, armor which causes alienation and emptiness experienced as a result of our disconnection from our feelings. But hidden within the defensive armor, I imprinted the rigid connective tissue with blurry scenes of generalized memory[394] associated with shame-humiliation, as if the memories were running through their hollow bodies on a continuous loop—an intended nod to Dr.

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[392] In yoga, muscle tightness indicates affliction, painful, unintegrated experiences. Movement and breath release muscle tension, and therefore, surface memory fragments imprinted physically in the neuromuscular tissue, often causing the sudden release of emotions and unblocking energy.

[393] Following Antonio Damasio's interpretation of this process, emotion-feeling coupling is broken into an affect, which is the feeling of an emotion, and the feeling part, which is triggered by a memory, and processed in a different brain region than where the affect was triggered.

[394] People who experience trauma, PTSD, emotional or physical abuse replay memories as over-generalizations; the details are lost as a protective mechanism.

Daystrom's M-5 computer from Star Trek, which could think by impressing memory engrams on its circuits. Hence, the back wall also points to the dehumanizing nature of intelligent technology as a form of slow violence resulting from techno-stress, causing the audience to question whether the dancers are merely avatars inhabiting a physical form.

Fig. 24 – Example of polygonal bodies representing connective tissue embedded with memories shot and edited by Heidi Boisvert (2013)

Immersive Environment:

A physical, sonic and visual ecosystem, *[radical]* functioned as a quasi-cognitive niche construction for both the performers and the audience. Defined by Laland et al (2000), niche construction consists of:

> The activities, choices and metabolic processes of organisms, through which they define, choose, modify and partly create their own niches. For instance, to varying degrees, organisms choose their own habitats, mates, and resources and construct important components of their local environments such as nests, holes, burrows, paths, webs, dams, and chemical environments.[395]

[395] Andy Clark, *Supersizing the Mind: Embodiment, Action and Cognition* (New York: Oxford University Press, 2008), 61.

I repeat here for emphasis, that, by extension, a cognitive niche construction is an iterative process whereby we build physical structures that transform problem spaces in ways that aid (though sometimes) impede thinking and reasoning about some target domain. So, while the physical set was pre-determined and the technical infrastructure and rules established, the open, almost imperceptible framework, encouraged the "organisms"—the audience and the performers—to modify, scaffold onto, make choices from, and re-construct the cognitive niche construction—the dynamic systems—from moment to moment through performative actions. The sparse and natural design elements, consisting of scrim wooden panels and reflecting pools were intended to materially support and balance the self-organizing, and heavily mediated sound, visuals and movement systems. Inside the solid infrastructure of the set all the particles of energy and matter—the data-driven content—was in flux. As a result, human decision-making by dancers, composer, lighting designer and audience responding to this unstable universe were spontaneous and unpredictable. For instance, even if the dancers followed the rules, but their timing was off, causing them to misalign with a fellow dancer at a certain node on the grid, the neural connection could not form, or if a dancer missed a particular gesture (due to cognitive overload and assembly misfire), synchronization of movement could not occur. Since these motions dictated the flow of both the sound and visual palimpsests within the environment, the margin of error cascaded, resulting in cognitive overload or the misfiring of a memory engram.[396]

Like the "ecosystem of interruption" brought about by intelligent technology, the environment was intended to be one of both distraction and absorption, of observation and participation. *[radical]* enabled the audience to simultaneously observe the ramifications of our easy adaption to technology on social interaction and neurobiology, at-a-distance, as if in a lab, as well as experience a change in their nervous system through the embodiment of low frequency vibration and interaction with an object that slows the metabolic rate. The water adds to this calm. Reminiscent of McLuhan' "The Gadget Lover," I also intended the water to reveal how the dancers, like Narcissus, had adapted to the extension of themselves and become closed systems. Yet they were both

[396] This is what feed-forward residual error correction, like PCM, intends to fix.

Echo and Narcissus, in that when cued, they could pick up and mirror back only a part of a phrase. The music, too, functioned as another layer of call and response, in addition to evoking the sensation of immersion through the speaker configuration, which were designed around the space on a slow rake from the front to the back of the space. This conscious design enabled sonic gesture to be transformed into a spatial and sculptural phenomenon. See FIG. 25 below for more details.

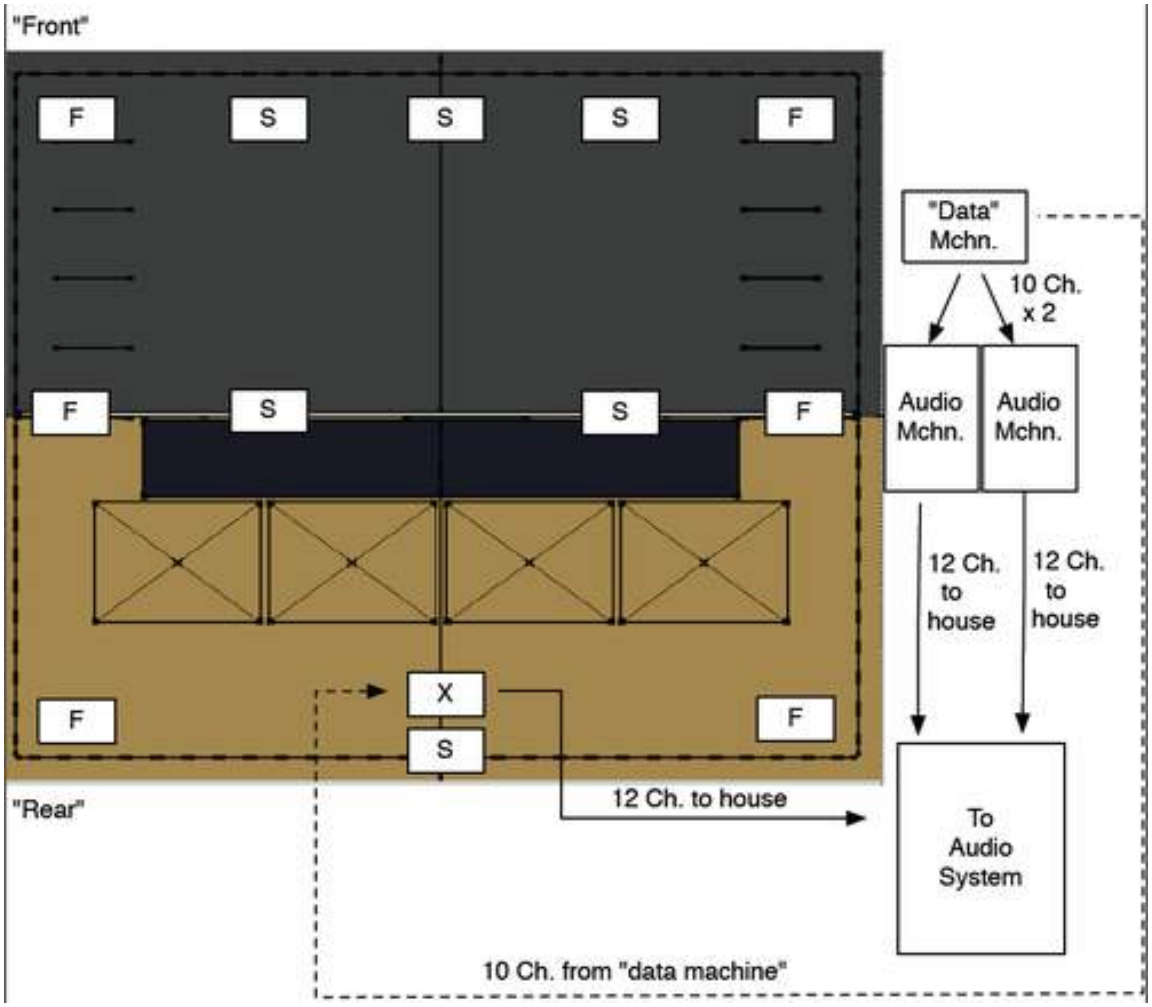

Fig. 25 – Speaker configuration mocked up by Doug Van Nort to conceptualize immersion (2013)

1. F = Full range speakers on stands. Subs in corners.
S = Smaller, but reasonably full-range speakers such as the Genelecs
X = table for musician/performer
2. The spatial layout (height) is as follows:
i. Front speakers should be lower: from knee to just-above-head height
ii. Height of speakers should increase from Front to Rear
iii. The mid/center "s" speakers need to be above scrim (8ft)
3. Routing diagram: Ch. = Channel(s) & Mchn. = Machine

[radical] also attempted to explore the behavior of improvisational dancers and their audience as a channel to imitate complex natural systems. Structural coupling between agent and environment instigates the feedback loop that sustains the dynamism of self-organizing systems. If the dancer represents the agent (human, animal, neuronal) and the audience the environment, together they form a coupled system. By introducing a screen between the agent and the environment, emergence is visually represented through non-verbal expression. In an autopoetic sense, the audience functioned as the observer, triggering reorganization of the AI creature. Reciprocally, the audience was offered a novel immersive environment onto which they could cognitively scaffold, establishing the conditions for the cultivation of empathy.

A study by Wayne Gray and V.D. Veksler on resource-recruitment shows that humans actually minimize biomemory and instead maximize the use of environmental support as extended cognitive scaffolding to reduce effort (which they calculate in time), but without any particular hierarchical distribution. Moreover, Gray et al discovered that the "degree of embodiment" is directly proportional to our reliance upon external scaffolding; the more immersive the environment (virtual, real or mixed reality), the more we offload. Gray's findings on the degree of embodiment suggest that if humans are provided a cognitive niche construction in the form of an embodied virtual simulation, where gesture plays an integral role, the tendency would be to somehow shift or reduce aspects of the overall neural cognitive load by displacing processing onto the extended tool, thus freeing up resources for the memory task, and enabling higher assembly processes, like empathy, to take place. The screen, therefore, was intended to serve as another layer of immersion reinforcing the cognitive niche construction for the audience established by the full staging, thereby creating the conditions to encourage their experience of empathy through mirror neuronal engagement causing a temporal generation of what Andy Clark describes in as “whole new agent-world circuits.” This will be further detailed in the implementation section.

6.2.3. Implementation

Process of Open Design & Development

I conceived, directed and produced the work in collaboration with an international team of artists. These included Pauline Jennings (Choreographer), Doug Van Nort (Sound Designer), Allen Hahn (Set & Lighting Designer), Raven Kwok (Visual Designer), Amy Nielson (Costume Designer) and Marco Donnarumma (Sensor Designer & Developer). The performance features 5 dancers: Jennifer Mellor, Ellen Smith Ahern, Hanna Satterlee, Avi Waring and Willow Wonder. Additionally, MJ Caselden (Wireless Network Engineer), Krystal Persaud (Industrial Designer) and John Umphlett (Fabricator) were indispensible.

Because I wanted the process to match the organic nature of non-hierarchical evolution and generative frameworks espoused conceptually by the work, and because cross-disciplinary collaboration is central to my philosophy of open design, whether the work of art is autonomous or committed, I organized a kick off event at EMPAC to talk about how concepts of emergence, self-organization and cybernetic principles informed our respective creative processes across the fields of game design, choreography, electronic music, generative art, experimental video, biotechnology, wearable fashion and engineering. In addition to the artists listed above, I invited a few well-respected practitioners working at the intersection of art, technology and science to participate in the discussion: Susan Sgorbati, Kathy High, Ted Krueger, Pauline Oliveros, Tomie Hahn and Josephine Dorado. None of the artists selected to collaborate on the project had ever worked together before, except for the choreographer and the lead dancer in attendance, Jennifer Mellor. I divided the day into four parts: 1) an overview of the conceptual framework of the piece as I originally envisioned it 2) a discussion of emergence and self-organization, 3) presentations by each of the artists who spoke of their past work and tools developed as they related to the concepts outlined. Of particular interest was a demo by Marco Donnarumma on the capabilities of his wired version of the Xth Sense hardware and software. A closing discussion about the contours of the remote collaborative process ended the day.

Like an architect, I closely worked with each area's respective artist coordinating and guiding the development of each necessary element required for the whole design I

imagined. As outlined in rich detail below, I established conceptual, aesthetic and technical frameworks that enabled the diverse aesthetic languages to seamlessly cohere into a unifying vision, but also encouraged the artists and engineers to interpret these rule-like parameters in accordance with their own unique valence. We only brought all of the elements (choreography, electronic music, generative art, lighting, set, lighting, costumes, experimental video projects and wireless sensor network) together for the first time two days before the premiere at EMPAC. I was astonished that the organic external execution which unfolded before me so closely adhered to the artistic conception which I had mentally mapped in detail, that a collective of artists could so sensitively communicate among themselves to accurately produce a vision which, initially created by one imagination came to be shared by all.

Upon reflection, I would come to comprehend how the creative process aligned closely with the experience of the work. To employ an apt metaphor, both process and experience grew ontogenetically like a crystal, which retains its pre-individual essence, which is both a structuring principle and the force catalyzing the emergent formation of the next layer of polymorphic molecules, which constituted on the most recent top layer, and serve as the basis for the emergent layer. This "meta-stable" approach starkly contrasts N. Katherine Hayles description of the history of cybernetics as a "seriation"—a pattern of overlapping replication and innovation—rendering technology indeterminant.

The implementation process described below emerges in the order that each multi-media layer was added, so one can envision a time lapse of the reticular structuring. Each layer itself possesses multiple layers of process and meaning, all of which are dynamic, emergent, and unstable. Once the structuring principle—the framework for each element was established, then the layers simultaneously grew at their own rate.

Choreography

Initially, the choreography for *[radical]* emerged in layers as choreographer, Pauline Jennings, and I took long walks and made meals together during my residency at the Vermont Studio Center. Our conversations circled around three interrelated topics: 1) we discussed how to shape phrasing around the five essential types of muscle isolation to exploit/explore/extend the Xth Sense's gesture mapping potentiality (i.e. vibratory, sharp,

curved); 2) we spoke of how to create an organic juxtaposition of bodily articulation between geometric angularity and sensual softness to underscore the creative tension between quantifiable data-bodies and subjective memory-bodies; and 3) we identified a taxonomy of environmental cues—type and number—that dancers could comprehend to determine the game mechanics behind the rules, including spatial, sound, visuals, lighting, and fellow dancers' gestures.

Based upon these early discussions, Jennings began to create a shared movement database, consisting of nine phrases. We had hoped to teach the dancers twenty-six phrases to match a deck of cards, so we could create Laban-like graphic icons that visually communicated each phrase, adding a variable of increased uncertainty at the outset of each show, but we discovered a knowledge-retention threshold with the dancers, the result of the complexity of layering on the game-rules and trajectories. Each phrase is roughly one minute in length, and has a 100 BPM tempo as well as a unique meter. Jennings created each phrase to be both visually and aesthetically interesting in its own right, but she also intended each to reinforce the key goals I established for the work. Movement vocabulary was to be 1) visually complimentary, since instances of movement unison were rare in the performance; 2) produce diverse sound textures, that is create phrases to focus upon different muscles and muscle movement so that the sensor data sent to the composer would produce enough nuance; 3) cohere with overall aesthetics, phrases would match the conceptual frameworks of the work, and would harmoniously mirror visual and audio representation. Jennings suggested,

> if Phrase 3, which uses only arms and does not move through space is juxtaposed with Phrase 4, which consists of many small, quick hops and jumps, the resulting visual, kinesthetic and sonic texture would be quite rich. Adding Phrase 5, an adagio phrase that is performed entirely while standing on the right leg, lent even greater depth of texture.[397]

Of primary importance to Jennings and myself was the intent to provide shared gestures or shapes between multiple phrases to facilitate the mixing of phrases during the performance and to provide common gestures to inform the sound composition.

Once the dancers learned all nine phrases, we then introduced the rule sets that dictated which phrase the dancer would perform, how she should performs it and within which space. We played with generating a tension between the adherence to rules

[397] Pauline Jennings, email message to author, March 3, 2013.

established and the agency/autonomy of the dancer, since this tension was essential to the conceptual framework of the piece. Therefore, the dancers were responsible for determining in which direction they would face when they performed a phrase (no set front), and in which order they would perform the content of the phrase (i.e. linearly, non-linearly, accumulated and retrograded). They were also given the option to hack the system. The same tension and interpretative flexibility was woven into the shape of each movement phrase (soft and angular, sensual and robotic).

Jennings and I iteratively co-designed the choreographic framework for *[radical]* based loosely on three well-known game theories (described in the ideation section above): Conway's Game of Life, Hebb's Rule and Markov's stochastic patterning. The structure for the piece flows organically from one rule-set to the other, much like leveling in a game, and is, therefore, subject to emergence and durational uncertainty. Below is a run down of the original structure and a visual representation of the movement trajectories across space that helped embody the rules, which evolved once Jennings and the dancers began rehearsals, since humans, unlike computer processors, are subject error and variability.

Rules:

<u>Establish Universals</u>

1. The performance space will be gridded in approx. 6-8 10'x10' cells. The measurement of the cells is based on an average kinesphere size and will be measured visually by each dancer. Exact grid will be known following decision on layout.
2. There will be five dancers and all five will have a shared movement database consisting of predetermined phrases. Each movement phrase will be between 45-90 sec. in length. During the performance, the dancers will pull phrases from this database either by their choosing or in accordance with imposed rules.
3. Dancers will not be required to begin a phrase from the beginning (unless a rule contradicts that). Rather, they may begin the phrase at any point between the phrase's beginning and end. Likewise, baring rules to the contrary, they may accumulate the phrase, do it multiple times, perform parts of the phrase out of order, engage in a canon with another dancer doing the same phrase, augment and diminish its timing, etc.

Level 1

The movement of each dancer is uniquely triggered by the movement choices of other dancers (see example A below). When triggered, dancer must begin the phrase designated by the trigger and perform the phrase in the correct cell (Example B); if Dancer 1 sees a Jump, she must move to Cell #1 to begin Phrase 9. Each dancer will also have a set of qualifying neighbors as in the Game of Life, which will control activity versus stillness (see Example C below). Our Game of Life dictates that a dancer with 0 neighbors dies of loneliness, a dancer with 1-2 neighbors thrives and a dancer with 3+ neighbors dies of overcrowding. Spacing is thus determined through relationships and chance. In the original configuration, there will be 4x2 cells (8 total) (See Example D).

Example A: Movement Triggers

	Jump	***Go to Floor***	***Strong Trajectory***
Dancer 1:	Phrase 9	Phrase 4	Phrase 6
Dancer 2:	Phrase 1	Phrase 4	Phrase 3
Dancer 3:	Phrase 2	Wildcard	Phrase 7
Dancer 4:	Phrase 9	Phrase 1	Phrase 8
Dancer 5:	Phrase 5	Phrase 3	Wildcard

Example B: Phrase Assignments

1 Phrase 1, 9	2 Phrase 2, 10	3 Phrase 3, 11	4 Phrase 4, 12
Phrase 5, 13 5	Phrase 6 6	Phrase 7 7	Phrase 8 8

Example C: Qualifying Neighbors

Dancer 1:	Dancer	Dancer	Dancer
Dancer 2:	Dancer	Back Wall	Light/Curtain
Dancer 3:	Dancer	Front Scrim	Dancer
Dancer 4:	Dancer	Front Scrim	Light/Curtain
Dancer 5:	Dancer	Dancer	Dancer

* When only 1 dancer remains active, that dancer will begin their Level B trajectory and do 1 complete leg / phrase of it before others may start.

Fig. 26 – Layout of Rules Co-Designed by Pauline Jennings & Heidi Boisvert (2013)

Level 2

Each dancer will have a specific trajectory composed of five legs and five nodes, where each leg (representing the physical space between two nodes) is assigned a specific movement phrase (see Example D below). When a dancer reaches her next node, she may

pause between movement phrases for a period of time up to her. When two dancers meet at a node for the third time, they form a connection and begin a new trajectory that includes a mix of their original phrases. This new relationship is based in mutual learning. Here are the trajectories for each dancer broken out:

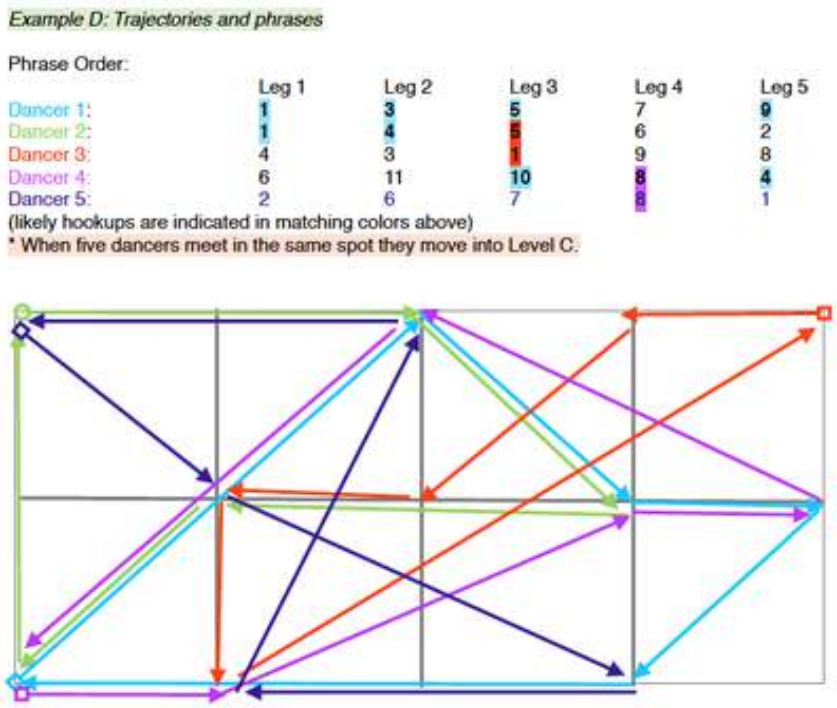

Fig. 27 – Layout of Trajectories Co-Designed by Pauline Jennings & Heidi Boisvert (2013)

Level 3

Each dancer will begin level 3 performing a phrase they pulled from a deck of cards prior to the run to ensure that they will not all begin enacting the same phrase. Each dancer must respond to the same movement triggers as in level 1, but may respond with any phrase of her choice (see example E below). The card drawn will also dictate the cell in which each dancer must spatially remain. Thus, each dancer will draw a card that says "Phrase #__" and "Cell # __". Because there are more phrases than cells, it is possible that more than one dancer will draw the same cell assignment. When all dancers reach a state of unison, i.e., when they are all doing the same phrase, they may ignore movement triggers and complete the phrase in its entirety. Once the phrase is completed, they must resume Level 1's rules.

Example E: Movement Triggers

	Jump	Floor	Strong Locomotory
All dancers:	?	?	?

Fig. 28 – Level 3 Autonomy & Hacking Potential (2013)

Once these rules were in place, we figured out the gesture mapping; how to map the gestures to sound and visual systems to expand Donnarumma's arm-based gesture vocabulary.

Sound Design & Gesture Mapping

One of the core components of sound design was the mapping of gestures to musical parameters. The features extracted on their own once amplified are the noise of raw data. In order to play music with them, Donnarumma conceived the concept of a "sound gesture" (explained in the preceding chapter). To remind the reader, a sound gesture possesses two purposes: 1) to activate neural impulse to excite the muscle, which the software then analyzes as acoustic properties and amplifies, 2) to sculpt amplified data mapped to musical parameters to control the sounds emanating from the inner body.

When I first met Marco at Harvestworks and saw him perform with the Xth Sense, I noticed he only used his forearms to produce sound and that his instrument was limited because it was wired. I told him I wanted to put it on dancers bodies to see if we could explore the full range of sonic textures from various muscles and that I would be open to developing a wireless version and network to make this happen. I had already been exploring using the Emotiv and other neurofeedback types of technology for affective games, but these, too, had limitations. Furthermore, the data was not granular enough to produce sophisticated mechanics.

As we began to use the software, we discovered that it could learn four different behaviors from the performer: still, moving, fast gesture, and slow gesture. For Marco's performances, he plays with these possibilities through using his left and right arm for various tasks to alter delay, pitch, tone, grain size, and panning. Below is a visual representation of the movement patterns and associated musical parameters.

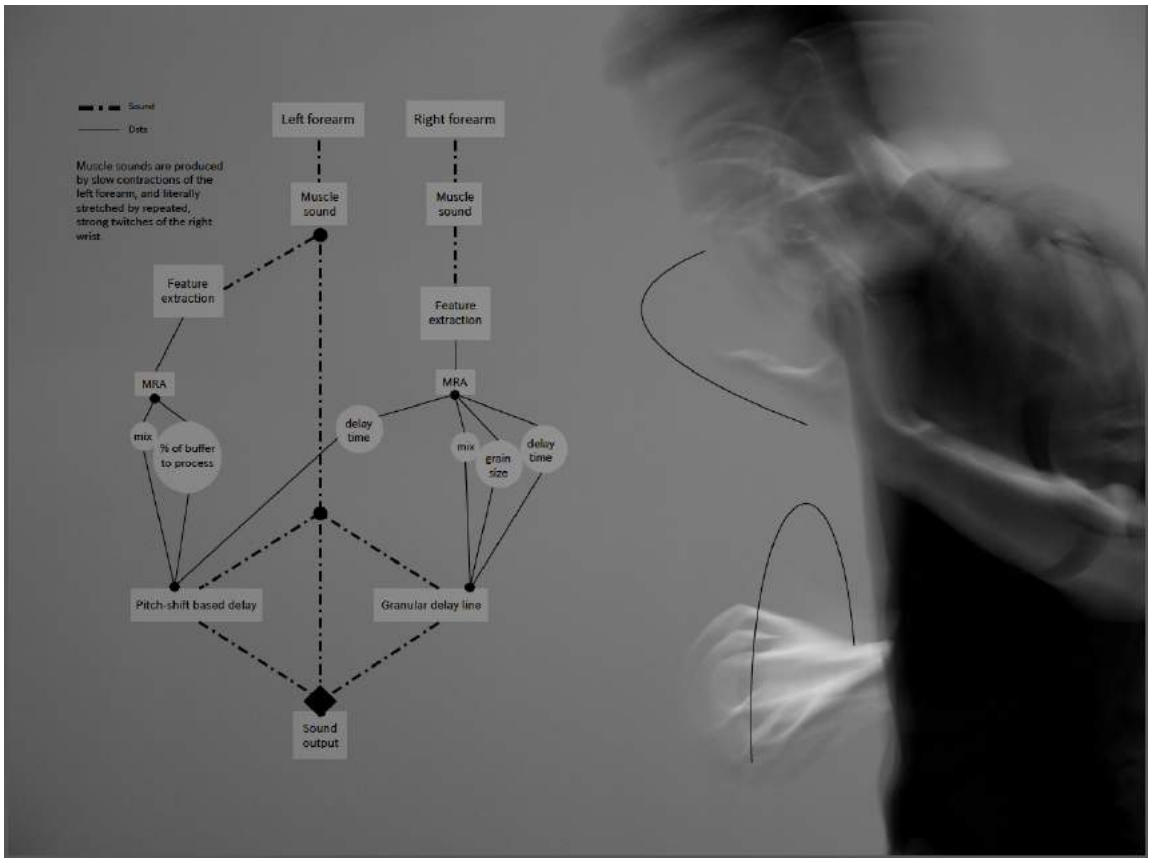

Fig. 29 – Original mapping of gestures to musical parameters developed by Marco Donnarumma (2012)

When Jen, one of the dancers, put the XS even on her arm for the first time during the project Kick Off, her training as a dancer produced a spectrum of sound that Marco had not previously achieved, even after two years of developing the instrument. Therefore, we realized we would have to build upon his sound gestures and map them to entirely different musical parameters.

During the early stages of designing the wireless system, Pauline and I experimented with re-mapping the gesture vocabulary and the placement of sensors to determine the parts of the body that generated a rich diversity of sonic texture. We began with Martha Graham's theory of "contraction and release," the idea that movement originates in the tension of a contracted muscle and continues in the flow of energy release as the muscle is relaxed. Based upon this assumption, Graham's disruptive movement style emerged with a focus on harsh angularity and dramatic falls; this had

been a departure from the familiar smooth and lyrical bodily motions of well-known choreographers of the time, such as Isadora Duncan.

To convey the tension between smooth human sensuality and angular robotic systemization, Jennings and I explored the various ways in which we could isolate muscles: vibratory, angular, circular, smooth, sharp, rolling and so on. We also played with the pacing of these articulations, like Graham, through breathing and impulse control—to feed into the machine learning behaviors established by Donnarumma in the software. During this process, we discovered that the leg and stomach regions produced the most percussive sounds, while the arm and neck regions elicited more subtle qualities. The resulting motion and shapes emanating from "contraction and release" between movements cultivated a unique base materiality upon which to build the phrases. Jennings then set to work choreographing the phrases to accentuate the isolation of the particular muscles we had identified as most salient. Through this initial trial and error, Jennings narrowed which set of muscles would best amplify and diversify the sonic textures, and where we would place the sensors on the dancers. Based on these ten discrete regions, each dancer chose two muscles she felt comfortable personalizing. Below is a chart of the sensor placement on the body of the dancers, and the specific muscles each sensor targets:

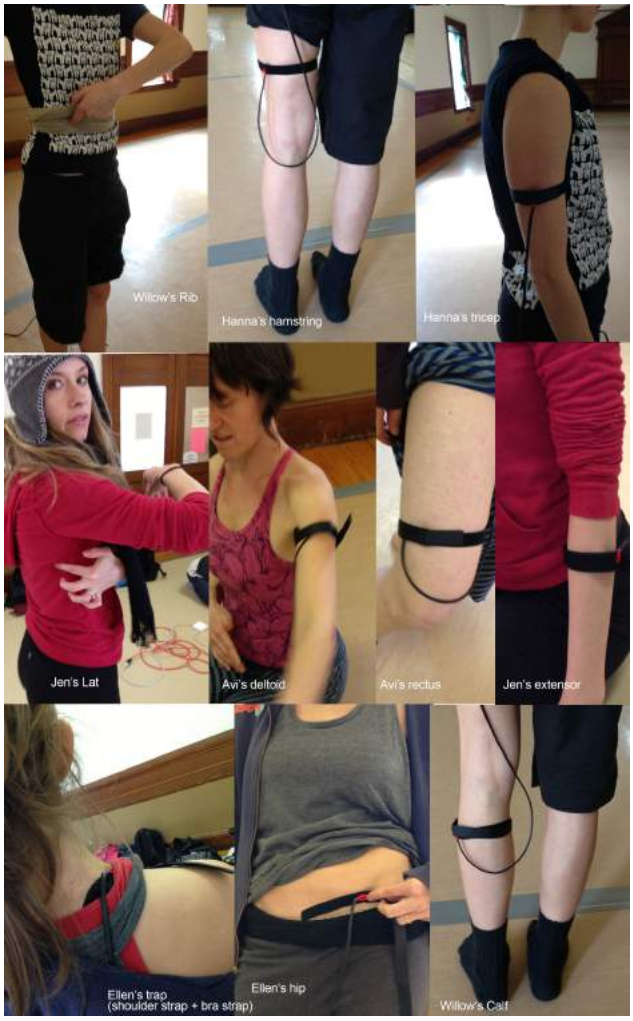

Fig. 30 – Sensor placement on each dancers body during testing phase (2013)

Once the phrases were mastered, we began placing the sensors on the dancers' bodies to test our assumptions. Based on our assessment, the phrases were revisited for fine-tuning. It also allowed us to test the prototype, and to make adjustments to the firmware. A week-long residency afforded an in-progress preview at the Contemporary Dance and Fitness Center in Montpelier, Vermont, during which Doug Van Nort joined us for a couple of days to begin sampling, mapping and spatializing sounds from the dancers bodies. He then fed the sounds back, so the dancers could hear how their different gestures and movement patterns affected the real-time improvisatory soundscape. The process also allowed Van Nort to get a keener sense of the range of subtlety offered by the source material stemming from each unique body and muscle family with which he had to work.

By placing each sensor on a separate channel, he was able to conduct a rough mapping of each phrase breakdown and set some parameters for sonic sampling.[398]

During this process, I was able to observe how each dancer's gesture altered the self-tension designed into the visual system and I was able to tweak the code. Now that we understood how the different muscles, interpretative gestures and movement trajectories affected the features extraction driving the sound and visual system, I worked closely with Van Nort and Raven Kwok to hone the look and feel of the experience design that, together with the minimal elements from the set, would cultivate an immersive environment.

Set Design & Fabrication

Early on, the set and lighting designer, Allen Hahn, and I put together some rough sketches of the layout (see FIG. 31), and design elements I had intended to communicate the cognitive niche construction. The brown desk locates where Van Nort mixed the body data live. In front of him where the four crossed out boxes appear is the active audience area. Four Microsoft Kinects were placed above the heads of the audience to capture their aerial movement using blob detection. This tracked movement caused the imagery on the screen to alter. Between the audience and the first layer of screens are reflecting pools initially designed with transducers[399] on the bottom causing the water to oscillate in response to body data, distorting the projected images. The screens, based on Fibonacci's golden ratio (discussed earlier) consist of six differently seized textilene screens moving along two tracks. The dancer area, demarcated by eight square territories, rested behind the screens. Lights gently cast from both the right and the left masking area moved across the dancers' bodies. Behind the dancers, another set of imagery is projected onto the natural surface of the gridded walls. In contrast, this imagery consists of bio-memory, triggered periodically and based on the clustering of the dancers bodies, signifying an engram. Speakers, as I previously mentioned, were arrayed about the space on a rake from the front wall behind the dancers to the back wall above the technology staging.

[398] Due to time constraints and the complexity of the movement patterns, we were not able to conduct the full, expanded mapping I envisioned.

[399] We had to forego the transducers because EMPAC required the pools to be flat on the ground for insurance purposes. They were concerned about water damage.

The set arose from an impulse Allan and I had to subsume the physical figure in a data landscape, signifying the "ecology of interruptions." Because I had already established the conceptual underpinnings of the work, Hahn instead focused upon the physicalization and illumination of the audience's experience. As Hahn elaborates:

> It was clear from early discussions that this piece would be thick and deep with technology—that it could only exist within a technological landscape. It seemed appropriate that elements defining the physical space should be aligned sub rosa with the natural world, and more specifically with the proportions of the dancers' bodies— hence the golden section. The choice of water as the surface for the projections to reflect in was intended to balance, or perhaps even subvert the technology in subtle ways. What makes this work so compelling for me is the delicate relationships between human and computer, intention and chance. In our collaboration, I argued that the design choices in the lighting and spatial elements should capitalize on that as well.

Fig. 31 – Sketch Up mock up of set, performance and audience area designed by Allen Hahn (2013)

The physical limitation of Studio 2 at EMPAC established interesting creative constraints. Because the space is not a perfect black box—the shape of the acoustic panels made the space inherently not neutral—the constraints became integral to the decision-making process about other design elements. The constraints also presented an opportunity for a secondary projection surface, which then created a web of interdependence. For instance, dance productions typically rely on low angle lighting to carve out bodies against the dark background, but we wanted video to project cleanly onto multiple surfaces. If too high, the lighting will bounce up and dilute the video image on both the back wall and front screens. This decision to have multiple projection surfaces forced us to make conventional choices with regards to employing masking to hide lights on the side. In addition to its conceptual purpose, the water also served a functional purpose; it created a barrier between the audience and the dancers, so projectors could map cleanly onto the surface without audience shadows. The screen sizes were similarly dictated by the dimensions of the textiline roll (6-7 feet by yards long), a material required to allow for the imagery to pass through without obscuring the dancers. In turn, the screens determined the size of the reflecting pools. Both were fabricated by artist, John Umphlett.

We had also wanted to have a pulley system to move the screens. However, considerations of cost and ease of set up determined that humans would work between scenes to advance the progression of each level in the game. This choice created an interesting opportunity for the audience to decide how to interface with the work (to move around or not, how to move), adding an element of agency. They could look past the video into the dance space between the screens or through the screens.

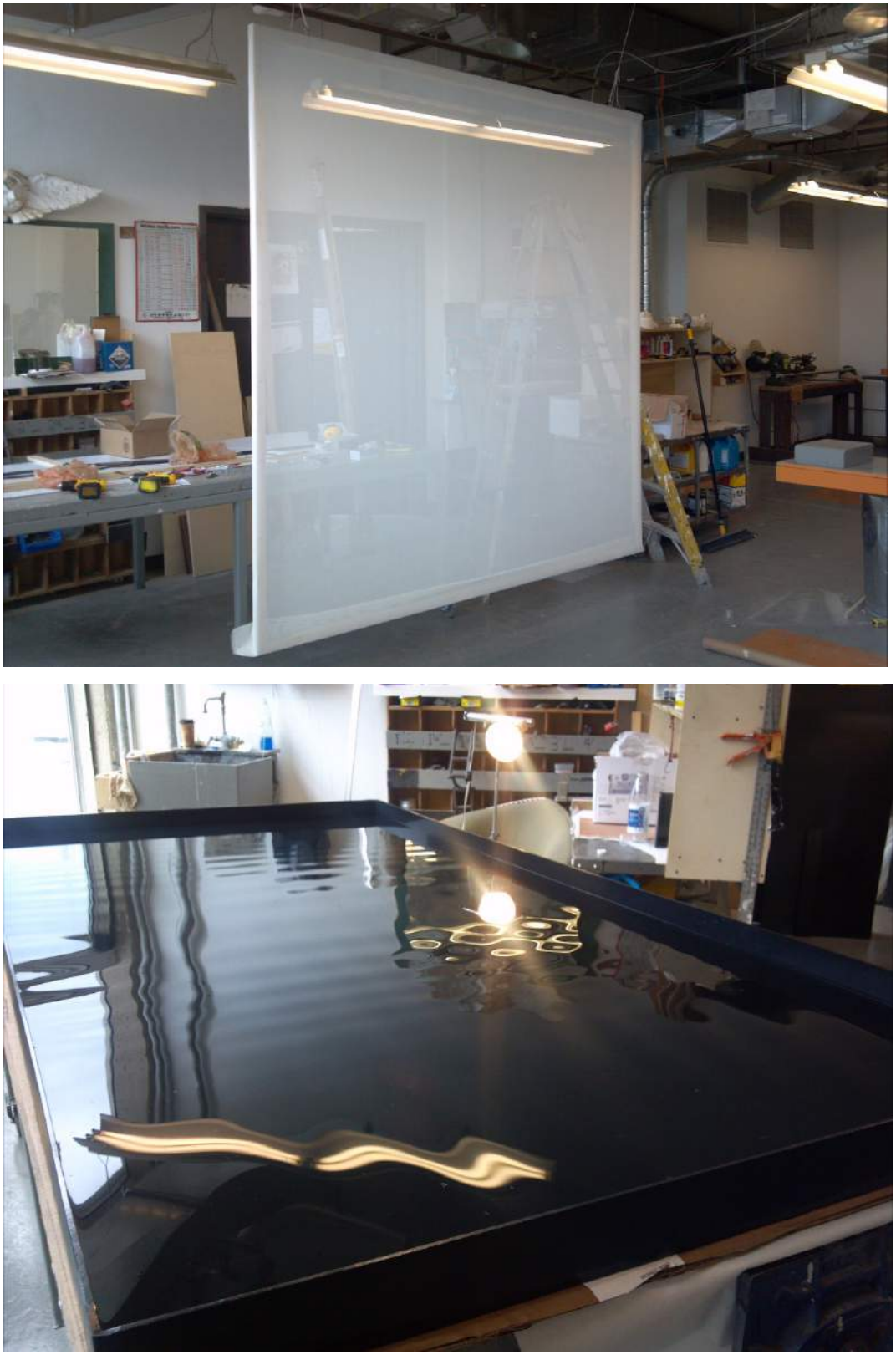

Fig. 32 – Moving Screens & Reflecting Pools fabricated by John Umphlett (2013)

Front Wall

In addition to developing the code to run the neurobiological algorithms, we had to build a system to receive the feature extraction data sent by Xth Sense software from a patch I wrote in Open Sound Controller (OSC) to map the ten channels from the dancers.

On a technical level, challenges were overcome to achieve the look and feel, as well as the user experience, envisioned for the front screens. First, we had to iteratively design the algorithms to be responsive to both the subtle, unregulated data from the individual dancers internal milieu and also the unpredictable external motion from multiple audience inputs. We needed a clear signal to sustain the evolving life forms when there was too much activity or too little activity. We solved this by assigning different responsive properties to the range of gestural inputs generated from both the dancer and the audience. We mapped individual sensors to the force and speed of each dancer's individual gestures; for the audience we employed blob detection rather than skeletal tracking to isolate larger changes to tension between discrete dancer spawns. Second, I wanted to establish a delicate balance between invisible technologies and clear interaction. This involved concealing the Kinects but lighting the audience area in such a way to indicate the active play space without blowing out the imagery on the front screens or deactivating the infrared sensor on the Kinect. To ensure the images could be seen, we had to rig the Kinects to the ceiling, roughly ten feet above the audience's head. We also brought up low light to highlight the blob detection range, as the screen configuration changed. Four Mac minis were placed in the rafters to run the interface with the four Kinects and video projections. Mapping the dual-head projectors for both front and back wall requirements also proved to be a curious feat. Projection from the front passed through the textiline inversely and needed to throw off enough excess imagery to bleed onto the dancers costumes, while not intruding upon the back wall. Masking was used to cut this. Lastly, it was important that both the dancer and audience interaction did not indicate a one-to-one latency. I wanted the experience to be a slow reveal, an open-ended field of discovery. However, Allen reminded me of the challenges of performer and audience driven experiences. He pointed to the difficulty of communicating dynamic agency to the audience.

Fig. 33 – Audience interaction with AI creatures via Kinect blob detection at EMPAC Premiere (2013)

Back Wall

As discussed above, the threshold of sound stemming from the dancers' gesture vocabulary trigger a second layer of imagery to project onto the back wall in a non-linear loop via Isadora, an interactive media presentation tool. This colorful, haptic imagery mirrors engrams—memory traces—produced by the clustering of cell assembly processes. Although randomized playback of the footage is triggered by sound thresholds set in Max/MSP, the engrams conceptually tied into the self-tension coded into the front visuals, beginning in level 2, when Hebb's law kicks in. Shot on a DSLR camera calibrated to a Microsoft Kinect, the unique system, the RGBD toolkit,[400] developed by James George, Jonathan Minard and Alexander Porter, can simulate both the blurring depth inherent in replaying memories and abstracted mesh-like forms associated with

[400] "DepthKit,"accessed August, 4, 204, http://www.rgbdtoolkit.com/.

data bodies. By inserting/embedding/hiding the mesh blur memories of personal scenes re-enacted by actors inside the data bodies, my attempt here was to underscore the discord between cognitive data and affective subjectivity—calling attention to the dangerous legacy of cybernetics that foregrounds one over the other.

I worked with sixteen local actors to shoot unscripted sequences of memories from my life. The scenes were a combination of my own experiences and those told to me by others, which had become part of me, coloring my perceptions of the world. Each memory had elicited a strong affect, predominantly shame-humiliation.[401] Initially, there were a total of twenty scenes, but due to the lighting requirements for the Kinect and the complex computer-camera-generator rigging, I only shot ten, choosing to include nine to match the database of phrases.

Each scene had to be shot in one take with natural light. The RGBD Toolkit involves a rigorous alignment and calibration process to get the Kinect to couple with the DSLR camera to capture data directly into the software. I chose this approach because the Toolkit interpolates flat two-dimensional video image into 3D content for polygonal manipulation. It also possesses software that enables the manipulation of footage to be ported to different interactive systems, like the Unity game engine, and openFrameworks. For *[radical]*, I used the Capture and Visualize software and focused primarily on point cloud and mesh effects[402] to produced a dream-like blur quality for the memory sequences. During the dance residency, I also shot a second set of footage of the dancers, which I reduced into hollowed 3D wireframes. Originally, I wanted to be able to interpolate the data real-time during the performance, but James George said the software API did not currently support this execution. All content for the back wall, therefore, was edited and rendered ahead of time, but randomized play back was triggered live through signals from Max/MSP.

[401] I categorize these as memories, which typically cause us to split of parts of ourselves, cutting us off from our feelings.

[402] Settings: time alignment: texture alignment select point cloud & wireframe & mesh depth of field = dof distance = low, doff range = low, dof blur = high ending = point alpha = high, point size = high, wireframe alpha - high, wireframe thickness = low, mesh alpha = low no rotation geometry = simplify x & y = high, edge clip & z threshold = high.

Lighting Design

The principle task of the lighting was to establish three distinct sections that would each have its own unique visual characteristics, just as the movement itself did. For instance, the game the dancers' were playing in level 1 was very clearly spatialized; it comprised of a series of actions and reactions that led dancers to occupy one of eight quadrants on the stage, marked out by gaffer's tape, four across two deep. The lighting for this level, therefore, reinforced the movement by overlaying a visual environment, consisting of circles and squares. Allen Hahn, the lighting and set designer, performed the lighting live in the most analog way available to allow for the unpredictable variability of dancers' choices. He had each light (see full plot below) on a sub master and used a slider to bring up and down lights as patterns from the dancers' trajectories emerged and shifted. He defined each quadrant within the grid as its own zone and turned lights on and off in relation to the clustering of the dancers. Circles designated two or more nodal connections at corners of quadrants and squares signified total coherence of movement.

If we had had more time in EMPAC, we could have created an additional layer of technology to identify the dancers positions in space, so that the lights were responsive to the performers in the same way that the sound and visuals were. But the act of a human agent performing live created another tension more in keeping with Donald MacKay's interpretive system design. Hahn saw his role as a translator cuing the audience visually; he wanted to help them make sense of the patterns, aiding in their experience of the work. As Hahn describes "What I was trying to do was to bridge the gap between the set of rules unknown to the audience and what the audience was experiencing temporally and spatially. I was trying to give the audience something that suggested the underlying structure in a less opaque way."[403] He was concerned that with everything that was happening sonically and visually, there was a question of legibility. Often in heavily technology-mediated works similar to *[radical]*, like Chunky Move or Troika Ranch, the audience is unaware that the performers have agency to change the audio and visual landscape. They simply read it as an operator controlling sound or images triggered

[403] Allen Hahn, audio transcript from Skype interview with author, March 18, 2015.

through a pre-designated event, unless they are given the agency to trigger events themselves. To alleviate this concern, Hahn decided,

> Rather than try to create a language in light that was dictated by the rule set, I was trying to create a broader structure that was about color, and overall intensity, and movement between states that allowed the audience to detect that there were patterns, not necessarily what the patterns were.

This included lighting flooding the audience area encouraging interaction with artificial creatures, and highlighting neural connections at nodes between squares.

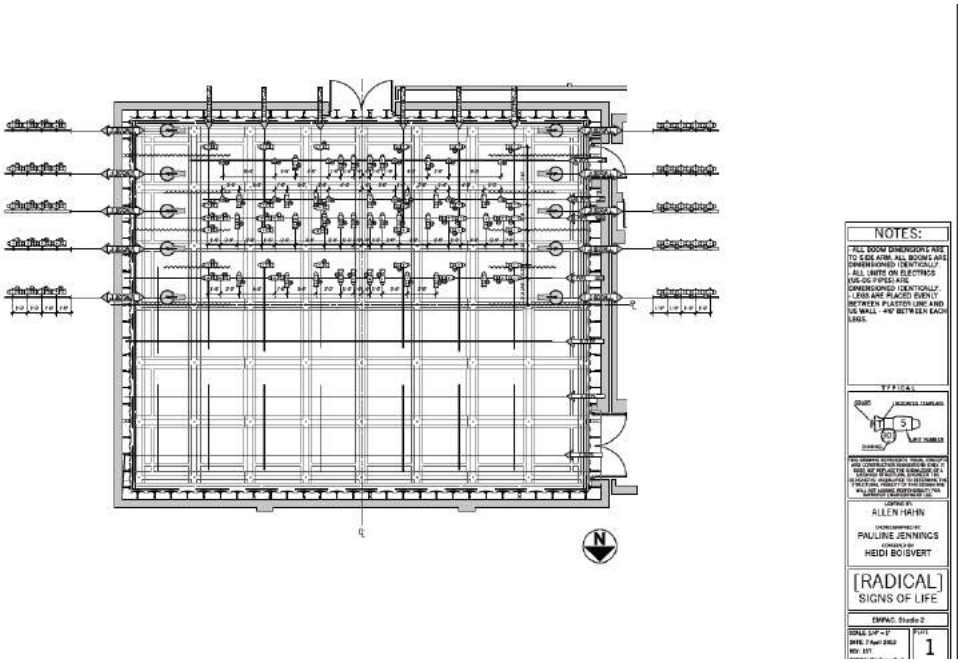

Fig. 34 – Lighting Plot designed by Allen Hahn (2013)

Qty Instrument Type Watt

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4 S4 15/30 Zoom 575w

.....

12 S4 PAR-WFL 575w

.....

8 S4 25/50 Zoom 575w

.....

52 36˚ S4 ERS 575w

.....

12 19˚ S4 ERS 575w

.....

26 26˚ S4 ERS 575w

.....

9 50˚ S4 ERS 575w

TOTAL LIGHTS: 123

Costume Design

Each dancer's costume uniquely accommodated the individual sensor placement. Each sensor also possessed a custom strap, and in some instances hand-sewn reinforcements to ensured that the microphone would not lose contact with the skin. We played with a couple of different earthy fabrics to harmonize with the water as a contrasting element. We ran tests with generative imagery that was projected onto the body through the screens, and against the background imagery to guarantee that the fabric blended seamlessly into the environment. Amy Nielson, the costume designer, created a custom applique on top of the fabric—slash marks to signify the slow degradation of the human beneath the bio-data; the *lived* body beneath corporeal. This was the initial direction for costumes hand-sketched by Nielson.

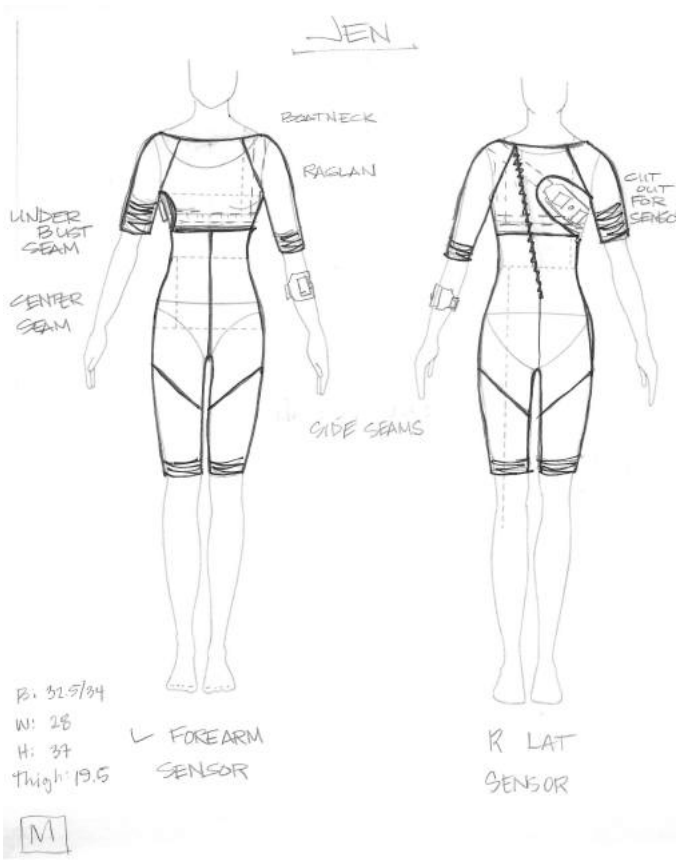

Fig. 35 – Initial costume & sensor band sketch by Amy Nielson (2013)

Wireless Development

Before we had a functional prototype, myself, MJ Caselden, wireless engineer, Krystal Persaud, industrial designer, Amy Nielson, costume designer, occasionally Marco Donnarumma, Xth Sense creator, and the New York dancers (who served as beta-testers) engaged in many strategy sessions, iterative design and methodological testing stages. During our six month Creativity + Technology = Enterprise residency at Harvestworks we determined:

1) The exact layout and design of the sensor, microcontroller PCB, the transmitter PCB and batteries.

2) The materials that would be most comfortable and secure for the dancers while protecting the hardware and networking environment. We decided upon silicon and nylon.

3) The proper sound quality and sensitivity, as well as the wireless range.

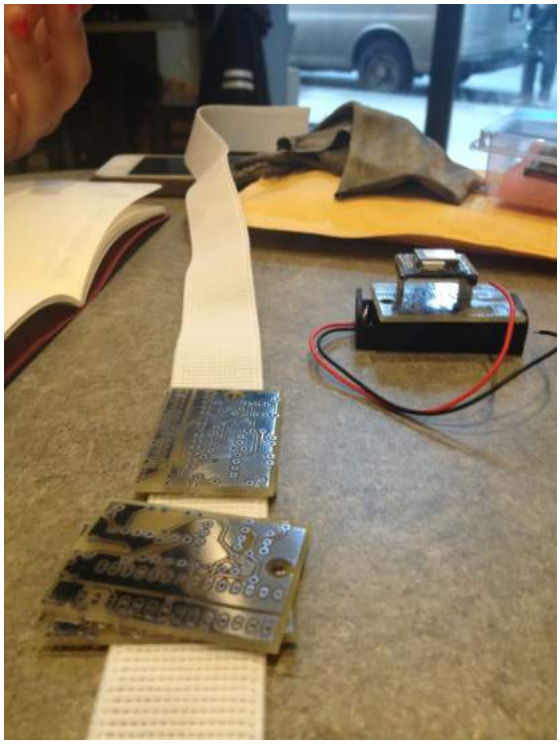

Fig. 36 – Experimenting with how to configure the stand-alone armbands with PCB boards (2013)

We decided upon a complete custom, open design for the wireless Xth Sense, but sent the PCB board prototype to a fabrication house for duplication. Here MJ Caselden expands upon the choices that were made and how they were implemented:

> In our initial prototype I considered several digital to analog converters, and experimented with the XBee family of wireless transmitters. The Xbee family did not perform up to our specifications, and through experimentation I found that PWM approximation of analog output was sufficient audio quality, so we didn't need to pay for a DAC chip. The choices ultimately made in design: Atmega microcontrollers are cheap enough and are the same chip used in the widely popular Arduino family, so will be accessible to the layman, so I worked out of those. The analog circuitry design was straightforward. In the transmitters, we needed sufficient amplification from contact microphones, 3rd-order anti-aliasing filters for analog input to the microcontrollers. The frequency band is below 100 Hz so we oversampled at a rate of approximately 4 KHz. Over on the receiving end, coming out of the microcontrollers, we needed another 3rd-order low pass filter to average the outputs of our PWM. Then we amplified/buffered the signal so that it was within the appropriate amplitude range for audio devices. By far the most costly component of the design was the wireless modules (RFDigital21813 modules). However, they proved quite reliable, avoidant of interference and were able to provide quality transmission well above our goal distances. All of the firmware for these are written in C, and compiled with the GCC tool chain.[404]

[404] MJ Caselden, email message to the author, November 26, 2012.

Once we had access to EMPAC we had to set up the wireless network in the grid above to avoid feedback with the transmitters. We ran a series of tests to ensure that each of the various software systems interfacing over OSC set off the chain of interrelationships required to sustain our living system: PureData > Max/MSP > Processing > Isadora. Before each show, we also had to recalibrate each sensor to the respective dancer's body in PureData.

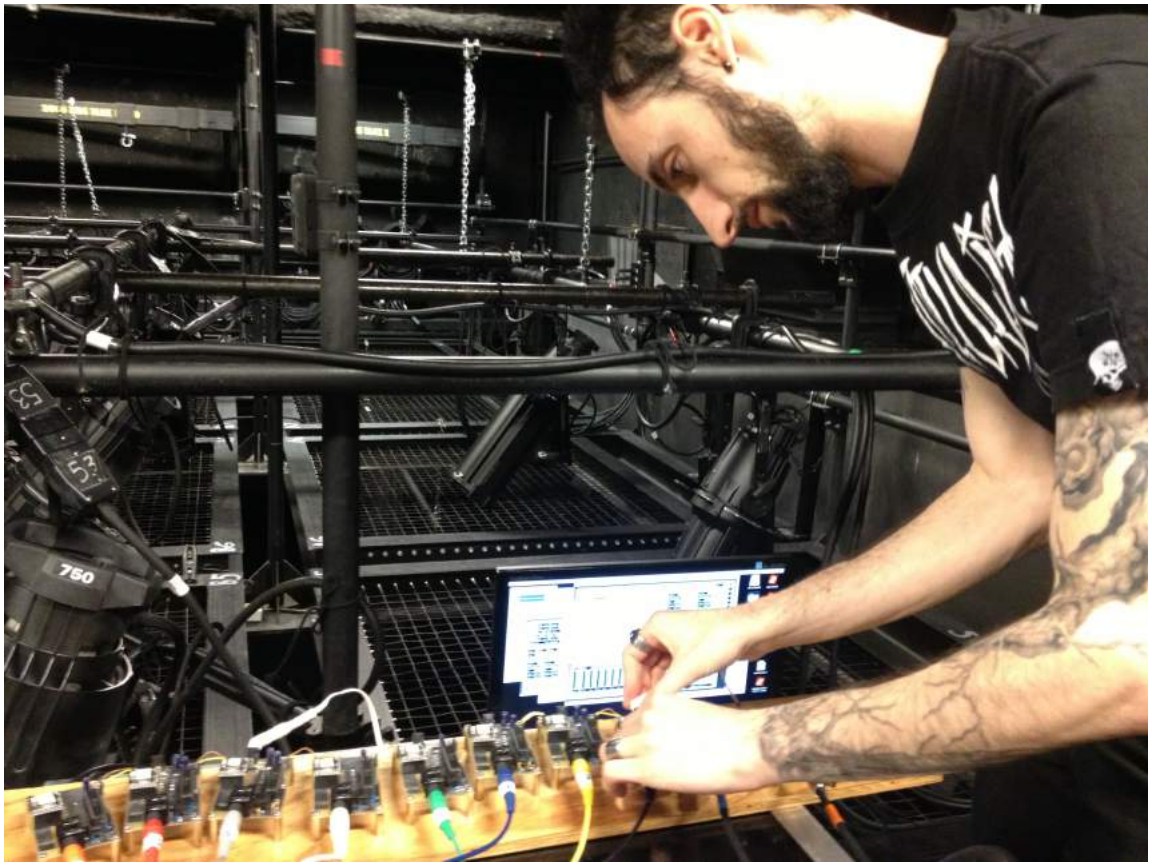

Fig. 37 – Marco Donnarumma patching the XS receivers into the audio interface & dedicated tower at EMPAC during tech set up (2013)

The technical requirements for creating and running the networked performance were extensive, and are worth mentioning as a final note:

1) Connectivity:
Local wired network to facilitate communication between the various computers.

2) Data:

1 data-crunching tower for:
Taking in 10-channel sensor data in Xth Sense software, sending over OSC to sound and visual processing towers

3) Sound:
2 audio towers
12-channel external sound card
6 full range speakers on stands
4 subwoofers in corners
6 smaller, genelec speakers

4) Visuals:
4 Mac minis for Processing patch
4 Microsoft Kinects for audience interaction
1 tower dedicated to Isadora for randomized video playback
4 dual-head video projectors, 2 at the back and 2 above the moving screens

5) Hardware:
10 wireless Xth Sense custom developed biophysical sensors (both transmitters & receivers)
Wacom tablet
2 Midi keyboards
DSLR camera calibrated to another Microsoft Kinect
4 dual-head projectors
12-channel audio interface

6) Software:
Xth Sense
Processing (would like to explore replacing it with Unity - a game-engine)
Max/MSP - GREIS (improvisational system) & FILTER (artificial performance partner)
Isadora
RGBD-Toolkit

6.2.4. Insights

To determine what knowledge production could be parsed from the assay, I interviewed each of the performers, the dancers and the sound and lighting designers, to better understand how the defining characteristics of ludic performance altered their creative process and embodied experience during the performance. In addition, I conducted a brief survey with audience members to garner their lasting impressions of the work, primarily what they felt physically and emotionally within the immersive environment and how they interpreted *[radical]* conceptually. Lastly, I examined my own bodily, affective and

sensory experience of the work and retrospective observations to assess whether or not the work addressed my guiding questions. Below is a summary of my findings and what I learned from the "thought experiment."

Performer Feedback

I conducted post-performance interviews with the five dancers, Ellen Ahern-Smith, Jennifer Mellor, Avi Waring, Willow Wonder and Hanna Satterlee, as well as with the sound design, Doug Van Nort and the lighting designer, Allan Hahn.[405] I was interested in how they each read, received and embodied the experience—how they experienced the work in the process of real-time co-creation. Each interview, conducted over Skype, was about an hour long and consisted of six to eight questions.[406] A number of overlapping themes emerged, which functioned more as hyphenated tensions existing on a continuum that were causally interdependent, reflecting my intent to reveal and transform the cybernetic principles. I touch upon each below briefly.

Unpredictability-Pre-Determined:

The dancers consistently remarked on the unusual combination of set choreography and improvisation, which allowed for endless combinations and freedom of play within the imposed constraints. Willow expands upon this:

> I think it's really interesting and exciting to have this mix of set, clear choreography, but with this total element of improvisation on top of that which creates this really beautiful thing to see where things can happen simultaneously and juxtaposed to each other that are different overtime. It was interesting to watch and to see. Depending upon the choices the dancers are making, it creates a different piece every time. I especially loved those moments of coincidence, moments of unison when there are so many different processes going on.

Jennifer, too, was surprised by the amount of variety that the nine phrases could generate and how the initial conditions pre-determined the outcome, but not the content of the

[405] All quotes that occur henceforth in this section are taken from transcription of Skype interviews conducted by author.

[406] Some of the main questions were: 1) What are you uncensored impressions of overall experience now that you've been away from it? 2) What was the process you went through conceptually, physically and intellectually leading up to the performance? 3) How did you experience the transition from learning the database of phrases to mapping these phrases to game rules? 4) Can you speak to the uniqueness and challenges of game-based choreography? 5) How did adding sensors affect your process and performance? 6) What were the social dynamics amongst the dancers? 7) What was your relationship to the environment, the set and audience? 8) Did you experience the various performances differently?

work. She noted that "there was so much material outside of the context of the piece that no matter what the movement was, it was amazing how many cues you get even from set choreography, and the unexpected choices others were making created an element of surprise." Doug admitted that he had to "let go of prediction and control beyond the level of gesture and the phrase. I thought little vignettes could happen based on phrases, but I gave up, because the emergent property of the choreography pushed me away from trying to predict larger structures." The uncertain conditions gave him more of a direct relationship to the work; he was forced to observe simply what was there, in the present moment, rather than conform his music to reflect established imagery. Instead he paid attention to how the information and gestural qualities would flow, and improvised accordingly. Overall, the unlimited choices within the constraints provided all of the performers more freedom of expression, more playfulness.

Attention-Distraction:

Allen, who was, like Van Nort, performing in response to the dancers also expressed that the unpredictability invoked by the rule set created a lot of subtle possibilities, which forced him to focus, and to become more attuned to the dancers. Secondly, Hahn articulated how he "had to feel it out" to "rely more on intuition." Van Nort echoes this sentiment. As Hahn further recalls:

> I remember having to pay very close attention. I had to count during Conway to anticipate what was happening next. In the case of other two, the rule set was subtle enough to watch carefully. The rule sets gave rise to much more subtle changes in the action that *I had to not watch, but feel*. I was very conscious of my own uncertainty about how long the piece was going to last, how long certain sections were going to last. Because the rule set and actions tied to rule set were so subtle, I had to make sure I was pacing the choices I was unfurling so we would get from the beginning and end in less easily detected energy flow over the course of the piece that was sympathetic to the audience.

For the dancers, as Avi explains, "everything was on the verge of being too complex all the time" and uncertain. As a result, they had to remain extremely focused, because the sound, video and audience movement was a distraction they could not afford. The environment caused stimulus confusion, which drove them towards increased attention, expanding awareness for one another, and all the cues were at times stressful, which encouraged them to "listen with all their senses." Ellen echoes this,

> The overall impression that I have was one of moving through feeling overwhelmed or confused,

> then moving through struggle enough to feel more and more capable of enjoying the movement. In the end it didn't feel like a complex structure. I was able to play with it and deviate from the rules and make different choices."

Jen describes the experience differently. She expressed that "forcing the brain to be aware of other people and all the cues forced me to do the movement most comfortable, which gave my body a little freedom, allowing my brain to focus on the new thing, which was the set of rules."

Inside-Outside:

The need to tune out the environment in order to focus so closely on the game rules and one another produced a consistent feeling of being inside a lab under observation. The dancers felt separated from the audience as if they were inside the video game engine in the movie *Tron*. As Hanna observed,

> People felt really far way because of the water and screens… and focus was so inside the game. If I looked out it was to our outside team. I felt like our audience was the tech panel because we were facing and relating to each. *We were producing information for them, but we were separate*, almost like a lab rat.

Ellen reinforces Hanna's sensation,

> As a performer on my own, I am really interested in and reliant upon my interaction with the audience, making eye contact, and being able to see them. So, that's a big part of dancing for me. So, the set you created, even with the screen, I was still taking opportunities to look through the screen and take note where audience was, but instead it gave me a sense of this is my world and out there is your world.

But all the dancers agreed that while the screen served as a mediating device, they could still sense the energy of the audience, and felt charged by having people there, though they were desirous of a deeper connection.

Mind-Body:

Repetition was important to embed phrases, so that Jennings complex choreography could move down into the body and out of the mind to make space for the game-rules, which all of the dancers experienced as in-the-moment problem solving as a result of the constant cueing and responsive nature of the choreography. Avi articulates the process most succinctly,

> *The whole process was very cerebral. It was like pushing the information down into my body*. Once the phrases were well known, and went into the subconscious, then it felt personal and emotional and different connections were being made. It was interesting to have that much complexity in a physical communication form coming out of body, in the moment decisions. Some sort of evolution of mind-body capability happened in a week. (emphasis mine)

Hanna, too, recalls the cognitive overload. When she first received the printed out rules, she recalls that she did a "walkthrough with paper for several rehearsals and visualizing how it looked on the paper. It was so numerical. Phrase 1 in box 1, and do not get out of node 3. But it was a mental dialogue. It was only once we were at EMPAC that I felt like it was in my body." Jen highlighted the discord between mind-body.

> Normally, I feel that moment when I grasp movement physically and it's in the muscle memory… usually, when I accompany other things. That's when I realize when I make that transition… liberated, and not really thinking about it that much. But with this choreography, suddenly I don't know what's next, and then you have to get back into your head. When we learned the rules, movement not fully in body… so, it forced transition. It was a little scary from that perspective.

Doug also observed a change to his own practice; the Xth Sense required that he interject his own body into the design and composing process. It was completely different than creating something for the dancers. Instead this interaction functioned as a translation process; there was a trace of him when mapping back to the dancers that he discovered sometimes missed.

Cooperation-Competition:

For the dancers, the progression of the piece grew from a sense of atomization to an understanding of interdependence. Willow describes her own journey:

> We were all trying to get somewhere together throughout. Even though level one was more about our individual pathways and process, it still felt part of a larger thing that was happening. Cooperation had to happen as we went through the levels to get to the end. For example, Hanna and I were working together and needed each other to get to the next level. We knew we had to meet up to do this, but when and where was different each time.

Ellen, too, nicely sums up the spirit of cooperation and also touches upon the movement-stillness tension:

> There was definitely a couple of moments that I could tell that someone was cuing an end to a section, and I felt oh…I'm not done yet, let's see what happens. I felt like a team player, because Jen, Avi and I had a very complicated set of trajectories that had to intersect a number of times to move forward, so we needed to have an awareness of where others were and get our timing to line up. It was very satisfying to meet up. Those couple moments of stillness were sublime, rewarding, because there's so much movement happening, so suddenly breathing together and being felt good.

Jen, a mathematician and computer scientist, however, was focused on defying probability to become the "beacon" (the leader) at the end. She felt playfully competitive: "I have this natural survival instinct; I just wanted to keep dancing as long as possible, then if someone killed me, I had to reframe it, you got a break, accept it in the moment."

Autonomy-Control:

Part of understanding the choreography and game play for many of the dancers was figuring out how strictly they had to adhere to the rules. For instance, Jen noted the potential for human error and intentional undermining that emerged:

> Some of the dancers would intentionally ignore a trigger, which made it fun. *I didn't have to be a robot, it allowed for human fallibility*. If I didn't capture someone's knee cue, it was not the end of the world. There was a strong motivation to do that, knowing myself what I could do to trigger other people. Sometimes they did or didn't acknowledge it. But this was another game element that they had that choice. (emphasis mine)

Avi gets at the autonomy I intended as a departure from traditional choreography once the rules were embedded enough to offer play. She also speaks to the notion of what Mihaly Csikszentmihalyi calls the "flow," a state of mental absorption that sustains motivation in games by balancing difficulty and ease of a challenge:

> The merging of those two worlds, the movement and game levels at first felt disorienting, but then they felt like this puzzle that was satisfying to figure out. And then there were times when I felt bored because it was so familiar, that's when you were really able to play and be mischievous by asserting a little free will.

Finally, Ellen eloquently underscores the presence of being rendered possible through occupying the mind with game play:

> Don't know if it felt like a game to me, more like a mission. I felt like I had objectives that I had to accomplish them. My traditional vision of a game, feels less driven. I had to be aware of where I was in every moment, and where others were, and where I needed to be to get a sense of the sequence. That is what occupied my brain, and that made the movement not an afterthought exactly, but it took the thinking out of the movement, and the movement became more organic, subconscious.

All the dancers expressed, however, that had they had more time to play with the rules or perform the piece again, they would have made bolder decisions and attempted to "game the system."

On a final note, Willow sent me a separate follow up email expressing the importance of the layered process Pauline Jennings, the choreographer, and I set up in addressing autism and other social disorders. She shared:

> This combination of set choreography as a base to *keep the mind quiet and focused with the improv aspect of 'the rules' which requires choices and social interaction*, seems like a useful activity for people with autism or other social challenges. The focus that the rules and the set choreography require *takes away the anxiety of social interaction*.

Willow equated "improvisation" as "social interaction" for autistic individuals. She believes improvisation is initially very hard for dancers because they are used to being told what to do, so that real-time decision-making often creates social unease when improvising in a group. But once the discomfort with uncertainty is worked through by establishing a confidence in one's own movement vocabulary and familiarity with fully inhabiting one's body around others, improvisation can be very healing.

Audience Impressions

In addition to follow up interviews with the performers, I gathered audience feedback through an anonymous online survey. The survey consisted of six open-ended questions[407] intended to unearth the cognitive, affective, sensorial and interactive bodily experiences participants encountered through the co-creation of the work. I also wanted to see if participants were transformed in some way, perhaps unconsciously moved from stimulus confusion to positive disintegration to end in a presence of being.

Some spoke of the "elegance of the design and installation" and the "involved sense of beauty" created by the "complex patterns of light, shifting and growing bodies interacting as if agents in a complex system." These were the dominant impressions, although differently phrased. Many felt "enveloped" by the "immersion capability" and the "sensorial beauty" of the show. Others touched upon the overwhelming nature of the visual, audio and movement, which led to "sensory overload" at moments, but then spoke of being "nudged towards the romantic word, transformation" by the end. For many heightened senses made them feel more present, attuned to the experience, often speaking

[407] The six questions consisted of the following: 1) What do you recall about the work, first or lasting impressions? 2) What did you think the work was about conceptually? 3) How did the work make you feel, physically, viscerally, vibrationally, emotionally? 4) Were you compelled to interact with the imagery on the screens? If so, how did it affect your experience of the work? 5) Did you feel ensconced by the visual and sonic environment? If so, what did you experience physically, emotionally, sensorially? 6) Were you able to discern any recognizable patterns or game play in the choreography, the visuals or music? If so, what did you observe?

in much the same way as the dancers. One person even noted feeling "more present within the constructed sensorial space and less present with my own body." Another expressed "losing awareness of myself within the experience." Both of which parallel Dabrowski's description of positive disintegration, whereby we must first let go of the corporeal to re-experience the lived body.

A few participants noted "feelings of unease" and uncertainty as a result of both the atypical set up of the space and the inability to predict the rules. While this invoked a "pleasant confusion" in many, others felt "frustration" because there were no set instructions informing them how to interact with the elements (having been trained since Elizabethan times to sit still). Many felt unclear how their own gestures were impacting the overall system and were unclear about the patterns. For instance, this audience member articulates the ambivalence well:

> The whole concept of interactivity is so crucial to the piece, but it was difficult for me to really understand in what ways the various parts, dancers, music, projections and audience really influenced each other…I feel that interaction in performance really words best if the audience can understand the general nature and details of interactivity…On the other hand, when I relaxed and went with the total environment, it was really engaging.

This observation echoes Allen Hahn's concern and desire to use lighting as a translator for the audience. During our follow up interview, he raised an important point about the challenges of performer-driven experiences:

> For a long time we have been experimenting with performance spaces that have tech embedded in them in various ways, which creates the possibility of performer driven triggers for aspects of the experience the audience can read. The trouble is it's not easy to demonstrate the patterns. Performers have agency to change the audio or visual landscape, but it's difficult to communicate this to the audience.

For others the uncertainty about whether to walk around, touch the screens, the water, talk to others, sit or even "wander over to the show-controllers and watch their own performance" gave participants a sense of being "in control of the physical presentation." To me, these responses indicate both a discomfort with open-ended UX and a preference for prescriptive interaction, or alternately a need to master ambiguity through controlling the system.

While many observed the physical and visual patterns of input, response, stillness, movement and repetition, the majority of the respondents could not make sense of the

"recognizable patterns," even with Hahn's cueing. They knew something was going on. Some were able to discern that the movements and visual patterning seemed to be governed by rules set. As one participant remarks, however, "to decode this was not something that engaged me. It would seem to turn the experience of the work into some kind of puzzle and conceptualizing a hypothesis would have interfered with the experience of the work." Still, others were quite taken by the "physical playing out of game mechanics and what seemed to be a multi-layered provocation of 'interaction' and 'performance' and 'game' and the ambiguous relationships between human and machine." Nevertheless, some felt that the piece could have been even more engrossing "if as an audience member [one] could really understand the game-like rules, which were driving the various parts of the piece."

A few expressed feeling a state of isolation, a feeling of being separated from the performance, yet intimately close due to the unusual expanse of the space. One person conveyed a sense of being "on the outside looking in but wanting to connect more intimately…if the audience were not there." Another audience member expressed "feeling exceedingly curious and just wanting to become part of it." One participant even projected her own confused and changing internal states onto the 'agents' evolving on the front screens. Sadly, the majority of participants did not interact with the screens. Most preferred to watch, rather than perform on the "extended stage;" they were just "too involved in watching everything that was going on." Some were completely unaware interaction was even possible; they expressed feeling "hypnotized, as if in a trance." However, one person keenly observed that "this might have something to do with how we are culturally trained to act as an audience," as I noted above.

Lastly, one particular respondent repeated a couple of times through out the survey that "this could be a whole new way to experience the 'theatrical moment.'" As the participant further explicated in the open comment field:

> The theater of the 20th century, especially the early years, probably really did change people upon viewing a serious play, but we all gradually have edged way out of that, and out of the hypnotic power of the old spiritual traditions, while "theater people" and "churchgoers" continue on telling themselves they are doing a great thing to change the world. They just are not. But no matter how "postmodern " we become, *we are still human, and we still need to remain fresh and have our hearts opened in public*. *I don't know what can save the human project now*, it has gone too long and too far into the ditch, but we should do more than just entertain ourselves as we walk out the back door. What Heidi is doing is in the right zone. (emphasis mine)

While my own outlook may be less bleak, opening hearts and restoring critical feeling in shared communal space aligns with my stated goal for producing the work. Invoking ambivalence, states of isolation, cognitive overload, sensory confusion, discomfort with unpredictability and ultimately absorption leading to presence of being seemed to connect at the limbic level with most of the audience members, offering both a mirror and an antidote to our daily dependence upon intelligent technology. There responses also echoed the performers, who, too, often felt simultaneously overwhelmed and confused, surprised and curious, and focused and more aware of others.

Personal Observations

My original stated goal for *[radical]* was to conceptually discern whether I could induce memory consolidation, rendering one more receptive to critical feeling by recreating the optimal conditions for stimulating the nervous system. I also wanted to consider current assumptions that cast the body as an ambivalent and autonomous technology, and how performative gesture and socio-collaborative play could change the script to re-attune us to others. Mapping these intentions for the performative assay to the interview findings and discoveries that result from a creative endeavor, I am now conscious as an artist that the work not only rehearsed, but also challenged my assumptions, provoked new awareness and suggested potential alternatives to the Cybernetic paradigm. It pointed toward a solution for and experimented with an antidote for, but it was not designed in a manner to scientifically prove a hypothesis or measure results. Instead, the act of creating and performing the work inspired more questions than it answered. It served as a space of possibility.

Reframing my work as "ontological theatre,"[408] advanced by British cyberneticists enables me to see *[radical]* as a non-dualistic approach to "doing cybernetics." Here, embodiment and performance are valued over cognition and representation; "it is the ground from which knowledge emerges and to which it returns."[409] Viewing *[radical]* through such a lens, the work transforms into an

[408] Pickering describes ontological theatre as "an approach that at once conjures up the overall vision and exemplifies how that vision might be distinctively instantiated and developed in real world practice." Andrew Pickering, *The Cybernetic Brain: Sketches of Another Future* (Chicago: University of Chicago Press, 2011), 88

[409] Ibid, 2.

ambivalent artifact; a dynamic verb, or an always in process gerund, rather than a sedimented noun. The dancers' movement patterns and the sonic and visual landscape, which *perform* the brain's complex, open-ended, performative interactions became an exercise for me, and by extension, for the audience, to non-linguistically understand how the brain continuously adapts to various environmental affordances, human and non-human. This approach allows me, as Pickering describes, to try on an alternate vision, which could be re-enacted in the "real world." Rather than modeling the brain to be applied to something else as the British cyberneticists did, I modeled the brain through performance to figure out how to retain performative balance. Creating initial conditions that resemble the "principle of ecological assembly" afforded me embodied knowledge of the performers (audience, dancers, composer et al) active negotiations between mind-body-environment as they balance a mix of problem-solving resources and dynamic loops capable of regulating a healthy assembly process. Many of the performers spoke to the issue of resource-recruitment and its effects on their choices and actions. The repetition of the database of phrases visually underscored the self-stimulated and sustained activation of soft assembly neural saccading, even as human errors arose. Observing these brain processes through the dancers movement patterns helped me comprehend how "feed forward residual errors" might cause unpredictable system-wide adaptation, inspiring phase transitions-like beauty across movement, visual and sonic environments, rather than collapse. It also represented a counterpoint to the intellectual ethic of cybernetics by celebrating unpredictability, surprise and entropy and a resistance to the anticipated imposition of sub-sensorial technologies to eradicate error.

More importantly, I had hoped that simulating a more balanced ecological assembly process through kinesthetic engagement and socio-collaborative play would model the optimal conditions for fostering memory consolidation and the thickening of gray matter in the audience. As has been my experience, I wanted the synaesthetic balance of the immersive environment to calm the sympathetic nervous system and arouse the parasympathetic by moving the audience from a place of stimulus confusion, cognitive overload, when they entered towards a threshold that catalyzed positive disintegtration, decentering of the self, and ultimately suspend them in a state of mindfulness, quiet absorption free from the "ecosystem of interruptions." I had hoped to

render them more receptive to critical feeling; what McLuhan perceived as the dangerous forces of "deep participation, empathy and experience."

I am confident that the physical set and the immersive, multi-modal environment successfully functioned as a cognitive niche construction, which enabled the dancers and (to some extent) the audience to scaffold onto the environment, negotiating among mind-body-environment. The database of phrases, rules, responsive cues and trajectories served as novel routine sensory-motor activities capable of quieting the nervous system (as Willow noted above in her follow up email) and transforming the neuromusculature formations, triggering dopamine, thereby, altering the interoceptive system. I also believe that *[radical]* succeeded in reasserting the centrality of the body to reveal the autonomous power that exists in sub-sensorial amplification made possible through the Xth Sense sonified through an array of subwoofers. The biofeedback from these, similar to Grey Walter's *Flicker* experiments, succeeded in both a decentering of the self and a bringing more bodily presence. I am less certain that the audience experienced the emotional arc envisioned. The pacing of sound and visual biofeedback may not have brought conscious awareness of breathing, but did induce a trance-like alpha state of mindfulness (as many audience members acknowledged) in which the breath was slowed, the body was engaged and non-linguistic social interaction was possible.

On a conceptual level, therefore, I believe that the work was successful as a counterpoint to U.S. based Cybernetic principles, represented by control, prediction, and quantification. The work communicated a both/and position. It not only represented both the current state of the human condition (i.e. dancers and audience separated by screens, dancers as servomechanisms, both performers and audience constrained by the "performance of connections"), but also embodied an opportunity for relearning "responsive" social cues, becoming kinesthetically engaged, slowing one's breathing and softening one's muscle tension and heightening one's senses to increase attunement. The performer and audience feedback suggests that both sets of participants came close to Teitelbaum's experience of performing *Spacecraft* in 1967, "the unusual sensations of body transcendence and ego-loss that occurred in this music—and in related biofeedback

experiences… a process of non-ordinary communication developed, guiding individual and collective consciousness, merging the many into one."[410]

As a thought experiment, *[radical]* also positively revealed the underlying mechanisms at play in the adaptable brain when affordances present themselves. But taken the work as a formal evidence-based assay on the neurobiological impacts, I am still uncertain as to whether experiencing the work mitigated the current effects of intelligent technology by re-scripting the nervous system and changing the brain-wiring diagram. Presently measuring these findings proves difficult to me. To quantify and measure, however, would be more in keeping with U.S. Cybernetic principles; to do so go against the value system forwarded by this dissertation. Perhaps, *[radical]* is best left as an unquantifiable subjective experience.

If I were to restage *[radical]*, I might work more closely with a cognitive neuroscientist to design a research study to factor into the creative process, so that we could effectively measure cortisol-related stress levels through physiological data points. I could also do a better job of conducting pre- and post-surveys targeted at understanding critical feeling by establishing the audience members baselines about body awareness, emotional states, cognitive processing ability and media consumption habits. But as an artist, this was neither my intent nor my process. I learn in the process of designing experiences. I prefer to design "experience grenades,"[411] whereby the audience encounters and internalizes the embodied experience, and may not know what shifts have taken place until weeks later, when a new awareness suddenly surfaces. For me, creative intervention should not be in the service of an idea, but operate quietly. I prefer not to inform people how to think or feel, not to use tools in the service of an issue, but rather let the work be a creative intervention in and of itself, inviting opportunity for change through co-creation and the quiet transformations of hearts and minds. I do not want to track, measure and quantify the impact. I plant a seed with many layers, holes and entry

[410] Ibid, 87.

[411] This is a term coined by Jane McGonigal on her blog which refers to the delayed effects games have upon one's perception. Extract in full: "you play them, and that's like pulling the pin on the grenade. Nothing has to happen right away. Nothing has to be solved right away. Then you wait. It's later, a day later, a week later, a month later...it goes off in your head, like the delayed explosion of a grenade, and you realize you've learned something. Your cognitive patterns are different. Your view of the possibilities of the world around you has changed. Your sense of your own potential has changed. You're ready for something you didn't even know was coming. You understand something intuitively that seems alien or confusing to others." "Avant Games," accessed December 12, 2012, http://blog.avantgames.com.

points and then watch how it grows. *So, what then can be learned from the work with regards to my initial questions?*

Even without embedded metrics, I do believe that the work succeeded in quieting the audiences' and the performers' nervous systems momentarily and that face-to-face, body-to-body social interactions strengthened mirror neuronal engagement. After eight weeks at the MBSR, the dancers conveyed that the rehearsal and performance process similarly afforded a greater sense of embodied subjectivity, my own experience. They felt greater attunement to their own internal milieu and to one another, found themselves more focused; the challenge of the rules quieted their mind. I did not anticipate that the performers' embodied learning processes would come closer to what I envisioned than would that of the audiences'. The combination of the set choreography (language) and intial conditions (game-rules) encouraged the artists to trust unpredictability and be responsive in the moment, which forced them to rely more upon their instinct, their innate biological intelligence, on feeling, producing a sense of presence, bodily awareness and attunement with others. Working with dancers also enabled me to understand how knowledge gets "pushed down into" the body in layers and that there exists a threshold. This allowed me see movement as an opportunity for internalized knowledge and that embodying abstract information about complexity through the performing body might offer an alternate model for teaching. What I gleaned from the dancers created a desire in me to replicate these insights with audience members. Initially, I had falsely presumed that the process of watching dancers move through the screens would encourage the audience to absorb a balanced negotiation among mind-body-environment, which would activate their mirror neurons, establishing an empathetic connection and the desire to non-linguistically communicate. But I was wrong. Most did not actively participate. Many became transfixed. I realized, therefore, that if I wanted to restore critical feeling in the audience (and, more importantly, make them receptive to intractable social change issues), I needed to turn the audience into the performers, to take them through a layered process of embodiment.

Admittedly, there are many gaps between what I proposed and what I observed, but the insights that emerged shows the promise in using ludic performance to conduct more rigorous scientific assays and the potential in iteratively adjusting the work to better

support my hypothesis. The gaps encourage me to push the method further and to refine the integration of biomedia, performative gesture and socio-collaborative play. The insights I have drawn have made more apparent my approach to social change as a fully embodied process. Below I elaborate upon these insights, which make highlight the critical role the body can play in discursively re-inscribing Culture. Following this, the next chapter applies the insights from this assay to offer a new approach to social change through an embodied, bio-adaptive immersive theatre experience.

Critical Reflections

While *[radical]* was an attempt to rescript the nervous system in the hopes of restoring critical feeling, it also sought to resolve the tension between autonomous technology and human agency by illustrating that technology is not an autonomous presence, operating separately from society, but instead, contingent upon society and a symbiotic relationship with the individual. I also discovered that I, too, am not separate but interdependently connected, functioning through an integration of control and autonomy within myself.

Certainly, cybernetics seems to take instrumentalism to an almost evangelical extreme by espousing technology's "cosmic significance." In contrast, *[radical]* advanced a "non-essentialist" stance, one that embraced the full complexity and contradictions inherent in technological development, and its relationships to physical bodies. The work also attempted to move beyond false binaries by instigating a both/and productive tension between autonomy and control, stillness and motion, unpredictability and the pre-determined. As such, the performance and the technologies it employs including the mediated human bodies become "ambivalent artifacts" inside a living system.

Echoing Adrian MacKenzie (discussed in Chapter 2), the technologically mediated bodies of the dancers in *[radical]*, who each wear two biophysical sensors that capture and amplify sounds from their muscle and blood flow, are more than data. Though their affectless faces and game-based trajectories mirror AI walk cycles run by scripts and protocols, their bodies—sites of technological action—are physical; they vibrate, and the amplification of their data generates a shared human experience imbued with complex, contradictory and constantly changing meaning as they move through and

interact across space. The choreography and layered interpenetration of dancers' bodies with various technological systems serve as a relational field of "technological action;" the work consists of a technological ensemble not only because of the wireless network and the various hardware and software used to drive the experience but also because of the social relationships established between dancers and the technology they wear, between the dancers themselves and their relationship with the composer-performer, lighting designer-performer and the audience-performer. The very existence of the work relies upon interdependent causality, which begins with the subtle articulation of viscera communicated through the performative gesture of the dancers. Without this, the "technium"—the living system—remain stillborn. For instance, the AI creatures on the front screen of *[radical]* enables the audience to witness what MacKenzie following Simondon (discussed in Chapter 2) describes as the "co-invention of pre-individuated realities" visually; the musculature contraction and blood flow of the dancers give birth to and sustain (through a Wi-Fi umbilical cord) the life form of the biological algorithm projected on moving screens in a quasi co-parenting relationship with the audience, whose gestures re-shape the non-material child. In addition, the choreography itself, which consists of a database of phrases, like language, becomes a technology—a protocol—for the dancers to communicate and connect with one another. Each layer of data transforms into units of meaning, and together they form an ecology—"a meshing of personal and impersonal forces"[412]—situated in a temporary and unpredictable social context and cultural practice.

The microcosmic entanglement between code and people in *[radical]* is an opportunity to examine, following Dodge and Kitchen, how code shapes socio-cultural and environmental space in everyday life. In this sense, *[radical]* can be considered a coded practice, and the environment in which the work takes place a transductive space. Imbued with *technicity*, the dancers' bodies, equipped with somatic sensors that amplify sound through software "make things happen" in the environment; they catalyze generative sound and imagery, which then invites the audience to interact. Here technology and human bodies fold into one another, establishing hybrid assemblages

[412] Adrian MacKenzie, "The Strange Meshing of Personal and Impersonal Forces in Technological Action," *Culture, Theory & Critique*, 47(2) (2006): 197.

wherein the relationship between the two is complex, contingent, relational and productive. And the dance space, marked off by a grid consisting of eight squares provides a sandbox for challenging what Simondon refers to in another context as "absolute ontological space" through the examination of the spatial formation of collective life and self-organizing systems. Here, space continuously isomorphs through social relations and material practices impacted by human endeavors.

Another tension I observed in *[radical]* lies in the ontonogenetic transduction of space that occurs within the confines of an ontological grid as evidenced by both the tape on the floor and the moving screens in between the dancers and the audience that are based on the golden ratio. MacKenzie describes transduction as a "kind of operation, in which a particular domain undergoes a certain kind of ontogenetic modulation. Through this modulation, in-formation or individuation occurs. That is, transduction involves "a domain taking-on-form sometimes repeatedly."[413]

The use of responsive choreography, whereby the dancers respond to cues from each other and the environment to make decisions about trajectories and phrases facilitates co-existence and oscillation between in-formation and individuation. Much like a crystal, the base materiality of their bodies leaves a trace of sound and imagery through each gesture, which build in density and texture, eventually accumulating into reticular structures. Also the geometric system of organization within which the dancers are located and sometimes confined as a result of specific game rules are repeatedly disrupted by responsive trajectories and unexpected flows of behavior, which ultimately result in the dancers' hacking the system.

But the externalization of the dancers' internal processes, which trigger other unexpected behavior, creates an extension of space, a disruption through sound and generative imagery. The dancers' bodies, in essence, dictate the code, and thereby disrupt the ontological space. One could say, therefore, that *[radical]* is a loose framework for "command and control" but one more akin to Donald MacKay's unrealized subjective-interpretive alternative. Here, the audience experiences the inside rather than the outside of Skinner's box, and the interplay of the experience design renders N. Katherine Hayle's

[413] Dodge, Martin and Robert Kitchin. "Code and the Transduction of Space," *Annals of the Association of American Geographers* 95(1) (2005): 170.

diagram (see FIG. 38 below), an adaptation of A.J. Greimas' semiotic square, physical, but extends it further. For Hayles, the semiotic square schematically exposes the relationships that can emerge when materiality and information "mutually imply one another," thus providing a theoretical framework in which apparently diverse ideas can be understood as different manifestations of the same underlying phenomenon. By establishing an integrated (rather than bifurcated) dialectic, or circuit, between presence/absence and pattern/randomness, she seeks to recuperate the body (a version at least) through an analysis of the implications of virtuality as a *crossing* between materiality and information. In this way, her post-human reworking represents an alternate re-construction of the "virtual body," one that partakes harmoniously of both the ephemerality of information (non-human) and the solidity of physicality (human).

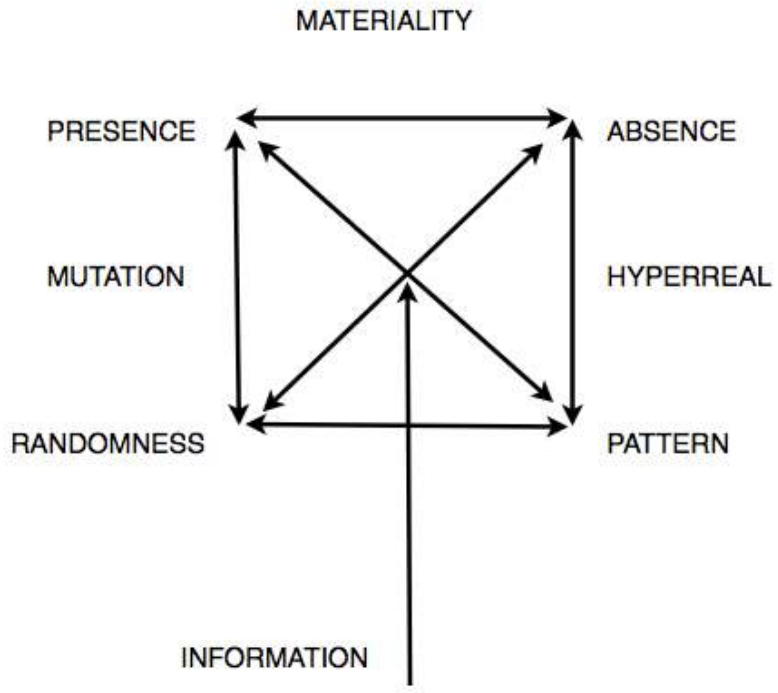

Fig. 38 – Virtuality and Semiotic Square, Recreated, Original by N. Katherine Hayles (1996)

[radical] establishes a similar interfolding, a tension, between the abstract pattern and material instantiation, but one which transmutes in-formation into signification—meaning. In doing so, the work also attempt to recover the body from the dualism that underlies its erasure, but more importantly, the bodies of the dancers serve as a site of resistance to the binary system, and their interpretive decision-making a recursive process of re-inscription—a discursive assertion—that instead seeks to de-stabilize meaning by rendering it contingent and relational. Rather than virtual bodies displacing physical bodies, the physical bodies of the dancers, their internal milieu brings virtual bodies into being and sustains them. The creatures then evolve on their own through adaptation and co-extension with the environment.

The three acts show different states of "transductive individuation," of human development, representing them as a temporary equilibrium for survival, for connection and eventually, albeit temporary, emergence of self-definition (the beacon). All stages, however, possess the pre-individual potential that sustains the process of becoming and induces self-stimulating feedback. Thus, the dancers are suspended in a constant pre-individual state that activates dynamic coupling required for emotion-feeling cycles and knowledge schema production to take place. Simondon sees this process of "constantly being brought into being" as an incomplete solution to a relational problem; each attempt at individuation is interrupted by the disintegration of in-formation. I intended the resulting meta-stability to offer not only a technological, but also a discursive alternative to the cybernetic paradigm, and its latest Renaissance, which I believe emphasizes data-driven predictability, order, control and life enhancing infallibility and immortality. One, which embraced the impermanence, unpredictability, unguided, spontaneous expression, associated with entropy—social chaos and affect.

The database of phrases, like language, becomes a technology—a protocol—for the dancers to communicate and connect with one another, but they also create social conventions to which the dancers must adhere. Adding a layer of game-rules on top of the phrases, created a second layer of constraint to their mobility. The sensors that were tracking, measuring and amplifying the dancers viscera—body data—created a third layer of control by transforming the dancers into functional objects of information for the

music and visual imagery. Dancers represented human APIs, but they were prone to error and cognitive dissonance as they reached thresholds in their processing.

Like the OULIPO poets in Paris, I had intended that the rules would instigate more freedom of play and expression within; the loose frameworks established would inspire the outgrowth of emergent systems. Once the dancers learned the rules, they were given full reign to "hack the system" set up by breaking or reinterpreting the rules, so they could better strategize how to "win the level" through chosen cooperative or competitive dynamics. I had hoped this approach would move away from traditional, pre-determined choreography, where the dancer is merely an AI for the choreographer's protocols. Instead, dancers were given the opportunity to maintain their autonomy by making decisions within the constraints of the established system, if they chose. However, active choice-making only became possible once the first two layers, were firmly embedded within their own system protocols, their muscle memory.

Music and visual imagery were equally determined in part by the singular data sets that were patched into the each artists respective system and the initial conditions that coincided with the rules established by the choreography. To contrast this, therefore, it was important for me to employ the back wall as a space to articulate the shame often underlying subjectivity, which often catalyzes individuation, albeit embedded inside the 3D polygonal connective tissue that represented the dancers "live bodies." Here, improvisational software systems processing/sculpting/composing the data real-time signified the affective body. The slow fade of generative imagery spawned on the front screen, and the final resolution and ramp down of the music that pans around the space before dissolving into a void of silence was intended to leave a tingling sensation of the dancers' affective bodies in the body of the audience, a vibration of shared resonance.

Through this case study of *[radical] signs of life*, I have attempted to explore how a sub-sensorial creative intervention can to recuperate the biological self by 1) re-inscribing the body, affect and the senses into current techno-utopian discourse, and 2) re-stimulating the peripheral nervous system through biomedia, performative gesture and socio-collaborative play.

7. Case Study – Beware of the Dandelions

"Each of us needs to be awakened to a personal and compassionate recognition of the inseparable interconnection between our hearts, minds and bodies; between our physical world and psychical well-being; and between ourselves and all the other selves in our country and world."[414] *Grace Lee Boggs*

7.1. Overview

I intended *[radical] signs of life* to be a "psychic dress rehearsal for the future," an assay, a laboratory space to explore the impacts of emerging technology and to ontologically offer a new technological paradigm that might restore critical feeling. Upon its completion, I wanted to draw upon what I had learned during the creative process, upon the insights offered by the dancers, collaborators and audience members and upon my own observations and reflections. I was particularly keen to make a new game-based experience that positioned the audience as performers shaping their own experience, a new project, one committed to social change. I also wanted to see if I could apply what I had learned from my formal aesthetic practice to a more committed approach. In addition, I sought an opportunity to test out the new Xth Sense functionality on a larger number of users to see if I could facilitate a shared experience that strengthened social connection. Lastly, I wanted to deepen my exploration of the power of play within the context of live performance.

An opportunity for just such an exploration arose through an unexpected collaboration with Complex Movements, an artist collective from Detroit to whom I was introduced after the Allied Media Conference, where I had given a workshop on designing games for social impact. I was struck by their in-progress showing of *Beware of the Dandelions*. Because it possessed so many parallels with *[radical]*, specifically its use of complex science as a framework for system change, I decided to take the project on when the collective approached me. Its story threads aligned with ideas I was working through in my dissertation regarding the legacy of cybernetics and the ways technology, artificial intelligence and life extension might impact the future of humanity. In addition, the collective was seeking an alternative approach to social change through pop culture, one that matched my own theory of change.

[414] Grace Lee Boggs, "These Are Times to Grow Our Souls" (speech at Animating Democracy's National Exchange on Art & Civic Dialogue in Flint, Michigan on October 2003)

7.2. Beware of the Dandelions

Beware of the Dandelions (henceforth BOTD) is an immersive theatre experience and interactive installation that teaches social movement building through complex science. A sci-fi parable set in 2300, the work integrates a data-driven narrative with alternative reality game-based problem solving and live hip-hop performances underscored by DJ samples. Participant-players wear biophysical sensors to control a 3D game engine projection mapped onto a 24 x 12 foot sentient pod hacked into by puppet masters—aka sound vandals. The pod's interface possesses the ability to see, capture and control the entire Hub in which the story unfolds: the Hub is the last habitable climate-controlled enclave where the Captains of Industry grow life extension apples. Player-participants spatially trigger real-time story content through clues, embodied puzzles and data sets. They must interpret the flow of dynamic information to make sense of the non-linear narrative, thereby acting collectively to transform the framework of the Pod—a metaphor for the oppressive social system.

7.2.1. Inspiration

Prior to my joining the group, Complex Movements had been developing different iterations of the concept for several years. They imagined the vehicle as, first, a human-size music box, then as an interactive installation, until it began to take shape as a live audio-visual performance. The collective created an in-progress version of *Beware of the Dandelions* for the Allied Media Conference in the summer of 2014. At that time, the piece consisted of several songs strung together with 3D graphics and DJ sampling all mixed live, but projected onto the pod as if performed elsewhere. A few opportunities for collective decision-making were folded in unnaturally, facilitated through voice prompts and physical objects inside bags with which the audience was to interact. The collective initially approached me to help them build game play into the work, but in the process of reviewing the materials they submitted to me, I realized that what they really needed was an experience designer and story architect to glue all the multi-media elements together and to get the audience to feel as though they were part of a compelling story. Once a

strong narrative and experience architecture was in place, I could integrate the game design into the established framework. During an intensive week-end meeting, during which I walked the collective through my four-part "play as process,"[415] a co-design process which attempts to balance message with engagement. Together, Hip Hop artist, Invincible, DJ Wajeed, graphic artist, Wes Taylor and creative technologist, Carlos Garcia and I completely deconstructed and rebuilt the work from scratch within two days.

Fig. 39 – "Play as Process" Co-Design Session with Complex Movements (2014)

We were able to accomplish so much in so short a session because they had thoroughly prepared for the meeting by thoughtfully responding to the questions I had requested. I asked that they first begin to assemble a world-building document (based on an example I had provided) to help me understand the movement building goals of the work, the themes the story was trying to convey and the issues the work sought to address in local communities. From the their considerations and reflections, I learned the collective's core goals and themes as listed below.

Core Goals

Complex Movements based the core goals on lessons learned and challenges faced through years of community-based activism. The collective cite their mentor Grace Lee Boggs, 99-year old life long activist and political thinker, as their source of inspiration for

[415] "Play as Process" is a co-design methodology that I have developed iterated over the past 5 years, which helps NGOs, educational and cultural institutions think about complexity social issues as a design challenge by undergoing a four-part process, where they work in small interdisciplinary groups. The approach moves participants from the rational to the emotional then onwards to the visual, spatial and temporal in order to unpack system's thinking. In the final stage, participants combine all the accrued documentation from the first three stages to fold into a paper prototype.

both the work and how they think about social change, organizing and the application of complex science to art making and movement building. Many of the goals listed suggest solutions to the "critical failure" they experience in their social justice efforts.

1) Participants will reflect on and reconsider/reimagine how they work for change.
2) Participants will think critically about charismatic singular leadership, and embody collective leadership and partnership models.
3) Participants will think critically about capitalism and resource inequity and embody collective distribution/generation of resources.
4) Participants will think critically about the contradictions inherent in how they work towards change and how these contradictions might reinforce the things they are working to change. They will embody practicing value alignment on multiple scales of a process.
5) Participants will think critically about who their communities are and to whom they relate, so they can embody transforming silos into intersections.
6) Participants will think critically about centralized structures of organization and coalitions, and about decentralized networks; embodying solidarity with autonomy.
7) Participants will embed critical reflection and dialectical thinking into the rest of their objectives/intentions to move beyond false binaries, and they should nurture a space for unexpected connections between those networks they typically would not engage when applied to their own issues.
8) Participants illuminate and support localized self-organized communities working for change and social justice through all of the above objectives.

Core Themes

The themes circled around six organizing principles communicated through emblems of emergence found in nature as an alternative to current movement building strategies. The emblems consist of: Starling (collective leadership), Ants (cooperation), Fern (scale), Dandelion (cross-pollinate), Wavicle (co-existence), and Mycelium (interdependence).

Mycelium was originally a circuit board in the drawings below. Each emblem possesses an inherent duality (i.e. ants are both cooperative, but territorial), which gets integrated by collecting knowledge about the principle, mastering it through use and embodying it through action.

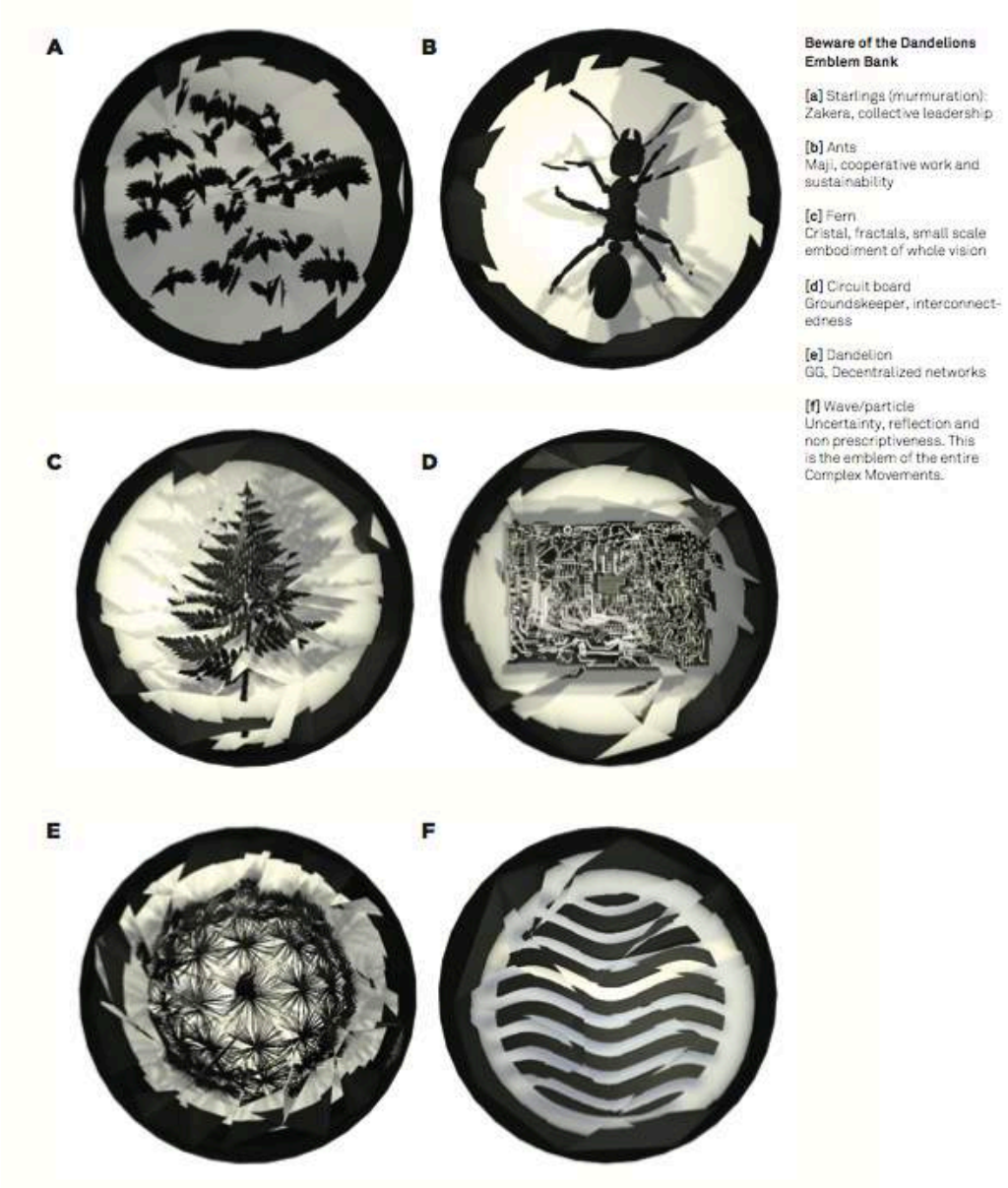

Fig. 40 – Emblems of Biomimetic Organizing Principles, Designed by Wes Taylor (2014)

Core Issues

Although set in the future, many of the issues were present concerns faced by Detroit citizens, specifically land speculation and water privatization. Detroit's issues point to those soon to be faced by national and even global urban areas. The narrative arc, however, also touches upon: insufficient natural resources, economic inequity, climate change, technological determinism, surveillance, militarization, media consolidation and propaganda, mass migration, access to health and bioengineering. The performance would offer alternatives to these issues through collective-decision making within the fictional experience, which would then be translated into local issues encountered by participant-players after the show.

Five key events

In addition to identifying core goals, themes and issues, I also needed to understand the look and feel of the world they envisioned, the scope of the setting, the historical timeline leading up and the five basic elements in the chain of events that would lead to the depicted dystopic crisis. Many of these elements were fleshed out during subsequent visits to Detroit and changed over the course of the development process. But the events remained as follows:

1) Climate land speculation causes displacement and massive immigration
2) Ecological, climate crisis leads to a shortage of water, air and fertile soil
3) Life-extension technology has occurred, but only the elite have access to it, which also creates a disparity in access to health
4) Water is the only currency
5) Mass militarization and surveillance constrain citizens freedom

In conjunction with the above events, I advised that they add the five trends I had sourced during my research into the socio-cultural impacts of technology (from Chapter 3). I used them—slightly transformed—to create dramaturgical design constraints in terms of world building and suggested tools to be employed by participants to heighten the experience of being in 2300. The trends and tools included:

1) Techno-scientific experimentation focused on biomimesis
2) Data-mining and data-driven environment
3) Dematerialized representation of the real caused by scarcity of resources
4) Algorithmic concept of life – computational universe
5) Pervasive gamification of all daily functions
6) Sousveillance via an increase in wearables sensors for quantification and prediction

Using this above information, Ill and I worked together over three intensive 3-4 day sprints to develop a plot and create an outline of narrative actions to convey the plot elements across the four acts, nodes, some linear, some non-linear, that must occur to communicate the story. During this process, we discovered the pre-existing narrative content[416] amounted to only one act. Therefore, we had to extend and revamp much of the plot to address the significant gaps.

Plot Summary[417]

The pseudo-sentient pod reveals the tale of *Beware of the Dandelions*, a post-apocalyptic, urban farming sci-fi parable, which takes place in a dystopian future. The plot unfolds in and around an industrial scale apple orchard dubbed a Planetation, a teeming mass of warehouses and impoverished slums crowded around a climate controlled, militarily guarded dome. The pod installation is imagined as the abandoned headquarters and surveillance station of the Planetation's Groundskeeper where surveillance footage of the dome is archived.

Inside the dome are the orchards, where townspeople are forced to work for their daily water rations by killing dandelions, the greatest threat to the orchards, and harvesting Life Extension Apples. These genetically modified fruits are eaten exclusively by dome-dwellers, the Planetation's relatively few elite, who live comfortably atop the dome and reach lifespans of close to 200 years. Dome-dwellers are governed by a

[416] Ill (aka Invincible) had worked with a story consultant, Nizar Wattad, a year prior to figure out narrative elements, but the format of the script was unusable. We began our process with the knowable and retainable plot points.
[417] This was a plot orally told to me by Ill and then mutually embellished and reworked over many sessions as a starting point. The script, however, took on a life of its own, using many of these plot points as backstory only and for content up to the end of Act 1.

council, which is comprised of captains of industry from the time before the Planetation. Overseeing it all is the obsessed genius Dr. Karrel, who motivated by fear of death to seek eternal life has created life extension apples. Dr. K. has tested these apples on patients without their consent. The first successful test subject was the beloved elder and healer Great Grandsibling (GG), who holds the memory of the time before the Planetation.

Water is controlled by the Planetation's dome dwellers, who use it for their irrigation system and as the last water filtration system. Water liters are the currency with which townspeople purchase necessities. Some, like Maji, the water runner, refuse to work in the Planetation and instead covertly hustle in the underground water economy. Maji is a lone ranger who lives apart from the townspeople, underground in the old dried up water system tunnels, always in ruthless competition with other water runners. This drastically changes after he witness one of the Groundskeeper's henchmen murdering another water runner who once was his arch-nemesis.

Pesticides used in the fields cause many of the townspeople and Planetation workers to fall ill, including the beloved elder GG. Her death is the spark that ignites the townspeople to organize against the inequity of the Apple Orchards Planetation. After years of oppression by the Dome-dwellers, the people begin a movement with sporadic moments of resistance rooted in community led actions. These small, decentralized uprisings are symbolized by the dandelion, held overhead by part-time Planetation worker and street artist Cristal. Their first confrontational action is hacking into the sound system of the Planetation to send the message of resistance: "Beware of the Dandelions".

The Dome-dwellers assign leadership of the resistance to the reluctant Zakera, a young worker and relative of GG. As the rebellion grows, townspeople gather at underground parties called Event Horizons and the movement begins to struggle. The movement splits into two groups (the Reformists and Revoltists). They begin to compete for Zakera's leadership as she passes on GG's wisdom to the group. The contentious groups also try to gain the townpeople's support in hopes of centralizing the tactics and slogan of the movement. The Reformist group seeks entry into the Planetation to enjoy its bounty. They use Zakera to present an anti-pesticide petition to the Groundskeeper who has improved his lot among the dome-dwellers by working to the keep the current system

of labor and inequity in place, though raised among the townspeople. Rejecting the petition, the Groundskeeper assigns a new set of bureaucratic obstacles. The Revoltist group believes that destroying the Planetation will free the townspeople from inequity.

At the next Reformist rally the Revoltists arrive and use forceful tactics that prompt an attack on the attending townspeople. Zakera, targeted as the leader, is brutally arrested. The townspeople are at a loss. In response to Zakera's arrest the Revoltists become more militant and hack into the climate-controlling furnace of the dome. But erupting fire engulfs the whole Planetation and surrounding town. Initially, the Revoltists celebrate, until they realize that they have also destroyed their last access to water filtration.

The survivors are forced to rebuild the town. Their temptation to recentralize partly causes their greatest complex failures. They decide to grow a new dandelion mono-crop to replace the orchard and to help cleanse the pesticides from their bodies, a healing method passed on to them by GG. After a massive drought lasting months, and without access to the Planetation irrigation system, their crops are blighted, and they turn on each other again, hoarding any remaining water liters. The question is to work with the remaining members of the Dome-dwellers who have also survived; this causes additional challenges, distrust, and divisiveness. When the first rain after drought nearly causes a flood the survivors to return to the decentralized approach for survival. They must collectively build emergency shelter from the rain, while simultaneously harvesting the water for their future survival. What develops are agreed upon principles and emblems, which guide their approach in rebuilding.

7.2.2. Ideation

As a result of the co-design process, I then created an architectural framework through which the audience would experience the content. I next focused upon translating the plot summary, narrative outline of major plot events and world-building backstory content that Ill, myself and the rest of the collective crafted together to the experience design by drafting a script in Scrivener to figure out which structure would best convey the essence of all the complex threads and accommodate the game design elements.

Experience Design

BOTD was originally envisioned to possess three modes: performance, installation and workshops. Rather than a limited run of performances, the collective selected key cities where they will actively embed themselves in local communities for a month. All modes are, therefore, intended to inform each other. I will only speak to the performance aspects for which I was responsible.

Performance:

The performance is broken into three parts: pre-experience, experience and post-experience. These three phases loosely map to Joseph Campbell's Hero's journey: separation, initiation and return. The pre-experience transitions the participant-players from the real world into the story world. It establishes the backstory and role the participants will play, functions as a walk through in a game and on a practical level creates a conceit to affix players with sensors. The experience begins once all players are locked inside the pod and is where the bulk of the participatory story unfolds. The post-experience transitions players back to the real world where they are guided through a group discussion by the collective to connect the themes raised in the fictional universe to the issues they face in their communities. The narrative arc possesses a four-act structure based on movement-building stages: stagnation, reaction, regression and transformation. Stagnation parallels the pre-experience; reaction, regression and transformation occur during the experience; and a return to stagnation during post-experience enables audience members to discuss applying what they have learned in an effort to solve their own community problems.

Narrative Structure:

The narrative structure possesses two threads: linear and non-linear. The linear thread, controlled by the Pod, is based on a four-act structure tied to movement-building stages mentioned above, but also loosely parallels Campbell's seventeen stages.[418] There is a

[418] In Joseph Campbell's monomyth the protagonist of the story (in this case the hero is collective, not singular, which ties into our goal to move from a singular charismatic leadership model to a collective one) goes through seventeen stages of self-growth. They include: call to adventure, refusal of call, supernatural aid, crossing first threshold, belly of the whale, road of trials, meeting with the goddess, temptation, atonement with the father, apostasies, the ultimate boon,

non-linear thread of hidden content that the audience triggers spatially, which creates context and texture for the linear elements. This content along with the dynamic data sets mapped to different locations within the Pod's graphic user interface (GUI) offer backstory about the world and characters that inhabit the Hub. Like a strategy game, this content also informs players' collective decision-making process within the linear structure, which enables them to impact the story outcome. As in *Mystery on Fifth Avenue*, where the family of the apartment was unaware that they were living within a game, the audience members will discover that they are in a game, once the glitching pod spits out the first lyric riddle. The collection of non-linear fragments grows in complexity and interconnectedness, enabling the player-participants to crack the final puzzle and alter the system framework. Each act consists of the following mechanics:

1) 5 non-linear hidden clues (visual/audio or lyric riddles)
2) 5 backstory data sets
3) 20 plot advancements (via dialogue, system text or song)
4) 2 songs (theme-based transitions)
5) 2-3 songs (interior monologues)
6) 1 puzzle
7) 1 emblem (embodied social interaction)
8) 1 memory map (multi-act puzzle)
9) 1 decision point

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refusal of return, magic flight, rescue from without, crossing the return threshold, master of two worlds, freedom to live.

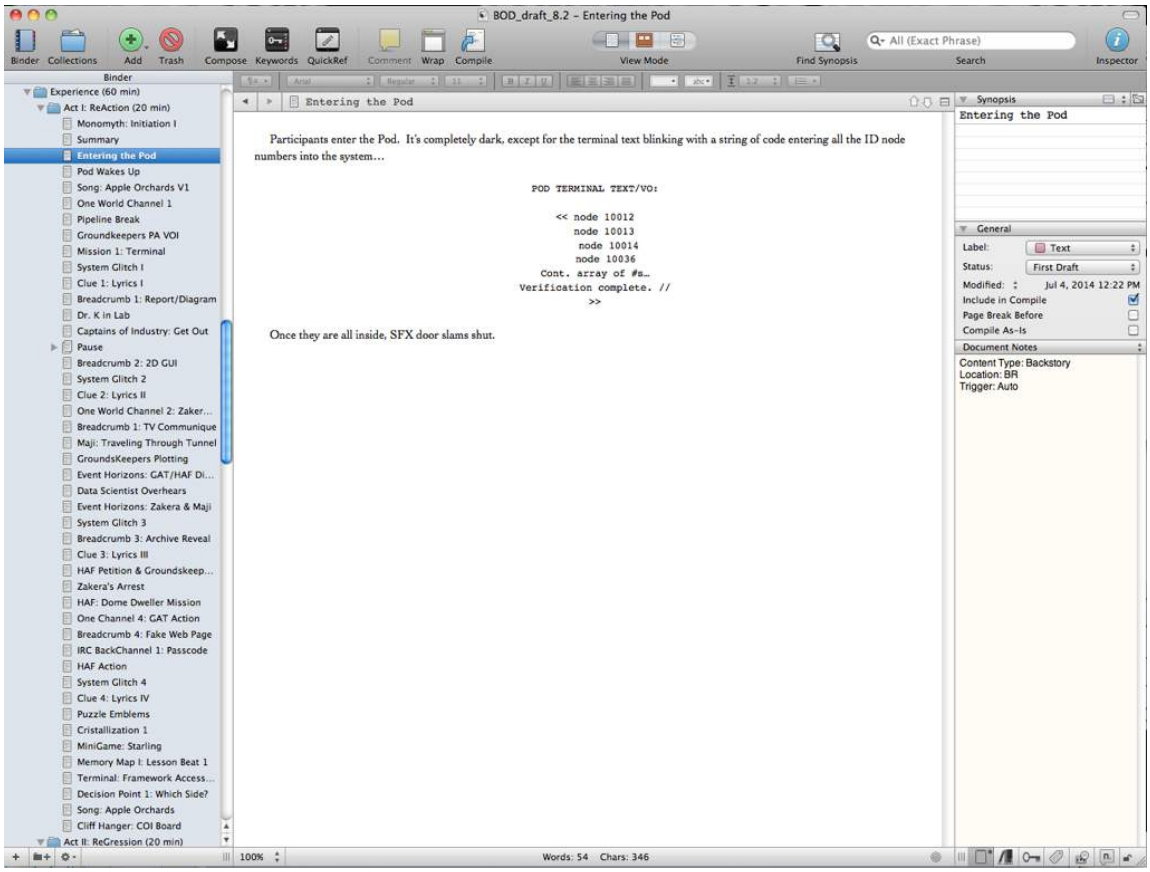

Fig. 41 – *Beware of the Dandelions* Script – Narrative Structure, Heidi Boisvert (2014)

Experience Architecture:

Participant-players are essentially inside a data-driven game engine. The pod serves as one big magic circle in which they experience the performance as an alternate reality game unfolding real-time through fragments of data they are collecting about the outside Hub (and beyond) from inside. The data collection and analysis enables them to make collective decisions that affect "the system" and the world outside. Like drone pilots, participants can control the outside environment remotely through bodily gesture and haptic recognition. Spatial triggers open hidden game layers that provide context and clues to navigate the interface and biometric sensors (which read muscle, blood flow as well as spatial and blood temperature information through the new Xth Sense[419]) allow them to work together to solve embodied puzzles that unlock new content.

[419] Marco Donnarumma and I received a second year of funding from Harvestworks through the Rockefeller Foundation to transform the wireless prototype developed for *[radical]* into a market-ready standalone product with added functionality and an API for interfacing with mobile devices, web-based applications and the Unity game engine.

It's like being on an episode of Star Trek and asked what would you do if you had an hour of your life to change the universe…?

Core Features

Some of the unusual hybrid mechanics woven into the performance are:

Alternative Reality Game (ARG):

BOTD combines a location-specific alternative reality game structure with data-driven narrative elements and multi-media live performance. Because the entire performance takes place inside a single environment, a 24 x 12 foot sentient "surveillance" pod, which fits about 35 people, the clues and puzzles, as well as backstory narrative fragments common to ARGs, are spatially triggered by audience movement patterns, in addition to those automatically triggered by pre-determined system inputs. Through the Pod interface, participants are able to see, capture and control the entire Hub world in which the story takes place. By parsing the various outputs occurring, sometimes simultaneously, participants are "decoding" the content real-time to make sense of the plot experienced as it unfolds, so they can work together to solve puzzles and make decisions that will affect the inhabitants of the Hub environment. The content triggers occur radially from the center of the triangle. The scrivener document (See FIG. 42) established a legend for mapping story content and clues to physical locations to balance the movement of the participant-players, since stasis and passivity was one of the main issues I observed with the original in-progress showing.

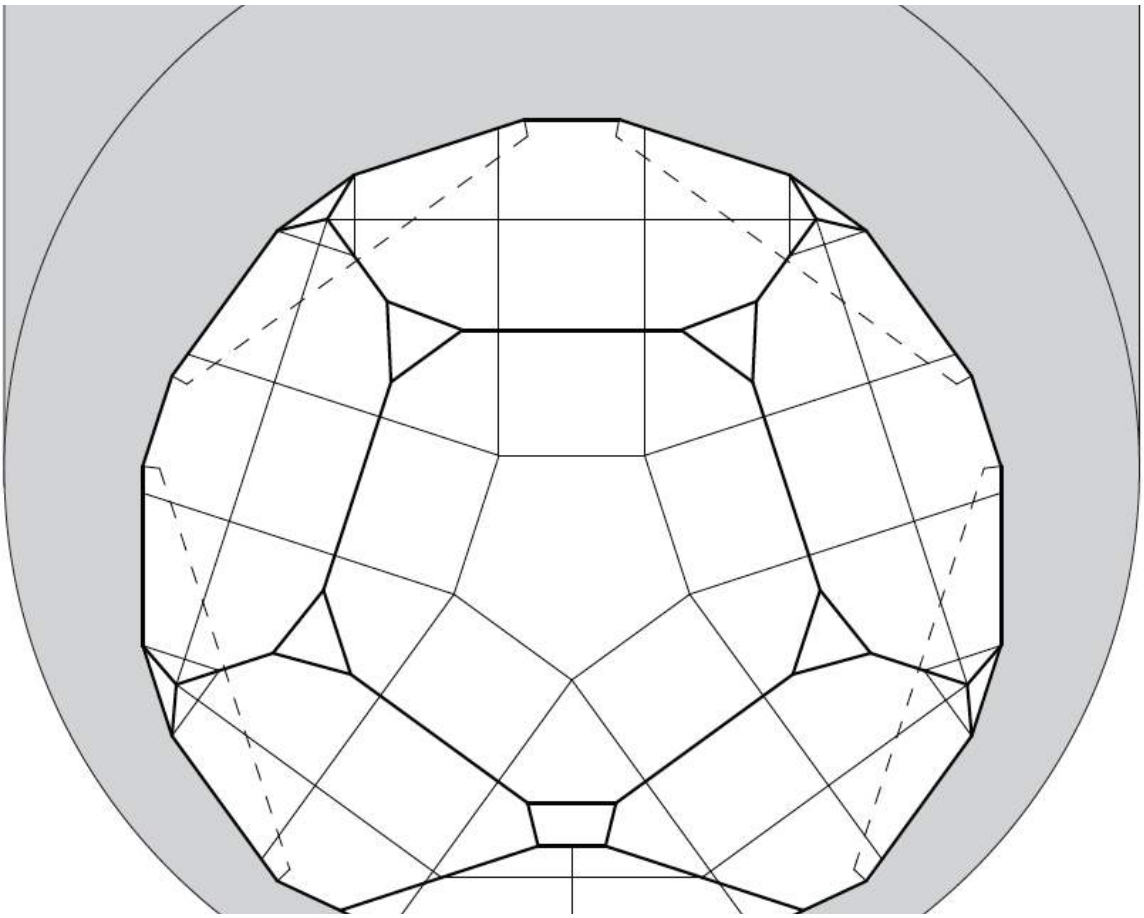

Fig. 42 – Mapping Spatial Content Triggers to Pod Architecture (2014)

The story and game-based elements loosely follow ARG mechanics. BOTD uses some very familiar features, but alters them slightly. For instance, the sound vandals (Complex Movement members) function as collective puppet masters, who are hidden behind (within) the system, hacking its system framework to communicate to the players covertly. Their identity and the larger goal of the mission is revealed at the end when they unlock the Pod door and usher the players out as Invincible, the lyricist, who plays Cris (the leader of the underground movement), reprises verse three of the theme song, *Apple Orchards*. This is intended to indicate that mean-ends are linked, but still subject to human control. Because puppet masters typically do not interact directly with the players in traditional ARGs, here they speak through the Pod as Hip Hop lyric clues. The rabbit hole or trailhead occurs in the pre-experience to drop players into the story world in the

form of a sound vandalism (coded messages sent through the private airwaves) that disrupts the media conglomerate, One Channel's, news programming. Part of the pre-experience is to create the illusion that this is not a game at all, but a real experience as they are being hastily indoctrinated into their jobs on the life extension apple orchard.

Each act possesses one main mission: the participant-players must accomplish it by clue harvesting, puzzle cracking and collective decision-making. Missions are initiated through Terminal code in riddle form, which runs continuously at the back of the Pod. Each mission has both a lesson and a goal. For instance, the goal of first mission is to learn to move beyond "false binaries" and "singular leadership" by applying a collective leadership model, which participant-players embody through a mini-game based on the interdependence of starling behavior. Once successfully completed, the mission helps the participant-players mitigate the chaos witnessed outside in the Hub, experienced through real-time visual changes to the 3D world projection mapped onto the Pod. This is operationalized through level change pushing. The missions are based on a common ARG 3-axis approach: rule-set, authorship, coherence.

Data-Driven Storytelling:

The script does not consist of typical dialogue. It is conveyed through a data narrative. The pod's interface and ability to see, capture and control the entire Hub world in which the story unfolds will tell the story real-time through a series of triggered multi-media displays, consisting of data visualizations, surveillance cameras, system communication, embodied puzzles and biometric data sets. Think a 360-degree *Minority Report* or better yet, a physicalized *Ender's Game*. The projection maps will integrate a 3D world (the Hub[420]) with 2D overlays (context-setting data sets). The audience must process and interpret the flow of information to make sense of the non-linear narrative, which enable them to make decisions based on collective social interaction. In doing so, they are learning complex, pattern recognition to enable them overtime to understand the quantum system to which they gain access. The key to creating this seamless experience was to

[420] The Hub is based on Belle Isle in Detroit. It consists of one level design of 3D interior and exteriors scenes. Participant-players movements will enable them to navigate this world, zoom in and out of certain scenes. But certain locations will also bring up interiors teleport users to new environment. Exterior locations are Dome Dwellers high-rise, Groundskeepers homes, warehouses where citizens live, Planetation, apple orchard and plant. Interior locations consist of underground tunnels, Dr. K's lab, Event Horizon's, Indoctrination Center and DIY Dandelion lab.

establish a timed balance between the constant dynamic content flow of non-linear backstory mixed with highly targeted, linear character scene prompts, which alternately disperse the audience's attention and narrowly focus it through zooming in on particular areas of the map, in an attempt to maintain the ecological assembly process.

Essentially, I wanted to transform information architecture into a form of world making. For this, the Pod needed to appear sentient, a living system with a defined and vocal character capable of nudging the audiences toward continued exploration of the world. To some extent, the Pod is a mad hatter of sorts; a bit delirious from being overloaded by data and fraying at the edges, indicated by glitching and system alerts. We later discover that the constant glitching is the result of sound vandals slowly chipping away at—hacking into—its inner framework, with the unknowing participants' help. In a sense, these base datasets and sound effects which emerge as the system increasingly malfunctions forms its character and also adds another narrative layer, revealing the human regaining control of the environment.

The story world expands through scattered 2D GUI windows. These backstory and context setting GUIs consist of dynamic datasets, including data visualizations, surveillance cameras, system protocols, embodied puzzles and biometric data, such as life extension apple stock, climate control dome levels, climate weirding forecasts, gamification type health meters, leaderboards and many more. These are intended to add color and texture to the story world as well as embed clues. They also resemble Douglas Rushkoff's concept of "fractalnoia;" drawing connection between things, sometimes inappropriately, to making sense of our world entirely in the present tense. The participant's ability to process and interpret the flow of information, act and make decisions teaches them complex, pattern recognition (essential for large-scale systemic change) over time through embodied play.

The narrative fragments triggered by the Pod, which expresses superior collective intelligence brings up, sometimes simultaneously, a diverse set of content types. They are as follows:

1) Backstory - The main linear character and plot points that shape the narrative arc per level told through the various output devices listed below.

2) Clues – They consist of hidden content fragments that get spatially triggered by

players who cause a glitch to the system.

3) Puzzles – They take the form of a riddle inside a song and are automatically loaded once participant-players trigger all non-linear content fragments. Once solved, the system unlocks an emblem, which gives participant-players access to the system's framework. They also serve as a foreshadowing device to help players with the decision points.

4) Mini-Games – They are comprised of embodied social interactions based on biomimetic algorithms mirroring each of the emblems, which players must perform together to affect the DNA of the Pod's framework.

5) Decision Points – After successfully changing the framework, participant-players are confronted by a decision point at the end of each act. These determine the storyline and mission for the next act.

6) Memory Maps – These are lessons that unlock in the form of a 3-part puzzle to offer deeper wisdom about the principles conveyed through the clues and emblems of each act. They also provide a larger historical context for the events happening in the story world, which enable the participant-players to make more informed decision in subsequent acts.

Various multi-media inputs and outputs are employed to communicate content triggers. To balance the spread of modalities, I created a schematic and legend in Scrivener by media content type that I could then map to one of the ten active areas inside the Pod to ensure continuous timing and movement patterns that would cue the participant-players.

Embodied Social Interaction:

In the future, many job functions may be increasingly incentivized by "gamification" strategies to motivate workers through forced play that is easily quantifiable—Taylorism with points and progress meters. This is how the Captains of Industry (corporate overseers) keep the Planetation running—via pervasive play. Additionally, gesture and voice-based interaction will become the norm with the rise of NUI and OUI interfaces, and thus the only way to interface with systems, rendering our relationship with technology ambient, fluid. Therefore, I designed embodied social interactions with the

Pod as a means to over-ride the system protocols through gesture-based biometric data input. BOTD offers two types of embodied social interaction, in addition to the general spatial content triggering: mini-games and memory maps.

Mini-Games

After answering the puzzle and selecting from one of the spinning emblems by a threshold of blob-detected waving hands, all three front panels will transform into a solar system of embodied social interaction. Each player will be outfitted with one new Xth Sense. These are read by the system as a 1:1 mode of interaction guiding the visual and sonic system through bodily gesture and movement orientation. For instance, for Act 1, a starling-like asset will be attached, along with seventy extra starling in their flock, so participants will experience both leading and following, and the visual representation will appear more realistically flock-like. The mini-game is time-based, not goal-oriented, open to emergence, and spontaneous gesture along with what is learned through embodying the emblem principles. This will allow participant-players with disabilities to participate. For instance, the flock might cluster around and merge with someone in a wheel chair, or the disabled individual might construct his or her own pattern, and not fully cohere with the group. The simple rule-sets will be coded generatively as an initial condition for the game play. For instance, the starling emblem consists of the following: 1) Players begin separate, 2) Players must organically cohere, 3) Bounding box or edge of screens cause phase transition, 4) Players must realign and continue on trajectory until they reach murmuration.

Memory Maps

Once the participant-players succeed in working together to move in concert, mirrored both visually and sonically, a part of a memory map beats will play and the terminal framework will simultaneously open. Each fragment will be a partial lesson from GG, encountered as a 3-part clue that will be solved at the end of Act 3. It will be rhythmic, rather than visual/graphic. Instead it will be based on beat/percussion patterns and maybe color patterns (like LEDs along a circuit board), much like Simon Says, which will get stored in the participant-players' inventory and decoded based on non-linguistic call and

response patterns at the end of the performance to garner the final message from GG. The message conveys the broader message of the work; the need to enact change with a more interdependent, complex, intersectional, multi-modal approach. The beats will be based on simple underscores from the theme song, *Apple Orchards*.

Live performance:
There are various types of live performance, which creates a unique interplay between Collective Movements, the audience and the responsive architectural environment. They are as follows:

Hip Hop Lyrics
These lyrics set up the context and themes for each act and serve as interior monologues for character development and plot advancement. In addition, riddle-like lyric clues function as "book codes" (i.e. individual letters, groups of letters are highlighted or underscored, or phrases are cast as visual icons) puncture through during system malfunction, causing a glitch scramble. These are threshold triggered by Kinect-based spatial cues and interrupt linear narrative flow unexpectedly. When all of the clues are collected at the end of the each act through an inventory integrated into the 2D GUI overlays, an emblem puzzle pop ups.

DJ Samples
These samples create motifs that support the themes for each act, but also serve to hold the work stylistically together the entire duration of the performance. They also provide beats for the Hip Hop lyrics and convey the character of the pod through Foley-like SFX.

7.2.3. Implementation
Complex Movements invited me to an artist residency at the Anacostia Art Center in Washington, D.C. in April 2014, and again in July where we tested out the technology options to realize the above concepts, received feedback on the storyline from audiences and conducted workshops on issues raised. All of this went into finalizing the experience design, game play and story architecture. I handed over the script for interpretation at the

beginning of August with enough guidance and openness to support Complex Movement's ability to self-manage the integration of concepts, modalities and experience during both the development process and the run of the show. Due to budget constraints, they were not able to implement the biometric sensor-based triggering or interfacing with unity game engine. Instead, sadly, they went with a combination of Touch Designer, Kinects and web-cam peripherals. The full vision outlined above was not carried out.

Fig. 43 – Testing Unity Projection Mapping in Mini Development Pod (2014)

7.2.4. Insights

BOTD premiered April 15th, 2015 and will stay in Seattle for a month. Audience feedback will be assessed after the first run, but will not coincide with the finalization of this document. The process of developing the experience design and story architecture for BOTD enabled me to see the shared characteristics with *[radical]*, which has helped me to clarify the unique characteristics of ludic performance (described below in more detail)

as an emerging genre. It also allowed me to distinguish ludic performance from other forms of science, technology and performance practices, as well as immersive theatre and implicit games, explored in section 8.2. Lastly, it has encouraged me to begin research and development on an open-source autonomic sensor (based on Silvan Tomkins affective system) to better assess changes to the nervous system and their relationship to critical feeling as they relate to media impact. Part of this research will involve designing an empathy index and methodology for improving culture change projects more in alignment with an embodied theory of social change. I will establish a baseline of ingredients and resolution for balancing the ecological assembly process and fostering memory consolidation before layering in narrative strategies.

Fig. 44 – Run through for Seattle Premiere (2015)

8. Imaginative Forward Glance[421]

"The most basic level of being is play rather than economics, fun rather than rules, goofing around rather than filing in forms." David Graeber in conversation with Stuart Jeffries at the Guardian.

8.1. Overview

Ludic performance offers a unique framework for cultivating critical feeling. This study has shown how the integration of biomedia attunes one to their own internal milieu, how performative gesture transforms social armor and how collaborative play can reactivate mirror neuronal engagement. Using a layered approach to embody knowledge of complex science, it can also equip us with 21st century skills in preparation for the social chaos of "liquid modernity"[422]: empathy, interdependence and adaptability. Like cybernetics, there are many applications of this framework. However, ludic performance can also be enhanced by observing other hybrid emerging forms to discover what can be garnered to further refine my approach to autonomous and committed art-making as a distinct genre. In the following sections, I discuss: 1) anticipated trends in games and performance where the ingredients of ludic performance can add value 2) harnessing emerging intelligent technologies sustainably to ensure critical feeling, and 3) best practices for advancing social change agendas employing new embodied tools. Additionally, I will touch upon future research I will be conducting around empathy, a core component of critical feeling.

8.2. Future of Ludic Performance, Fluid Reality & the Internet of Things

Theatre and games are beginning to overlap in surprising ways as a number of "immersive theatre" and "implicit games" surface and exchange narrative devices and game play conventions. Similar to ludic performance, both seek to strike a balance between specified paths and open exploration. In a recent article posted in the *Guardian*, Thomas McMullen observes,

> At first glance, theatre and games seem like opposing art forms – one steeped in hundreds of years of convention; the other technologically advanced and obsessively forward-looking. But beneath

[421] This is a nod to Norbert Wiener. In *Human Use of Humans* he uses this phrase to galvanize scientists and engineers in an "attempt to assess the impact of innovation, even before it is known."
[422] A term coined by sociologist, Zygmunt Bauman, to describe our shift to a remote, global economy driven by software, which believes heightens complexity, uncertainty and ambivalence.

> surface, there are many similarities. They can play with us in ways the film and television cannot. And increasingly they are moving closer together.[423]

The more embodied, personalized and collaborative they become, their further integration can restore critical feeling and serve to move us closer together.

Like BOTD, immersive theatre refers to any performance where the audience is transformed into participant-players, where they become part of the story and are given a physical role to play in the ensuing action. Sometimes the audience is lured from scene to scene and sometimes they are simply given free reign to explore the physical space and archaeologically dig into the sets densely laden with props adding layers of meaning to their experience. Over the past few years, a number of production companies have cropped up in Britain mainly, most notably Punchdrunk, Belt-up and dreamthinkspeak. The productions take over whole warehouses in various cities, wherein they orchestrate elaborate sets resembling level design in a game.

Sleep No More was probably the first to do this exceedingly well, helping to give birth to and shape the form. Considered "promenade theatre," the work is an adaptation of *Macbeth* that takes place in a 1930s hotel, resembling décor from *Bioshock* using sparse dialogue and Joseph Cornell box-like sets. I had a meeting with the producer, Colin Nightingale, a few years back after I experienced the production and saw the potential to interweave ARG mechanics into the experience design. At the time, I was developing a locative game on homelessness and wanted to comprehend how his show was operationalized and the branching narrative architected. What I found most illuminating from our conversation was that the timing of co-existing scenes hinged upon the actors responsiveness to sound cues.

[423] Thomas McMullen, "The immersed audience: how theatre is taking its cue from video games," accessed May 20, 2014, http://www.thegaurdian.com/technology/2014/may/20/how-theatre-is-taking-its-cue-from-video-games.

Fig. 45 – Sleep No More, Punchdrunk (2011)

Indie games, too, have begun to experiment in more nuanced ways with combining scripted events with audience freedom to get closer to achieving what Jonathan Blow refers to as "dynamic meaning."[424] Rather than reward-based narrative constructs, games such as *Gone Home* let players explore a 3D world entirely without non-player characters or established missions. As players navigate a vacated family home, they encounter journals and tapes that slowly open up the story world. *Drowned Man*, Punchdrunk's latest undertaking, was informed by the implicit narrative structure in *Gone Home*. Set within Temple Studio amidst a waning 1960s Hollywood, *Drowned Man* similarly allows audiences to physically encounter hidden messages and unusual objects that facilitate the weaving together of two distinct narratives. As the Creative Director, Felix Barrett explains "You've either just missed the action or its' just about to happen and you're suspended in-between…Rather than the audience crafting their own narrative they are peeling back layers of story."[425] The elaborately decorated sets

[424] During a GDC presentation, Jonathan Blow notes that games are uniquely positioned to: "superimpose story with 'dynamical meaning,' which is to say the meaning that grows out of exploring a game's rules and boundaries. While story can provide 'interesting mental stuff' such as theme and mood, this can and should grow out of what makes games unique: play." Tom Bissell, *Extra Lives: Why Video Games Matter* (New York: Pantheon Books, 2010), 92-3.
[425] Thomas McMullen, "The immersed audience: how theatre is taking its cue from video games," accessed May 20th, 2014, http://www.theguardian.com/technology/2014/may/20/how-theatre-is-taking-its-cue-from-video-games.

common to immersive theatre encourage audiences to physically dig into the story, much like a player virtually uncovers subplots in *Skyrim*. This is a method I employed in BOTD. I cast participant-players as "active assemblers" of the data-narrative, but the emphasis was on collective analysis of clues to crack puzzles to inform decision-making, which transforms the storyline. I wanted participant-players to actively co-create their own collective narrative—a time capsule—through embodied game play.

Fig. 46 – Fullbright, *Gone Home* (2013)

Still, Thomas McMullen is convinced that the boundaries between immersive theatre and implicit games are dissolving,

> Games are growing, breaching into other spaces to define their own territory. Theatre is doing the same, snatching at its neighbors, testing its barriers. They make spaces of their own but their overlap is quietly growing. Standing in a room, whether in a game or a performance, you still search for story. You have the same desire to explore.[426]

I, however, would argue that neither immersive theater nor implicit games come as close to the integration I suggest with ludic performance. While I agree story and exploration are critical ingredients to sustained engagement and both approaches create equally effective opportunities for audience improvisation, responsive interaction, agency, curiosity and surprise, all movements away from the procedural rhetoric associated with cybernetics, both mediums subordinate gameness to little more than interactive storytelling. When done well, the mechanics of play can become a form of narrative expression on their own. Blow would disagree; he argues that "story and challenge have a structural conflict that's so deeply ingrained that it prevents the stories from being

[426] Ibid.

good…and ends up making games that are fake, unimportant, arbitrary and careless," which, he implies here, short-circuits games' potential for emotional appeal. Blow's solution (first explored in *Braid*, a platformer game that plays with notions of time) seeks to cleverly integrate game play with themes and motifs, rather than words; "the language of game play is driven by sensations."[427] Evocative imagery, passionate silence and non-verbal expression is also a signature device skillfully executed in *Sleep No More*, but *Door into the Dark* gets closer to exploration and storytelling motivated by audience sensations.

Door into the Dark had its U.S. premiere this year at Tribeca Film Festival's *Storyscapes*. It was situated down a lonely hall separated from the rest of the hyped ocular-centric projects. It was by far the most compelling work I experienced at the Festival. Described as an immersive journey into "unmapped experience" encountered entirely through sound, touch and smell, the audience member is blindfolded, so to speak, with a hard-helmet and tinted visor that covers the face. A set of industrial-sized headphones completed the headgear. As I navigated the space by holding onto a rope, IBeacons trigger a soothing Janet-Cardiff-like philosophical narration into the headphones, metaphorically connecting the rope to the hippocampus and memory. Suddenly, I reached the end of my rope (literally and metaphorically) and was plunged into the void waiting for the next sound cue or sensation to guide me. Co-Director, May Abdalla, states in the press release: "Neuroscientific research tells us that the act of setting out in uncharted territory has a unique impact on the brain, sensorial sensitivity is heightened and we have the possibility to create new pathways, which we come to again and again." The documentaries often speak of a sense of necessarily surrendering to the void upon meeting with severe difficulties. The stories I heard as I walked up a steep slope felt somehow more intimately connected to my own when activated proprioceptively through the simple movement of my body. Stories told by anonymous subjects about their worlds going out of balance while experiencing sensory deprivation and absence of direction resonated with my own experiential sense of being lost after I unraveled this past year. But the installation held a similar power over others. Sara Wolozin, Director of the MIT Doc Lab, expressed that she, too, "found *Door into the*

[427] Tom Bissell, *Extra Lives: Why Video Games Matter* (New York: Pantheon Books, 2010), 94.

Dark to be a transformative experience." She claims, "When [she] exited, [she] had a whole new relationship to [her] body and [her] other senses." At the end of the experience, I was handed an envelope and asked to draw my journey through the space. I felt as though I had been going in tiny circles, back and forth, that I had only superficially travelled, but in fact the set is quite large. The Harmony Institute, a non-profit that researches the art and science of influence, conducted user studies employing biometric sensors to connect participant's vitals to story moments and the visual map. Their intent is to triangulate data points with moments of empathy constructed in the narrative. My instinct, however, was to suggest triggering story content with the sensors instead to change narrative contours based on real-time personalized physiological input. This is where I predict the convergence of games and performance to be heading as the Internet of things takes over. I see ludic performance adding tremendous value here as a medium to enhance critical feeling.

Robert Pratten, inventor of Conducttr, a transmedia storytelling platform, possesses a similar hunch. He believes that as the Internet of things becomes more seamlessly integrated into our daily lives, more opportunities for play and story to co-mingle will emerge. In a recent self-published article, "Where Next for Reality?" Pratten predicts that we are entering "an age of fluid reality."[428] As a result of our accommodation to the mediation of co-existing parallel realities, the blurring of virtual and real, our natural tendency to make meaning from various fragments through a cohesive story is transforming. He foresees that we will need to design stories that fit around people's pre-existing habits, interests and schedules and that "AR [augmented reality] and MR [mixed reality] offer an opportunity to create experiences that are more connected, personalized, participatory and social." But the Holy Grail is mixed reality (MR) where "experiences start in the real world, dip into a completely virtual world, go to an augmented reality and then finish with alternative reality before passing participant back into their preferred reality."[429] He cites "Meet Lucy"[430] as an example of what is to

[428] Robert Pratten, "Where Next for Reality?" *LinkedIn Pulse*, April 21st 2015, accessed April 21, 2015, https://www.linkedin.com/pulse/where-next-reality-robert-pratten?redirectFromSplash=true.
[429] Ibid.
[430] "Meet Lucy," accessed April 28, 2015, http://www.storycentral.com/interactive-purposeful-storytelling-meets-virtual-reality-at-learn-do-share-london-with-meet-lucy/.

come. “Meet Lucy” is a pervasive storytelling experience about housing issues in London created by Nina Simoes and written by David Varela which integrates Pratten’s Conducttr platform with the Oculus Rift and Unity Game Engine. Basically, players meet Lucy Maddox online via email, SMS and blogs posts, and then the story culminates in a live event where you can step into Lucy’s virtual world via the Oculus Rift.

But mixed reality experiences require huge time investment on the part of both the maker and player. *Ingress* offers a more fluid pervasive experience; it overlays players journey between places while they are on the go. *Ingress* is an augmented reality massively-multiplayer online role playing GPS-dependent game created by Niantic Labs initially for the Android, but now compatible with IPhone. I think that, perhaps, interfacing with Google glasses or another immersive display might make dramaturgical sense. The experience is a continuous open science fiction narrative and real-time strategy game about factions fighting for the future of the world. Players establish “portals” (rendered apparent by the “scanner,” your phone) at places of geographic and cultural significance. Portals can be different colors depending upon who controls that region, i.e. Enlightened, the Resistance or unclaimed. Players can claim portals for a faction by collecting eight resonators. Resonators establish “control fields” which are made by linking together three portals in a triangle geographically. *Ingress*, however, could easily be a starting point for the incorporation of mixed reality features; control fields could lead to VR experiences at sites of cultural significance, enabling deeper sensorial explorations into space and portals could function as nodal points for embedding ARG content fragments.

Through these works, I see the key features of ludic performance, biomedia, performative gesture and socio-collaborative play enhancing and personalizing mixed reality. Biomedia, particularly, could serve as a core driver of experience across augmented, alternative and virtual reality, the performer-player could play a more autonomous role in both integrating into and altering the story world and collaborative problem solving in physical spaces could add another dimension to designing experiences for pervasive, long-term play. *But how can we ensure that the Internet of things and mixed reality will not further erode areas of the brain required for emotion-feeling cycles and knowledge-schema production? How will ludic performance integrated within fluid*

reality connect humans, makes them more compassionate, empathetic and aware of their interdependence? How can we employ these technologies as a means to restore critical feeling and connect to social change issues in a meaningful way, which bridge the virtual and the physical? Because fluid reality suggests an opportunity for repetition and slow transformation, ludic performance can play an important role in neutralizing the effects of the various intelligent technology employed by reasserting sub-sensorial awareness of the body, affect and the senses.

8.3. Designing Empathy Engines for Social Change

Immersive theatre, implicit games and mixed reality, like ludic performance, indirectly move us closer to addressing some of the issues raised in the preceding chapters: loss of connection, emotional attunement, empathy and embodiment. *But what happens when we integrate delicate social justice content into immersive theatre and implicit games with or without emerging technology that erodes our ability to experience critical feeling?* For instance, the immersive theatre piece, *Struggles for Survival*,[431] a 75-minute refugee and poverty simulation attempts to represent experiences faced by those in need (i.e. lack of education, shelter, medical care, water, food, the squeeze of marketplace corruption and suffering the abusive opportunism of loan sharks in communities with weak legal infrastructure). The piece was created in collaboration with NGOs, fieldworkers and local communities faced by the very issues addressed and performed by humanitarian workers at Davos this past year. Another project, *Labyrinth Psychotica*, created by Dutch artist Jennifer Kanary and funded by Johnson and Johnson, seeks to cultivate empathy for those experiencing psychosis. As Kanary describes, "the aim of the artistic creation is to allow a person to temporarily surrender to a cinematic narrative in which reality is altered in such a way that it becomes similar to psychosis."[432] The participant is equipped with a head-mounted display with two LED screens, giving the effect of a wide screen TV and a single camera that enables the participant to see and hear the world in front but filtered real-time by software manipulation through a laptop computer strapped to their back. The audio and visual effects mirror the varying states of psychosis, whereby your "senses are

[431] "Struggles for Survival," accessed February 3, 2015, http://www.crossroads.org.hk.
[432] Labryrinth Psychotica," accessed July 15, 2014, http://labyrinthpsychotica.org/Labyrinth_Psychotica/Home.html.

under attack," depending upon the participant's choices and the path they travel through a physical installation of a labyrinth, triggered by a Wii game controller. For Kanary, psychosis, like a labyrinth, is a spiritual journey towards one self; it is both a losing and finding of one self.

Fig. 47 –Jennifer Kanary, *Labyrinth Psychotica* (2011-4)

Both works are well-intentioned and thoughtful articulations of sensitive content and incorporated cross-sector partnerships in the co-design process, yet they still raise concerns about poverty porn, exoticizing the "other" through dark tourism and the importance of establishing an "after-care" model when throwing participants into deep trauma, even virtually. Interestingly, Kanary is concerned about communicating the neurobiological mechanisms behind psychosis, but not about the neurobiological implications of choosing virtual reality as a medium that may be destroying key areas in the brain responsible for emotion regulation.

There has been a flurry of discussion about contradictions inherent in culture change interventions, such as these, which attempt to elicit empathy without acknowledging that the tools the creative technologists employ are eroding the critical feeling required to experience empathy. The past few months have specifically addressed the claims and limits of virtual reality (VR) as an "empathy engine." I contribute to a media impact list serve put together by Tribeca New Media Fund and MIT to discuss social justice documentary, interactive storytelling and games for change. Many have begun to voice concerns similar to those I have been suggesting here. The conversation arose as a result of a few projects showcased at Sundance this past year and a recent Ted talk by the artist Chris Milk, where he boldly asserts: "I think we can change minds with this machine."[433] One project in particular became the focus of a conversation thread on the list serve: *Clouds Over Sidra*, directed by Milk and funded by UNICEF, which premiered at Davos for policymakers and was later taken to Sundance. Media strategist Lina Srvistava stated, "It creates a deep sense of immersion and responsibility, but is there enough when talking about social impact in the realm of rights?" She further argued, "We may leave feeling more empathy or [after] having been rewired somehow want to act. But that has to be tied to a responsibility or an accountability on those who have the influence and ability to act."[434] Wendy Levy, Executive Director of NAMAC, expanded upon Lina's concern: "I cannot imagine that those suffering human rights abuses and living in deep risk would want us to feel as badly as they do because it is our project to do so, to manufacture feelings of the horror in order to replicate the experience for those of us privileged enough to turn the reality on and off." However, Liz Manne, CEO of Film Aid, while acknowledging the dangers in "vicarious trauma," sees that there is a greater need for in-depth, evidence-based training and guidance, which VR and immersive theatre could facilitate. She forwards,

> Being able to have these experiences has made me a stronger, more informed, more persuasive advocate, and I have to believe that is a good thing. And if VR and immersive theatre can get large numbers of people closer to being stronger, more informed, and more persuasive advocates, that's a good thing…a net positive for the planet.

[433] "How Virtual Reality Can Create the Ultimate Empathy Machine," TED, accessed March 20, 2015, http://www.ted.com/talks/chris_milk_how_virtual_reality_can_create_the_ultimate_empathy_machine.
[434] MIT media-impact list serve, email to the author, February 3, 2015.

Fig. 48 – Chris Milk & UNICEF, *Clouds Over Sid*ra (2015)

How then can I continue to make work employing emerging technology that cultivates critical feeling, empathy, without reproducing conditions of oppression through a colonizing or patrimonial gaze? Does an ocular-centric full 360-degree experience with binaural sound, which makes the frame disappear, allowing the participant to feel as if he or she are sitting on the same ground as Sidra, a refugee in the UNICEF project, enable him or her to "feel her humanity in a deeper way, empathize in a deeper way," than cinematic representation, as Milk contends? And what is our intention and responsibility as makers when we induce "vicarious trauma"? What, if anything, can ludic performance, ameliorate through the use of biomedia, performative gesture and socio-collaborative play? For one, it can offer a more embodied, grounded approach to social change and create the optimal conditions for a base layer of critical feeling on top of which issues-based content can be layered. Furthermore, I hope my chosen approach can augment presence through mobility, personalize the experience through biofeedback and encourage us to act through social interaction with other player-characters. Yet, the neurobiological ramifications (except for the limited CHI study reference in Chapter 2) of VR are not known.

Adding movement, biofeedback, and social interaction into the mix with other non-virtual human beings within the experience might get us closer to being there, and even touch us enough to move us to act, but we will still experience the lives of others "at-a-distance." But maybe losing ourselves through the acceptance of counter transference of the other, even if momentarily, to feel psychologically touched by another's discomfort as if it were our own, can reignite the critical feeling necessary for social change. Maybe a "machine" can simulate the naturally occurring phenomenon of presence.

Telepresence, simulated touch, was coined by Patrick Gunkel and brought into the mainstream by Marvin Minsky in a 1980 essay. To create genuine telepresence, wrote Minksy "we must supply more natural sensory channels – touch, pressure, textures and vibration. We must learn which sensory defects are most tolerable."[435] BeAnotherLab sets out to manifest Minsky's vision. The lab's mission is "to create experiential demos to promote empathy." A *Machine to Be Another*, the lab's first product, creates different scenarios that enable participants to inhabit another persons body and thoughts through a simple set up: Oculus Rift, Arduino, Webcam, Headphones and Laptop. *Gender Swap* is a popular version of the demo, which has been seen (though not experienced) by millions. Here participants put on an Oculus Rift and are asked to close their eyes. The researchers transition the visual program to the field of view of the performer. While the participant's eyes are closed, sound is piped in of the female performer talking about feminism and body issues. Once the participant opens their eyes, they are handed an object, which they reach for, helping the participant to experience the performer's body as his own.[436] The self-image and thoughts now become part of the participant's own stream of consciousness. Co-Founder Phillip Betrand believes the machine has transformative potential, even in its fledgling stages. He proposes:

> What we have seen is that this machine can work to promote empathy between people with bias and there are neuroscientific experiments that provide that this individual of technology can reduce this implicit bias. Just seeing yourself in a black avatar, it reduces your bias; it's really incredible and powerful.[437]

[435] Marvin Minsky, "Telepresence,", accessed April 20, 2015, http://web.media.mit.edu/~minksky/papers/Telepresence.html. Originally printed in OMNI magazine, June 1980.
[436] An update on Catherine Richardson's work referenced in Chapter 4.
[437] Aaron Souppouris, "Virtual reality made me believe I was someone else," accessed March 24, 2014, http://www.theverge.com/2014/3/24/5526694/virtual-reality-made-me-believe-i-was-someone-else.

Fig. 49 – BeAnother Lab, *Gender Swap* (2015)

Robert Coxon, a professor at the University of Southern Denmark, agrees with Betrand. He has been researching the ecology of care and thinks technologies like *A Machine to Be Another* can aid his ability to design systems that improve the healthcare system. It might allow him "to get close to [patient's] world and the way they see it." However, during his experience of *Gender Swap*, Coxon oddly enough was unable to fully transport himself into Norma's (the other performer) mind. He said "my researcher brain, my logical brain, was constantly at war with relaxing and just letting it flow and happen rather than just being receptive towards it." But he felt the small transference was enough to prove the feasibility of the experiment, though also its limitations. "Our bodies are giving us all sorts of signals all the time; it's a very complex system to try and trick, it has all sorts of safeguards."[438] Coxon raises three important points: 1) one must experience the loss of the self, let go of one's own ego and social armor, to empathize with another; 2) changing implicit bias requires cracking the culture code lodged in the limbic system, which forms between the ages of 3-7; and 3) neural plasticity occurs through repeat exposure and mirror neuronal engagement. Current intelligent technology, which

[438] Ibid.

reinforces the ego and limits mirror neuronal engagement may actually contribute to the firewalls Coxon encountered.

While it is not clear if one-off experiences can enable us to feel what another feels, the proliferation of creative projects and technologies targeted at eliciting empathy over the past year points to a concern that critical feeling, human connection and a relationship to our bodies, emotions and the senses are being eroded by our dependence upon technologies, and an awareness that they are necessary to both well-being and social cohesion. *Yet, I still wonder, isn't it counter-intuitive to tackle our technology addiction with technology?* As these examples have shown, there are many contradictions inherent in employing technology to evoke empathy, especially if the root cause of its loss is not addressed. As I have argued throughout this dissertation, both knowledge-schemas and emotion-feeling activation and regulation ignite the critical feeling essential for not only instigating attitudinal and behavior change, but also mobilizing large-scale systemic change. One cannot study empathy without understanding the mechanisms behind critical feeling. Because the brain regions responsible for memory consolidation, which catalyzes these two processes, are overloaded, we are becoming less responsive to socio-emotional cues and our capacity for empathy is decreasing as a result of our dependence upon intelligent technologies. Empathy, as Antonio Damasio's team revealed,[439] requires slower processing, more attention, perspective taking, and dual awareness, rare commodities these days.

My future research will, therefore, attempt to better understand how emerging, intelligent technologies, narrative strategies, interactive mechanics and content can cultivate empathy and the conversion into social action. I want to create stories that move and apply what I have learned from ludic performance practices to a design methodology for the creation of more impactful culture/change projects. When we talk about impact, we need to develop more rigorous scientific metrics, and a deeper, context-specific knowledge of how tools and content affect the limbic system. To this end, I have accepted a fellowship at the Harmony Institute to explore this intersection and to extend this research to figure out how we can still harness emerging intelligent technology to

[439] See full study described in Chapter 2.

create compelling narrative and sensory experiences that specifically enhance empathy for social change efforts.

9. Conclusion

"How can we get out of the maelstrom of our own ingenuity?" Marshall McLuhan

Critical thought on the role of technology has oriented from two opposed camps for over two centuries: as an unavoidable force driving progress or as a phenomenon that harms human agency. In this dissertation I have attempted to outline a both/and position. I have framed Technology as an ambivalent artifact and designed creative interventions to re-balance our “dance of agency” with technological systems, but I still believe that the design of current intelligent technology, namely the Internet, mobile devices, immersive displays and wearables, and the cultural habits that form around our consumption is making us less human. It is numbing our biological selves through a form of what Marshall McLuhan calls "auto-amputation." Through both personal experience and clinical findings, I have argued that this not only dissolves our knowledge-schemas and renders us emotionally void, but also temporarily re-wires neurons to prefer technology to actual human engagement. Many people are addicted to technology. Like any form of addiction, it is a way of numbing; what one typically numb is shame, a fear of disconnection for not being worthy of love and belonging. Technology encourages the "performance of connections" which affords a greater ability to control relationships and manage presentational selves. It enables us to effectively defend against vulnerability, emotion and the messiness of subjectivity. In doing so, we have allowed technology to co-opt our cognitive and affective faculties, a form of slow violence spiking cortisol levels and re-scripting our nervous system, and we have become less human. Unknowingly, we have unknowingly become like our tools, APIs run by software protocols and algorithms devised by invisible technological ensembles masked as participation. Many clinical studies, as I have shown, support these personal observations.

First, Nicholas Carr reveals how the Internet clogs working memory and decreases the ability to empathize with others (it disallows synaptic terminals to form in the frontal lobe, which serves to truncate explicit memory consolidation). Second, a study at Xidian University in Shanghai monitored the effects of long-term Internet addiction on the adolescent brain. Their findings reveal that changes to the gray matter volume, impair

psychological well-being, increase academic failure, and reduce work performance. Lastly, just a few months ago, UCLA scientists showed the rise of social-emotional incompetence in young people as a result of less face-to-face time. When students were sent to a nature and science camp without any electronic devices their ability to read facial expressions and non-verbal cues significantly increased in only five days.

My encounter with these findings and numerable others led me to become wary of the easy technology-first solutions to social problems. I began asking provocative questions about the design of contemporary intelligent technology—the Internet, mobile devices, immersive displays and wearables. I began to deconstruct my own theory of social change: *How can large-scale change happen in our current media ecology of constant interruption? Is behavior and attitudinal shift still possible in an increasingly affectless society, even if we take up the commercial tools that surreptitiously shape the public imagination? And is social engineering for good just another form of propaganda and mind control?* In stepping back, I have observed how my own culture change work was potentially feeding into the cybernetic legacy of quantification, predication and control and possibly undermining my efforts. By appropriating intelligent technology as value-neutral and instrumental, I realized that change agents, too, were potentially reinforcing the systems of oppression caused by our dependence on technology. As a creative technologist, I came to the conclusion that it was my responsibility to not only reflect upon how emerging technology shapes our cultural values and social behavior, but also to anticipate, and actively contribute to a counter discourse and design practice that challenged and transformed these technologies.

To delve more deeply into some of these problems and solutions, I went completely off the grid to the coast of Maine—a self-imposed detoxification program from all social media and most technology—to deeply reflect upon the socio-cultural and neurobiological effects of intelligent technologies. This retreat and un-wiring afforded me the opportunity to live more deliberatively and engage with others in person. From this place of solitude, I observed that before large-scale mind and heart shifts can happen, we must restore "critical feeling."

In an attempt to explore how to restore critical feeling, I began to further experiment with creating multi-media performances using biotechnology inside

immersive environments as a microcosmic sandbox to test out an alternative technological paradigm. Interestingly, my research has shown that the same areas of the brain—the hippocampus and the amygdala—are regenerated through mindfulness and kinesthetic engagement. While *[radical] signs of life* afforded me an opportunity to test if biomedia combined with performative gesture and socio-collaborative play could re-stimulate numbed areas of the brain through sonic vibration emanating from an array of subwoofers (amplifying body sounds), transporting audiences from stimulus confusion to presence of being, *Beware of the Dandelions*, enabled me to apply my findings more consciously to movement building.

Through both my creative process and life experiences, I have also discovered the powerful role that our somatic and autonomic systems play in shaping our perception of the world; the look and feel of the world is quite literally colored by our own nervous system. With the rising levels of techno-stress, most nervous systems whether conscious or not are now poised at a higher threshold of fight or flight. Fear-based response over time may become not only a permanent neuro-musculature feature reinforcing a defensive social armor and disconnecting us from our feelings, but it might also shape our neuropeptide communication networks. Both can contribute to slowly re-scripting the nervous system and quite possibly epigenetic structure, as a recent study on intergenerational cortisol level changes resulting from Holocaust trauma indicates.[440]

By contrast, deep breathing, body alignment and releasing muscle contraction through kinesthesia and the learning of new gestures, as Carrie Noland contends, and as the subject of *Enter the Faun* demonstrates, can quiet the nervous system and allow us to process emotions that get lodged in the psychosomatic network, the connective tissue and neuropeptide ligands. My own experience, too, attests to the educability of the nervous system and an awareness that the immune, endocrine and nervous system all depend upon

[440] A recent study at Icahn School of Medicine at Mount Sinai and the James Veteran's Affairs Medical Center in the Bronx, N.Y. conducted by Rachel Yehuda examined the intergenerational effects of trauma. The results show that the offspring of Holocaust survivors have lower cortisol levels, as well as enzyme levels, which helps breakdown cortisol. This increases their risk for anxiety and chronic stress. Epigenetic changes typically prepare offspring for the environment, but this adaption produces the opposite; children of survivors are unprepared for conditions of starvation, and stress experienced by their parents. This also makes them more at risk for metabolic syndromes. While today's techno-stress due to the constant onslaught of our media ecology is certainly not as overtly damaging, I am establishing a correlation between the slow violence—the erosion of key regulation functions for emotions, and other stress response systems tied to cortisol spikes caused by technology—and epigenetic (in utero) changes outlined in this study.

the health of the hippocampus as a nodal point for neuropeptide receptors communication. Candice Pert reminds, "What's real, therefore, is determined by past learnings and emotions attached to those experiences,"[441] which are held in receptors. In short, our emotions decide what is worth paying attention to and how open and receptive we are to our world and to one another. Empathy, part of critical feeling, relies on body awareness and health. Pert and Noland's research, and my personal experience, therefore, support how the mind can heal the body and the body can heal the mind. But can we return to body awareness when technology divorces us from that very connection? Without it, I am convinced social change is not possible.

This question led me to ruminate upon the need for an embodied theory of social change. I contemplated the unconscious defensive postures we sometimes take on when we encounter intractable social issues, such as homelessness, which might dictate our unwillingness to change attitudes. That is, when we observe homeless individuals on the street, our neuromuscular system might unconsciously cringe, forming a defensive posture, and our eyes might avert, signifying shame, which disallows empathy to flow. The social armor that forms might be the result of the ambivalence or fear imprinted in the limbic system at an early age. Fear-based limbic responses create a "culture code," a sedimented belief system that becomes entrenched and difficult to change. French psychologist Clotaire Rapaille, however, believes, "If we can tap into people's limbic responses and position our message in a way that resonates with their own emotionally charged reactions and the context in which the learnings took place, we can evoke a superior level of commitment."[442] Because the limbic system is tied to autonomic functions, we often falsely presume we have little control over it. Yet I discovered that we can take conscious control over our physiological processes previously thought to be autonomous and not susceptible to voluntary intervention by attaining a state of deep relaxation. In doing so, we can regulate emotions and relax defensive postures, rendering ourselves more open to empathetic encounters. Kinesthetic play and biofeedback encourages this. When we are closed systems, our perceptions are highly filtered,

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[441] Candice Pert, *Molecule of Emotion: The Science Behind Mind-Body Medicine* (New York: Simon & Schuster, 1999).
[442] Rapaille, Clotaire, *The Culture Code: An Ingenious Way to Understand Why People Around the World Live and Buy as They Do* (New York: Crown Business Publishing, 2007).

resulting in blind spots, a sense of separateness and a fear of unpredictability and surprise. Intelligent technology may not be the cause of these behaviors, but it is appears to be eroding the same areas of the brain—the hippocampus and amygdala—dedicated to internal communication, external perceptions and healing. It might be blocking an ability to be receptive to perspective taking, to change. Ludic performance is an attempt to take this personal awareness into account to design experiences that instead restore critical feeling and attunement in others.

I would say that, for every generation, technology gives us the opportunity to reflect on our shared cultural values and social direction, and to forge different paths. According to Daniel Smihula, we are currently witnessing the sixth wave of innovation, the "post-biological phase." He predicts that this phase will peak around 2035, meaning that as a society, we will only become more dependent on biotechnology, robotics, bio-mimicry, nanotechnology and transhuman enhancement in the years to come. As a result of this deep inquiry, I believe that we are at a critical juncture, where we simply have to press pause and reconsider this prospected trajectory. Bio-media, like the Xth Sense, offers an alternative, more human, and more sustainable pathway by reconfiguring biotechnologies. The Xth Sense allows us to embrace that which makes us human and social beings—creative expression. Through performative gesture and socio-collaborative play spontaneous bodily expression offers a site of sub-sensorial resistance and re-inscription and a kinesthetic animator of "critical feeling."

Technology is not going away, but together, we can redirect the Cybernetic Renaissance through the conscious design and development of more human-centered intelligent technology and experiences that contribute to maintaining a balanced assembly process and re-scripting the nervous system towards a sense of calm abiding, as I have attempted to demonstrate through my own creative work. In doing so, I hope to build a movement away from what I perceive to be fear-oriented prediction, quantification and control and towards love-oriented interdependence, emergence and impermanence. Instead of brandishing technology that rejects the body, regulates emotions and canalizes the senses, expressive technology, like the Xth Sense, facilitated through ludic performance can serve as a vehicle for re-becoming human.

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