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Interactive Art and the Action of Behavioral Aesthetics in Embodied Philosophy

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INTERACTIVE ART AND THE ACTION OF
BEHAVIORAL AESTHETICS IN EMBODIED PHILOSOPHY

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Submitted to the faculty of

The Institute for Doctoral Studies in the Visual Arts

in partial fulfillment of the requirements

for the degree Doctor of Philosophy

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Accepted by the faculty of the Institute for Doctoral Studies in the Visual Arts in
partial fulfillment of the degree of Doctor of Philosophy.

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October 12, 2014

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Jennifer Ann Hall

You who are looking for the way, please do not lose the present moment.

Sekito Kisen, Soto Zen master, A.D. 700

This document is dedicated to my wife Blyth Hazen, who has cheerfully and lovingly carried the burden of my absent years as a mid-career student.

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ABSTRACT

Jennifer Ann Hall

INTERACTIVE ART AND THE ACTION OF BEHAVIORAL AESTHETICS IN EMBODIED PHILOSOPHY

A new language to discuss and critique interactive artwork is emerging from the intersections of cybernetics, neuroscience, and embodied philosophy. This language includes both biological materialism and posthuman developments as part of an evolutionary trend in aesthetics. Interactive aesthetics has emerged from the historical discourse of a phenomenally situated subject. Adding a neuroscientific lens to our understanding of embodiment brings into further focus some of the detailed ways in which we deploy choices in our actions. This project challenges the traditional notion of neuroaesthetics as a reductionist methodology. As an alternative, neuroscientific findings can provide ways in which to understand the brain as a series of patterns of activity that provide introspection for full-body actions within the larger world. Using the frame of behavioral aesthetics, this project offers a critique that argues interactivity as a common language for the post-biological object to have voice approximate to that of the biological subject. This multidisciplinary investigation explores the ways in which interactive artworks are reinventing a place in contemporary practice that focuses our attention on how experience creates aesthetic purpose.

Embodied aesthetics deploys the phenomenological affirmation that we are always present in thought and perception. We load cognitive work onto the environment and the environment offers us fresh stimuli. The environment is very much a part of a cognitive system and is able to impact the configuration of our cognitive function, often in unpredictable ways. Cognition is body-based and works in a distributed way across all systems to employ—to urge from the environment—an empathetic participation. A study of interactive artworks brings attention to this act of creative inhabitation.

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Introduction to Interactivity

Interactive art requires a new aesthetic critique. As an approach situated in the intersections of cybernetics, neuroscience, and embodied philosophy, this dissertation explores the inherent qualities of interactive art that necessitate the development of a new interdisciplinary framework for its understanding. In that sense, it studies the disciplines and philosophies that might underpin such a framework but also appropriate for these disciplines in aesthetic discourse.

Together, the viewer and the object have risen to a new interactive art status that demands a deep range of conceptual and social interrelationships. This contemporary interactive aesthetic has emerged from the historical position of a phenomenally situated art subject and into a new art. Adding a neuroscientific lens to our understanding of embodiment brings into further focus some of the detailed ways in which we deploy choices in our actions. Most importantly, this contemporary art challenges the traditional notion of neuroaesthetics as a reductionist methodology, which is useful for understanding what is happening in the aesthetic body system. As an alternative, neuroscientific findings can provide ways in which we can understand the brain and body as a series of patterns of activity that provide introspection for full-body actions within the larger world. In this way, the brain can show us patterns that connect thought to action and this action is a key way to better understand our own functionality and aesthetic voice. Using the frame of behavioral aesthetics, this project also critiques interactivity as

a common language to review both the theory and practice of human to object communication, and that intends to give the post-biological subject and the biological subject equal voice in the aesthetic discussion. This multidisciplinary investigation explores ways in which interactive artworks are reinventing our aesthetic place and purpose.

Embodied aesthetics deploys the phenomenological affirmation that we are always present in thought and perception. We load cognitive work onto the environment and the environment offers us fresh stimuli. The environment is integral to our cognitive system and it is able to impact the configuration of our cognitive function, often in unpredictable ways. Cognition is body-based and distributes itself across all systems to employ—to urge from the environment—participation. A study of interactive artworks brings attention to this act of creative inhabitation.

This new aesthetic critique looks closely at the language historically used to describe art, which stresses the primacy of sense perception and of sensible experience. To investigate interactivity as it relates to art involves an examination of both the contextual character of contemporary aesthetics and the theory of embodied action. It also seeks to include an analytical understanding of the biological system through material structure and the situational functionality of action. And finally it considers the dynamic forms of interactivity that are key to the development of a new interactive language for art.

Interactive aesthetic events have two shared behaviors that necessarily shift the traditional focus of aesthetic critique: one is the *event*, and the other is *cause*. The first point is that philosophical intersubjectivity requires the philosophical activation of a full-body experience. A subject's interior functions are inextricably tied to the phenomenological experiences of the whole subject. Each interactive event produces interdependent events that reverberate to affect the subject—and beyond. Everything that arises from an event stems from multiple causes and conditions. Nothing exists as an isolated, independent event, including the contemporary object. This understanding forms the aesthetic space to analyze the participant and the object, the personal and the shared. In providing a deeper look at these events and conditions, the kinds of phenomena that emerge can be coded by the behaviors of the events in which specific situations emerge. The second behavior of interactivity is that there will always be causal events generated by every embodied experience. Events are dynamic and can run very far from the events that set them off. This does not mean they are disengaged from their sources. On the contrary: subjects are not only embodied, but are inseparable from the environment they interact with; each event, therefore, is an interacting event, bound by intentionality and activation. Intersubjectivity is a way that the subject keeps track of the nuances of experience and works to make them perceivably whole. Framed in contemporary aesthetics, intersubjectivity can be used as an intermediate perspective of the world, providing a view between personal experiences and communal judgments.

Two important additional points emerge from creating behaviors of interactivity. One is that an expansion of existing notions of intersubjectivity is not just a personal understanding of the world. The individual is a permeable structure and the flow that is encountered to and from the environment is called experience. Intersubjectivity is the way in which emotions are bound to experiences and then are shared. The second critical understanding is that individuals are very creative in that they find ways to maximize the stimulation this flow affords, by actively seeking diverse and challenging experiences. This philosophical activation of a full-body event is a complex system of other events that deploys a variety of aesthetic behaviors within the art experience. Depending upon the intentionality of those behaviors, they may render further experiences far more profound than the sum of the parts involved. Interactive art makes these connections more apparent.

Interactive art is a field within contemporary aesthetics that is the intersection of both scientific and aesthetic fields. Like phenomenology— frequently the source of current embodied theory— interactive art brings together many distinct fields through the phenomenological issues of intentionality, consciousness, and bodily experience. The move in western art towards the performative provides fertile ground for interdisciplinary experimentation and contributes to an ongoing discourse fundamental to philosophy: how does the body raise consciousness and how are we are propelled towards opportunity through that same vessel?

Behavioral aesthetics help describe what might arise in the process of

interactive aesthetic engagement. The body is so natural to us that, as long as it functions normally, we tend to neglect its existence. We experience the things we see directly, as if we were touching them with our very thoughts. Yet, perception happens within—not through—the body. The body operates on a sub-personal level independent of conscious awareness, actively modulating perception to determine which information will be picked up, when, and how. This process has two outstanding features. One is that perception is formulated through intermingling with the larger world. The other is that the body must be an active participant in this world in order for perception to arise. The two features are so obvious that they are taken for granted as we move about every day.

An instance of this interactive claim is the reinvention of our understanding of the brain's relationship to the embodied system. The brain is itself an intersection of possibilities that is activated by the things with which it comes into contact. The more we look to the brain to understand how it functions, the more we need to step back and see it in the larger situation of engagement in which it is interacting. One way to dislodge the traditional dichotomy between thought and action and to challenge the distinctions constructed between interiority and exteriority of action is to regard the brain as a biological spread of intentionality in aesthetics that includes more than a binary model. In traditional philosophical aesthetics, the aesthetic experience requires a specific attitude and a characteristic work of imagination. Cognitive sciences offer an alternative narrative, which is useful in explaining aesthetics in naturalistic terms. When we consider how experiences arise, we must also consider issues such as time, space,

and actions within these contexts. This complex arena creates a new domain of discourse called interactive aesthetics. Studying the brain shows us, in part, how imagination is tied to embodied theories and the rise of aesthetic behaviors.

One aspect of behavioral aesthetics involves identifying organic systems that we can associate with aesthetic experience. Autopoiesis is a system of self-creation that suggests a schema for interaction between subjects and art. According to Francisco Varela, credited with creating the term *autopoiesis*, these controls can be identified in both artificial living systems and self-generating mechanical forms. While autopoiesis refers to biological systems that self-reproduce, it also applies to non-biological systems that possess the characteristics of self-sustaining processes, usually through the use of internal feedback controls. The integration of autopoietic biological and mechanical systems also creates phenomenological boundaries—semi-permeable membranes of demarcation among objects. When autopoietic systems overlap or blend with one another, they create new typologies according to their behavioral characteristics. Both transformative and destructive, these independent systems in turn become agents to and within other seemingly unrelated systems and can be sourced back to the original autopoietic system. Autopoiesis is a new way to conceptualize our relationship to everything with which we come in contact. This blending also produces a larger, more complex, second-level union of interaction that is how we relate to an artwork and how we can critique those aesthetic experiences.

The frame of interactive art can help human subjects focus attention towards their bodies and how their bodies are in constant play with everything the

world has to offer. Our senses involve a larger and more dynamic situation that accesses time, space, action, and intent. The subject has authority over some of these but not much. Engagement, therefore, is part of the process of accepting responsibility as a co-creator of experience for the subject as part of the world that surrounds the event. It also is part of a system that cannot be controlled. The complexity of how these events take place and the meaning they provide in aesthetics becomes of particular importance for deploying an enactive approach: the more involved and aware subjects can be, the more they can understand their possibilities and limits. Awareness in interaction is also fundamental to the contemplation of the interiority and exteriority of the self and is how we develop expression through the acts of expression.

A rudimentary principle of interactivity is that it is an exploratory act. It serves as a basis supporting existence or determining essential structure and is the fundamental mechanism of asking, offering, and receiving in the world. Interaction as an expression is what Mikhail Bakhtin proposes to be an embodied act of creation. He claims that “what underlies the unity of an answerable consciousness is not a principle as a starting point but the fact of an actual acknowledgement of one’s own participation as a unity as a being as event. And this fact cannot be expressed in theoretical terms but can only be participatively experienced.”¹

It is the immediacy of experience that accounts for the uniqueness that substantiates the acts themselves. To frame an action as art, therefore, offers a way to look at embodied experience different from the everyday. This action, in

turn, has the power to shift our own thinking about our choices as active participants in the world. To investigate the nature of interactivity is to stress the priority of action over doctrine, of experience over fixed principles, and to hold that ideas derive meaning from their consequences and truths from their verification. To ask “what is the act of interactivity?” is to understand that experience is process. Consciousness is always a dynamic set of correlations, and not necessarily explanations.

Chapter 1: Historical Overview

The Field of Interactive Art

The new language to discuss and critique interactive art includes both biological materialism and posthuman developments as part of an evolutionary trend in aesthetics. The contemporary art viewer claims an ever-increasing authorship in art and the object has taken on a more complex role as the site of aesthetic experience. Together, the viewer and the object have risen to a new interactive status that demands a deep range of conceptual, physiological, and social interrelationships. This contemporary interactive aesthetic has emerged from a historical discourse on how we are phenomenally situated in the world at large. Adding a neuroscientific lens to our understanding of embodiment brings into focus some of the detailed ways in which we deploy our activities and choices. Replacement of many human actions by mechanical devices has provided a fresh look at what it is to be human—dissolving distinctions between living and non-living subjects by activating the domain of the post-biological. Using the frame of behavioral aesthetics, we can better understand that humanness is more about our actions in the world than the material properties of form alone. Critiquing interactivity therefore, allows the post-biological to have agency along with with that of the biological because the focus becomes what we do with all the part together. This multidisciplinary investigation explores a

variety of ways in which interactive artwork is reinventing our aesthetic place and purpose.

Media theorist Ryszard W. Kluszczyński describes this new aesthetic framing as an area of participatory activity. He writes:

An interactive artwork takes on the shape of an event. An artist does not make a final, completed piece of art, instead produces an area of activity for the receivers, whose interactive actions bring to life an artwork-event. Regardless of what shape the final product of an artist's activity takes on, an interactive artwork finds its final formation only as a result of participative behavior of the viewers.²

According to Kluszczyński, the embodied aspect of open action—the coalescence of an experience rather than a focus on the mimetic potential of the object—is an essential element of any interactive endeavor. The focus of an interactive event is therefore upon the relationship *between* the events of the interactant and the events of the object. Interactive installations require that the interactants make certain physical actions with their bodies, such as the use of limbs, eyes, voices, brainwaves, or breath, in order to activate the space of the aesthetic exchange. Rising from these events is a new phenomenological discourse for embodiment in art that includes a scientific understanding of brain, body, and consciousness.

Cybernetic art involves the use of feedback from the object and through to the viewer to create an active loop of the two with some kind of electronic or digital technology. Neuroaesthetics studies the relationship between aesthetics and brain function. Embodied aesthetics deploys the phenomenological

affirmation that we are always present in thought and perception. As we offload cognitive work onto the environment we deploy avenues of exploration that are inherently creative. Cognition, as a body-based system that exchanges with the world, is always full of participatory potential.

Challenging traditional notions of Western aesthetics, embodied aesthetics provides a fresh perspective on what Immanuel Kant described as the “finality of form” in his 1790 treatise, *Critique of Judgment*. We can look to Kant’s study of the beautiful and the sublime as part of a larger project to explore the logical mind through understanding emotions, feelings, and the patterns that emerge from our responses to objects in our environment—as opposed to merely evaluating an object’s materiality for aesthetic value. This distinction binds the senses to the intellect and is a critical step in the collapse of René Descartes’ *Cogito ergo sum*. Bringing our full selves to the aesthetic object is arguably the start of the contemporary moment for art. The subject and the object—where they stand separate and where they bind together through action—is one of the essential ontological questions of what is beautiful in contemporary art.

Kant understood the mind as always *a priori* and judgments of taste that are part of the mind and part of the senses as both subjective and universal. These aesthetic judgments are subjective because they are responses of personal pleasure and do not essentially involve any claims about the properties of the object itself. On the other hand, they are universal because they are grounded in logic; they call upon intellectual discourse and are what Kant describes as “disinterested” in everything but the object’s formal analysis. It is this claim of beauty that permits

logical thinking to be part of the aesthetic discourse of the beautiful. It was Kant who, perhaps inadvertently, found a world of both logic and beauty that can slide between the rational and the emotional with aesthetic judgment bound to both.

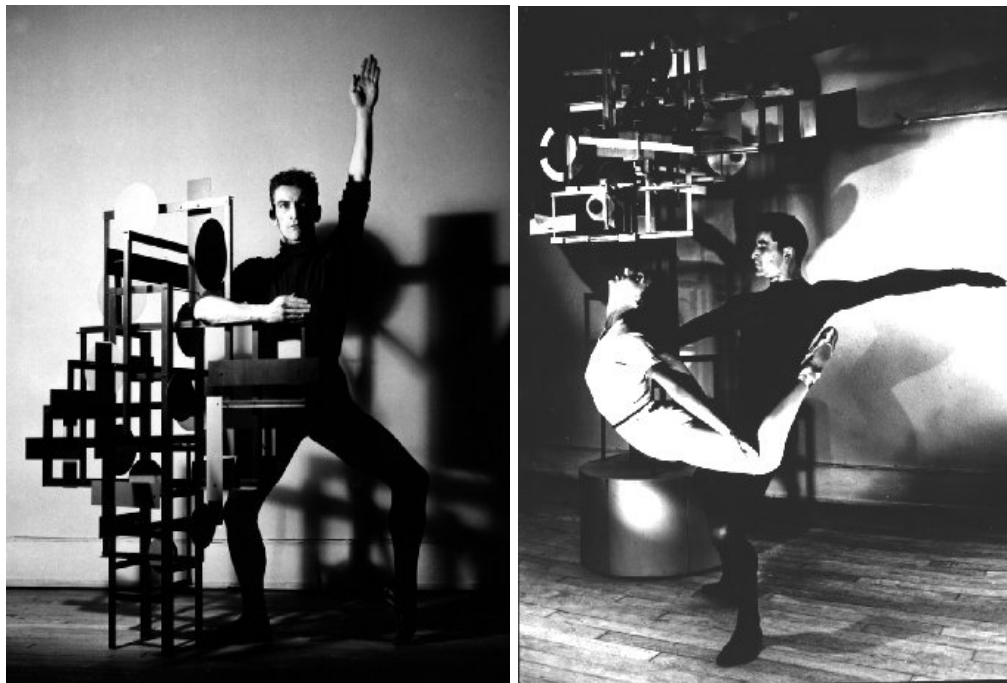
The object for Kant is one of contemplation; this contemplation must display a kind of undefined purposefulness, so that it seems to be organized with a final purpose in mind, although it is not possible to say what that purpose is. In this way, the object must release part of its own authority into the world in a search for its own identity. And, in turn, the viewer reciprocates. A work of art displays a kind of free play of forms, consistent with the presence of a purpose that we are unable to access until we are involved with the act of contemplation. That inaccessibility can be understood as the missing component of perception that may only be acquired through experience. This experience—the play that is acquired in the space between viewer and object—needs to be actively sought out by the viewer with both the intellect and the senses.

For a short period of time, Kant followed the ideas of Alexander Gottlieb Baumgarten, another philosopher of the European Enlightenment. Baumgarten undertook the concept of aesthetics as the science of sensory cognition with his 1730 treatise, *Metaphysica*. Fearing an elusive and subjective approach that could menace the philosophical status of modern analytic aesthetics, his fellow philosophers ultimately refused to endorse the idea of an academic discipline concerned with sensory perception and experience. In recent years, however, Baumgarten's perspective has been revived not only by contemporary trends in aesthetics, such as neuroaesthetics and somaesthetics, but also by new approaches

within other philosophical branches, such as metaphysics, gnoseology (the human faculties for learning), or more directly, phenomenology. This revival attests to Baumgarten's significance to the current expansion of the aesthetics field, three centuries after his effort to propose it as a new discipline with philosophical legitimacy. However, Kant declared that Baumgarten's aesthetics could never contain objective rules, laws, or principles of natural or artistic beauty because his use of "taste" drew from a rational critique of aesthetics rather than what Kant's new aesthetics had to offer—a hybrid philosophy that was rational yet fixed on individual judgment. The loss suffered in the birth of Kant's modern aesthetics was a dislodging of the embodied and sensorial aspect to the beautiful that dated back to the ancient Greeks. It was at this historical moment that modern aesthetics turned away from Baumgarten's understanding of the important role the senses play in aesthetics, and the study of embodiment in Continental philosophy was temporarily derailed.

An embodied reading of Kant and Baumgarten would find that both, to an extent, were correct. Baumgarten highlighted the importance of our senses to experience and Kant realized that the intellect must play a role in aesthetic judgment. What neither was able to express at the time was that the brain's functions for developing ideas, memories, and logical concepts are all also part of embodiment. The senses play a far more strategic role in our actions than simply activating pleasure or displeasure. Pleasure and displeasure involve a complex union of the relational nature of embodiment with recognition of such scientific theories as representational intentionality, exposure to choice-making, and the

triggers of desires upon actions. Embodiment involves all these activities as an integral part of a bonded process—acting together is what gives us the feeling that experience is a whole phenomenon. The critique of an aesthetic experience is an excellent forum for debunking the paradoxical separation between mental phenomena and physical action.

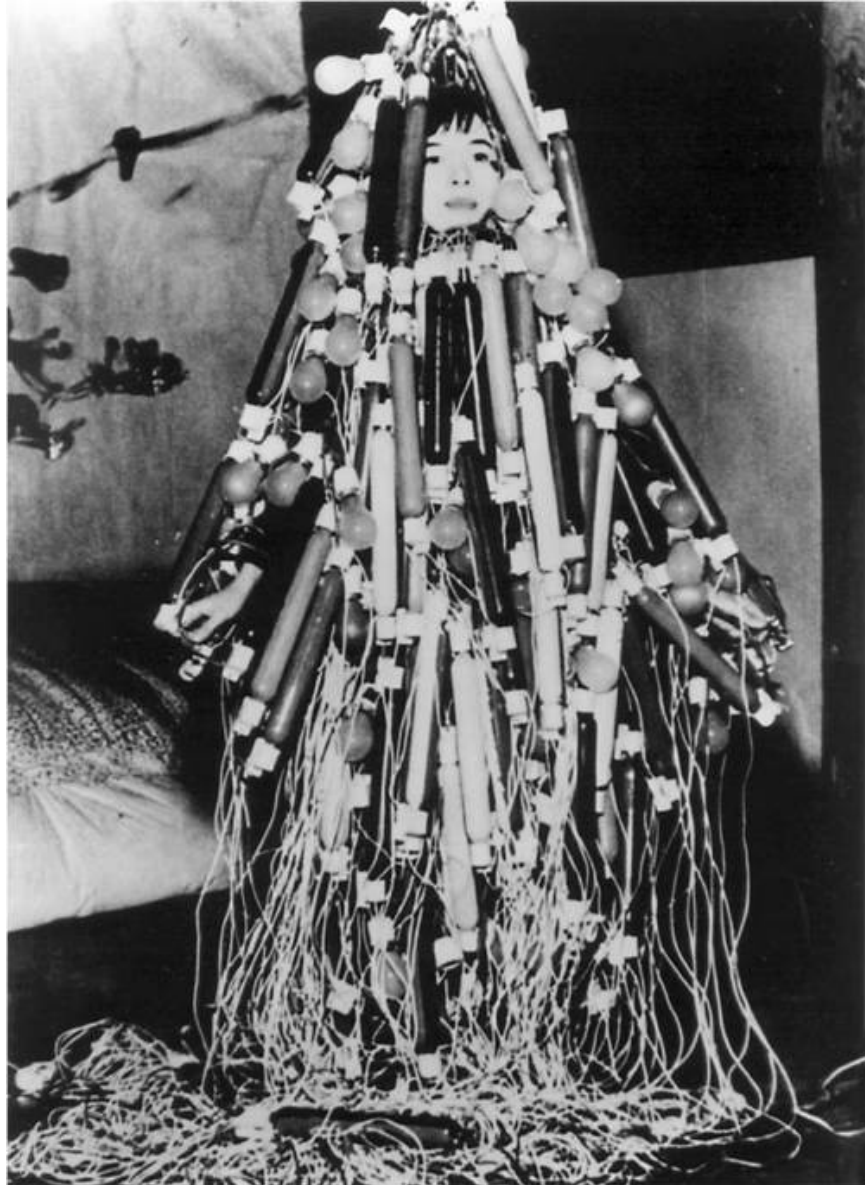


Stills from two untitled and undated films by Nicholas Schöffer (26:00 and 52:00, respectively) as featured in *SCHÖFFER-TINGUELY-Hommage*, Original footage by Marion Sarraut; reproduced in a 1993 documentary by Bernard Vincent on Schöffer's work. While the original films are undated, they are probably ca. 1956.

In a continuation of the transformation set in motion by the industrial revolution, art and science were able to come together to create a new field of intelligent machines by using internal models of external reality.³ The concept of intelligent machinery became a key impetus for reconstructing how the cognitive

world might work. Cyberneticists, such as Norbert Wiener, searched for a common understanding between machine and animal by using ideas from the disciplines of mechanics, art, and biology.⁴

Nicolas Schöffer's *CYPI (spatiodynamic sculptures)* of 1956 is commonly considered to be the first cybernetic artwork. Attached on the metal mechanisms for the kinetic structures are an onboard electronic brain to coordinate events, photoelectric cells to activate vision, and a microphone to record variations of color, light, and sound in the surrounding environment. The sculpture moves according to its digital sense of the environment, including the movement of nearby dancers. This was, arguably, the first attempt to converge the spectacle of robotic sculpture with the choreographed movement of humans; it sits squarely at the intersection of cybernetics and embodied arts. Schöffer's "spatiodynamic sculptures" also relate to the cybernetic study of the mechanical mind, or machine intelligence, which gained prominence in popular science, along with the modeling of brain processes, during the middle of the twentieth century.



Atsuko Tanaka, *Electronic Dress*, 1956.
Enamel paint on light bulbs, electric cords, and control console.

In 1956, the artist Atsuko Tanaka covered herself in electric wires and painted light bulbs. Creating a tension between the cyborg spectacle and the vulnerable female body, Tanaka's barely visible face peers out from an entanglement of technology as adornment. The work overwhelms the viewer with intense light and weight. In what Tanaka herself described as an "incessant and

chaotic”⁵ barrage that limits sight and movement, the performer can only stand and bear the overwhelming contraption as a technological metaphor. The drama of the device is to Tanaka a kind of external and cultural circulatory system—a sight where the privacy of the internal is exposed and used as a shrouding of the human condition of modernity. The apparatus becomes the technological structure, which cocoons the human and prepares the cyborg in transition.



Atsuko Tanaka, *Electronic Dress*, 1956, reconstruction, 1986.
Enamel paint on light bulbs, electric cords, and control console.

The body as a living form can also be considered in direct juxtaposition to technology, with technology that sets apart as a kind of corruption of human nature. Charles Baudelaire coined the term *modernité* to refer to the modern social condition, the human relationship to industrial depravity. This *modernité* as represented through art is, according to Baudelaire, a challenge to historical

beauty. The work of Tanaka is thus embroiled with a century-old discourse of the human struggle with the technological apparatus. Technology challenges the human as a historical condition but, at the same time, *modernité* also brings about an understanding that aesthetics is connected to the mechanistic makings of the observer. This juxtaposition of human to machine replaces the historical relationship of *human to nature* with one that critiques *living to technology*.

Embodied philosophers also expose the need for crossing philosophical divides between human and machine, so that “the cognitive sciences [can become] a meeting place between the transitions, with benefits in both.”⁶ The development of embodied aesthetics as we understand it today stands upon the shoulders of such mid-century interdisciplinary projects. In 1967, the artist and theorist Roy Ascott defined cybernetic art as having certain characteristics of dada, surrealism, fluxus, happenings, and pop art, combined with the science of cybernetics.⁷ One important commonality between these particular art movements is the object’s shift to performativity. The coupling of these art movements with the science of cybernetics provides a distinctly embodied and activity-oriented perspective on the digital era that began in the 1970s. In this way, technology became a particular kind of performative element. As critic Edward A. Shanken reveals, “the value lay more in the event, the process, the shared experience.”⁸ The interconnection between computers, telecommunications, and the people who use them becomes an entire nervous system of social organization, which includes the viewer as an active agent in a dynamic aesthetic exchange.

The co-construction of technology and modernity remains an essential quality within the multidisciplinary work of contemporary art. As a study of divides and crossovers, life against or in balance with, technology has been a theme within aesthetics for well over a century. Both life and technological apparatus have their own embodiments and both are in negotiation with the other for shared space and resources.



Guto Nóbrega, *Equilibrium*, 2008.
Motors, solar cells, microchip, light sensors and a plant.

The sculptures of Guto Nóbrega expose this nuanced relationship between the living and technology. *Equilibrium* is part of a series that Nóbrega calls “hybrid organisms.” These hybrid organisms are systems in which a plant and an

artificial mechanism share mutual relationships. The whole *Equilibrium* system is arranged as a balanced sculpture that is able to spin around its own axis. The technological system occupies one side of the balance and it is set to perform in a photovore (light-seeking) behavior by controlling two propellers, which set the whole system to rotate clockwise or counter-clockwise. A growing plant is located on the other side of the balance; when the balance rotates its axes the plant is re-positioned towards the light. In turn, along with the plant two solar cells absorb light and feed the artificial system. *Equilibrium* is an environment with both relational and autonomous behavior. It belongs to a class of artificial hybrids emerging from contemporary art practices that create new man-made organisms. Nóbrega writes, “This class of beings points to new questions on the issue of interaction as their relationship with the observer is not only based on rules of cause and effect. More than interactive response to human behavior these organisms ask for dialogues, requiring a sort of investigation into their own nature in order to unfold the network of meaning to which they belong.”⁹ The project suggests that nature is a concept never achieved objectively, but only subjectively. “Art,” Nóbrega writes, “is one of the most powerful tools to modulate subjectivity, ultimately our consciousness, the hybrid of plants and artificial systems may bring new insights about the world we live in and its ongoing metamorphosis.”¹⁰ Introspection then becomes a crucial way in which the aesthetic experience arises from the occurring act of changing relationships of the parts.

Neuroaesthetics was defined around 1999 by neuroscientist Semir Zeki as the scientific study of the neural bases for the contemplation and creation of a work of art.¹¹ But it was as early as 1991 that Zeki along with M. Lamb wrote a paper on brain scientists' understanding of kinetic art.¹² Although Zeki and Lamb take here an empirical and reductionist approach towards the visual cortex to explain aesthetic experiences, their claim about what artists are doing when they make kinetic art is compelling. Zeki/Lamb write, "artists are unknowingly exploring the organization of the visual brain though with techniques unique to them."¹³ This suggests that Zeki/Lamb see artists providing instinctual or intuitive contributions to the science of movement.

It is possible to combine the knowledge from Zeki and Lamb's reductionist studies with the performativity of contemporary art, because they are both on the hunt for aesthetics through the coupling of embodied action within the environment. Zeki's interest in musical beauty has led him to suggest that a specific part of the emotional brain, field A1 of the medial orbito-frontal cortex, is critical for such time-based experiences.¹⁴ Emotions and decision-making appear to use this part of the brain for processing, which may also help mediate subjective hedonic experience.¹⁵ The aesthetics of interactive art looks at the open event of the entire, knowable experience—people, places, and things all in action together, all working towards the rise of an aesthetic experience that requires a new form of systems critique. Interactive art goes beyond and corrects Zeki's reductionist localization of aesthetic experience. Aesthetics is more than a brain processing. Interactive art consists of sets of functional and behavioral attributes

shared through the action of participation. Neuroaesthetics can help in locating particular electrochemical events that can be observed for their patterning in the larger embodied event.

Cybernetic culture remains in a state of uncertainty. The impact that technological innovation is predicted to have on human beings ranges from the development of utopian living standards to devastation and destruction. But if cybernetic culture is a miasmatic condition in which biological humanism and human embodiment are challenged, interactivity between the biological and the post-biological, first and foremost, is a response to this ubiquitous human condition. In other words, the formality of framing the human being as one that hinges on biology has ended. Humanness is better described not by material properties but by intentions and actions. Because action and participation are the key elements of interactive art, defining an aesthetic space includes the endeavors of many forms of existence that are ready to participate in the act of life-negotiation.

The post-biological claim that organic matter no longer has a singular hold on life distinguishes the contemporary moment from the last century of technological integration. Interactive art also can be defined as post-biological. Together, the post-biological and post-cybernetic collapse any substantive distinction between living organisms and the technology that they invent or consume. Post-delineation, the idea that form always involves some sort of displacement, but not necessarily along existing lines of demarcation, exposes the permeable structures of life and casts a wider net over aesthetic experience.

Furthermore, art projects that use both aesthetic and scientific methodologies are changing the cultural landscape, allowing a more fluid understanding of participatory identity in both to emerge.

Contemporary art encompasses a broad domain of temporal and polysystemic techniques claiming that it is action which brings art meaning. Interactive art furthers this realization with the understanding that being *of* the world rather than passively *in* it, creates kinesthetic self-awareness, a self-awareness that can be aesthetically critiqued through the study of an action's material, mechanical, and interactive components. The process of this examination points to aesthetic functionalities within the systems of a post-biological, post-cybernetic, and post-delineated existence. By bringing these conditions into very close proximity, interactive art demands a new aesthetics of behavioral attributes.

Behavioral aesthetics can be defined as biological and post-biological elements that make up a bodily gesture. Because parts of the aesthetic behavior may be sourced from biological forms and other parts may not, interactive art has little need to define actions of the organism through the distinctions of living or nonliving. Instead, actions that are created within the interacting system may also be regarded as a gesture of the organism. Behavioral aesthetics dislocates traditional notions of subjectivity as the center or purpose of art. Art critic Claire Bishop's aesthetic perspective on interactive art is that viewer activation and viewer decentering are ways in which installation art is experienced.¹⁶

"Decentering" is a moving about of the subject, a constant re-establishment of a

self in time and space. Behavioral aesthetics therefore expands on Bishop's 2005 idea of activation and decentering by positioning the behavioral aspects of engagement as key strategies in the engagement with interactive art. This includes all forms of body and thought, because all forms work within and upon the same material and behavioral forces. A collapse between mind/body distinctions also works to unify our physical selves with our feelings and experiences.

Phenomenological Patterns of Action

Activation is a key theme of embodied philosophy. The energy involved with activating a process is part of the larger function of any act. Activation and the event itself cannot be separated from the ability to perform the function of the action to which it is connected. An action has a built-in transitory state, as it is always pushing intention into activation; this is a dynamic state that is exhibited in many fields of material science, from chemistry and biology to physics and neuroscience. Brain science reveals that patterns in the brain associated with intention are similar to patterns associated with full-body actions in the world. The brain is stimulated by what the body senses to be activity—these sensations perform as activators and pattern-makers. Neuroscience remains unclear as to what the particular patterns may mean, but the relational potential of the patterns of activation in embodied cognition is abundant. These patterns become the material activity of a scalable concept of decentering, and interactive artists are developing projects that reflect this dynamic form of activation. Through

interacting with installations, the complexity of intention and action are exposed as an aesthetic consideration. Interactive projects, in turn, change the way our brains are stimulated, reshape our neural networks, and facilitate new associations—all creating feedback connections.

An example of this scalable activity can be observed in how an animal cell activates neighboring cells to work together. First, the cell stimulates and then connects to another, creating a path of adhesion. The path becomes a structure of signaling molecules that relays positional information among many neighboring cells in a tissue. These signaling pathways are critical to maintaining homeostasis within the tissues to form structural stability. The processes involved in the body healing a flesh wound depend on positional information in the skin organ in order to restore normal tissue architecture. As the cell pathway extends, the equilibrium of the entire system must be readjusted. The system is in a constant state of sending and receiving signals and, therefore, in a constant state of homeostatic readjustment as the system remains in balance. Other intersecting and competing tissues must negotiate the healing and will recharge the lost energy needed for mending the torn structure. The parameters of a homeostatic readjustment event include a constant metabolic remodeling of the system itself and the ability to reassign the duties of one cell for the need of another.

The whole body behaves in a similar way. It is constantly in search of a state of balance, and will constantly adapt to and negotiate with neighboring parts. The body is extremely complex, requiring countless tiny adjustments every second as new input propels the body off balance. The imperfection that exists

within any balance is a particular pattern that also serves as a general phenomenological observation of being in the world. Stasis is simply ontological idealism. The body, the self, is always in a state of becoming. Adjustments become more than a temporary element of the system; they are the mechanism that allows for imperfection to become a binding force for all events.



Brian Knep, *Healing Tiles*, 2012. Harvard Medical School.
Projected software animation.
<http://www.21cmuseumhotels.com/cincinnati/museum/collection/> accessed March 14, 2014.

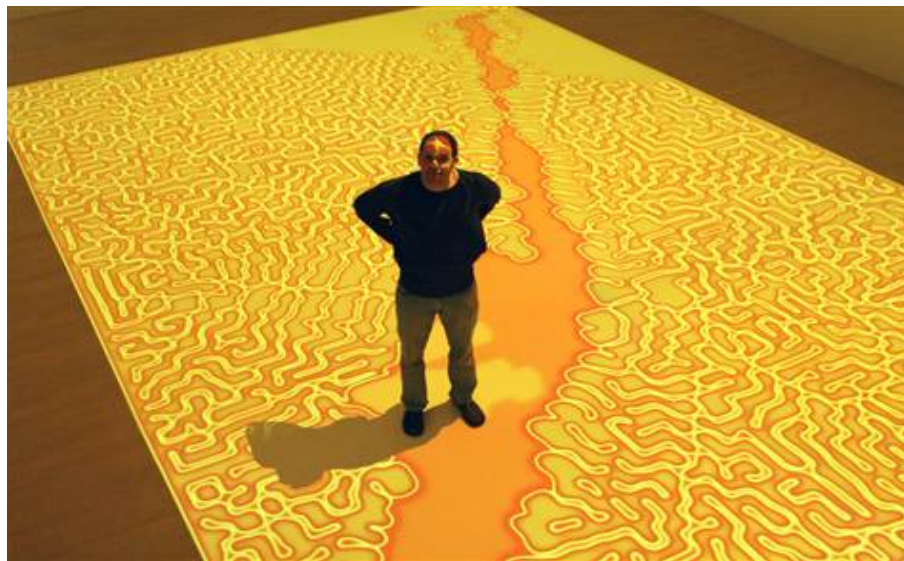
In 2012 Brian Knep developed a series of public interactive-art installations entitled *Healing Series*. The work serves to demonstrate the dynamic nature of interaction. Each individual installation project is built upon a computer projection of a patterned carpet. Left alone, the patterns slowly pulsate and shift. When an interactant walks across the carpet, he/she leaves a trail through the projection, “wounding” the pattern. After a short time, the carpet heals the path left by the interactant, but the original pattern is forever altered. The wounds heal differently after each person walks on the carpet, reflecting, over time, an accumulation of interaction and response. From the time the installation is turned on, the graphic pattern reflects a piece of every single interactant.

Knep explains his interests in natural patterns that emerge from this process:

Think about a zebra—the mother isn’t painting those stripes on. What is happening is that there are cells. And the cells are expressing a certain color—either black or white. And each cell—all they know about is neighboring cells and they have some sort of complex system in place that tell them to be black and white. Somehow, in this very simple interaction between each cell and its neighbor is stabilizing to these beautiful patterns.... And you can look at lots of systems that way. Under a microscope our brains are billions of neurons and all each neuron knows about is its neighboring neurons and sends signals to them. Each neuron wants to survive—the connections want to survive—and out of that we get this amazing illusion of consciousness, free will, and all these things.”¹⁷



Brian Knep, *Healing Pool*, 2008. Milwaukee Art Museum, Milwaukee, Wisconsin.
Projected software animation. <http://www.blep.com/> accessed March 14, 2014.



Brian Knep, *Healing Pool*, 2008. Milwaukee Art Museum, Milwaukee, Wisconsin.
Projected software animation. <http://www.blep.com/> accessed March 14, 2014.

Knep is less interested in the discussion of whether the patterns created are illusions or not. Issues of illusion and representation are, he argues, an aesthetic for a past century. His attention is focused on how the temporality of self is

constituted from billions of smaller interactions and how those interactions create a new aesthetic. Knep is an example of a contemporary artist who brings together the rich history of cybernetics, new knowledge drawn from neuroscience, and the desire to sustain an embodied practice that retains a focus on the physical and temporal nature of our relationship to the art object. The idea of causality—how everything affects everything else—becomes part of a new aesthetic drive that runs through a wide variety of interactive artworks. It is this combination of body and world that lays claim to the creation of a new behavioral aesthetic.

Materiality of Ideas

Claire Bishop's collapse of distinction between the spectator and the art object is a critical offering to interactive art because it involves an ongoing act of decentering the subject. It is a slippage of time, intentions, and the material properties of being-in-the-world that shifts aesthetic expressions beyond such purposes as the beautiful or sublime and towards an exploratory dynamic. How the spectator transforms into the interactant, Bishop would argue, is certainly part of the modernist project. In this case, only since the willful design of interactive projects started in the mid-twentieth century have the mechanics of intentionality been embraced in aesthetics.

Neuroaesthetics can also be described as the scientific investigation of what occurs in the brain during the act of observing/experiencing art. Generally speaking, this domain combines neurological research with Western aesthetics by

investigating a traditional understanding of beauty and appreciation of art at the level of brain function and mental state. Neuroaesthetics attempts to explain aesthetic experience through a set of physical laws at neurological sites. Currently, scientists use two main approaches in neuroaesthetic research. The first is to measure brain activity of individuals, usually artists, in order to uncover how brain mechanisms act in the making of art. The second is to study the art observer, with the aim of discovering general rules about how the brain functions through art appreciation. Both of these methods hinge upon the scientific precept that any act of individual consciousness can be replicated within the same brain and applied to other individuals. This method of research is both highly structuralist and reductionist in its approach to consciousness. Yet neuroscientists tend to agree that the biology of the brain relies on a far more fluid and non-reductive process than these methods of aesthetic research provide. A non-reductive materialism is one way in which scientists and artists can work together to develop an updated methodology for investigating consciousness. Neuroaesthetics can incorporate non-reductive materialism and provide a far wider reaching purpose to the research.

Badiou's "first ontology" is an excellent example of non-reductive materialism.¹⁸ Badiou designates material form as being in an "inconsistent multiplicity" in its very presentation. In Georg Cantor's mathematics terminology, an inconsistent multiplicity cannot be set because it is too large; it is an infinite possibility. Badiou opens up Cantor's strict language to alter the meaning and functionality of ontology itself: mathematics becomes a system of reflecting

relationships of being within the event of being. This includes the between-ness of individuals as well as larger world experiences. Materialism can hold all the inconsistent multiplicities that Badiou makes available to us, as demonstrated in the example of Cantor's mathematics lexicon. Through his examples, Badiou explains that any discrete field of study, such as mathematics, science, or art, is an arbitrary delineation that, in itself, lends no meaning to the subject at hand; meaning is found in the use of the system in context. The historical deployment of these systems leads to a similar contemporary revelation—a constant decentering of the parts of the system that come about through their use. It is enaction that moves one thing into another, displacing and reformulating new ideas as the action rolls out. Ideas, in this way, can be observed as a dynamic material, formulated by the convergence of thoughts and actions. It is this enaction in the philosophy of mind that explains how perception and action combine to allow us to perceive, and to have consciousness.

Badiou provides a philosophy of being, a subject in which historical time is of lesser importance in the construction of subjective perception. Only within the enaction of the *now* do we see the possibilities that change provides. Badiou's materialism, as part of a diverse schema of action in the world, describes the importance of the human body in contemporary society.¹⁹ By stating that materialism is the site where life is expressed, Badiou traces this decisive line of human demarcation and then moves forward to obliterate any possibility that life could be contained within a single body. From Badiou's understanding of the multiple subject and a bringing together of all the pieces and parts found within

action, we may find consciousness and meaning. But the current use of materialism within neuroaesthetics is reductionist and in many cases, without social context. This leads to a problem with the current state of neuroscience in general: the research is both scientifically reductionist *and* aesthetically modernist, which stunts any consideration of time-based interactions. This leaves out much of what contemporary art offers to the study of the brain—deployment of the temporal body and the decentering of intersubjective authorship whereby identity as a material substrate of the world can never be a fixed point.

Since 1980, biologist Francisco Varela and neuroscientist Antonio Damasio have been piecing together how the material brain creates experience at a biochemical level of the human body, providing another window onto the overall functioning of consciousness. Like most scientific researchers, however, they limit their description to pictorial representation. While the arts have moved toward a hybrid model of intersecting disciplines, the treatment of art by neuroscience remains insular and in need of updating. Recent neuroscientific research has addressed these complex modes, but it has yet to look at them as participatory, dynamically modeled systems in the visual arts. And although there has been research into human motion through dance, music and film theory, it has been limited. The relationships in which time-based mediums affect the body are far more complex than has previously been discussed in the critique of dance, music and film.²⁰ Furthermore, time-based research has yet to take into account the complex modes of participatory expression and social context in contemporary visual art.

Scientists' underlying interest in studying the brain is to understand what consciousness is and how it works. Artists' interest in consciousness may overlap that of science, but they may pursue areas of investigation that may be prohibited in traditional scientific discourse. Their range of investigation is open, for example, to data scientists will see as tainted, but artists may find useful. These areas are not exchangeable. The outcome of artistic research, therefore, may not directly serve scientific endeavors.

Multiple methodologies nevertheless may produce a fresh way of exploring any topic. So many overlapping disciplines stake a claim to the question of consciousness, it is arguably impossible to tease out a sole valuable field that provides a sense of the entire experience. This may be why there are so many different disciplines working on understanding consciousness at so many scales. In physics, for example, the external world is perceived as a hierarchy of objects that moves from water molecules to atoms to neutrons and then to down quarks, up quarks and electrons. Scientifically exchangeable aesthetic explorations can be seen as contributing uniquely to an overall understanding of consciousness.

The study of embodied consciousness demands that experience remains connected to the action in which it has been expressed. Maurice Merleau-Ponty offers a solid support to embodied action as his phenomenological view of *the wholeness* constitutes meaning in human experience through the ontological body-subject relationship. Merleau-Ponty maintains a general concept of consciousness in the larger world while describing the human body as a perceiving thing intricately intertwined and mutually engaged. By observing the

correlate of our body and its own sensory-motor functions, Merleau-Ponty finds the actions that make meaning in the world. In a ontology of becoming, as Merleau-Ponty argues for it, is an appropriate framework for the neuroscientific method because it reminds us to consider the wholeness of experience while also looking at substrate materials and their particular properties.

An example of how substrate materials may have larger implications for consciousness, can be found by reviewing—through a phenomenological lens—research common to both theoretical physics and quantum mechanics. New studies show that the smaller parts of the conscious processes are indeed physical: parts of consciousness can be observed as a state of matter, like a solid, a liquid, or a gas. From this, cosmologist Max Tegmark conjectures that, “consciousness can be understood as yet another state of matter. Just as there are many types of liquids, there are many types of consciousness.”²¹ If this is accurate, then the process of any action is also material, and that material process is also performative and varied. Tegmark’s research explores how the particular properties of consciousness might arise from the physical laws that govern our universe.

This idea of consciousness as materially based has spread into the field of physics. The material properties of consciousness, Tegmark explains, allow physicists to reason about the conditions under which consciousness arises, and to consider how we might exploit consciousness to better understand why the material world around us appears as it does.

This new approach to consciousness has largely originated outside the physics community, not only with cosmologists like Tegmark, but also with neuroscientists such as Giulio Tononi. In early 2014, Tononi corroborated a controversial twenty-year-old theory that consciousness has the literal structure of a microtubule.²² Microtubules are major components of the structural skeleton of cells. In this example of material consciousness, we see that form binds the product of the brain through to a material shape of the cell. Tononi's discovery of quantum vibrations in microtubules inside brain neurons corroborates that quantum vibration computations in microtubules are "orchestrated" by synaptic inputs and that memory stored in microtubules have the same material property of protein polymers inside the brain neurons. The vibrations have a form and the form makes the structure that is built upon by larger structures. These tiny patterns found in consciousness have both form and weight in the world. Perhaps more valuable for the study of interaction, these patterns are in a constant act of activation, decentering, and displacement. And perhaps even more profound, the vibrations are defined as material properties through their own enaction. The driving concept of enaction is the fundamental role of motor action for storing and acquiring knowledge. Yet microtubes as a material building block of the neuron cannot explain consciousness.

Microtubes in the act of vibrating show us that the structure emerges only in the activity of its own behavior. Behavior is the internally coordinated response (actions or inactions) to the whole living organism and microtubes find purpose and value only in the activation of the orchestration of its parts. Perception is the

organization of these parts through the technological transduction of stimulus.

Without perception, action would be unguided, and without action, perception would serve no purpose. This constructivist understanding as to how matter and action work together constitutes the conditionally open position of the subject. If all goes well, perception and enaction combined provide the rich environment in which consciousness emerges, and where activity is the agent for invention.

Chapter 2: Brain Spread

The combination of neurological research and aesthetics does not need to follow a strict scientific script to be valuable. Scientific methodologies are used regularly by artists in ways that may not have been originally intended by science but have become useful in many overlapping disciplines—such as design or psychology, as examples. In many cases, hybrid research comes back around as useful in both art and science. There are contemporary artists whose work with recent findings about the brain also blur the distinction between art and science, the subjective and the objective of a *thing*. This work, in turn, has compelled scientists to reframe many of their own guiding questions. Artistic and scientific methods have a great deal in common: they provide—and often share—fundamental insights into how we organize the world.

One of these shared insights is that strikingly different systems can produce similar patterns. Moving particles in gas, bacterial colonies, and neighborhoods of people, for example, create similar, continually complex patterns that both science and art can observe.

The brain is one such complex system that shares a common space of autonomy and community. At the material level, high-resolution images of nerve cells linked by dense webs of intricate pathways look very much like models of social networks. And study of social networks shows us patterns of embodied systems similar to those in the constructed world of shared experiences. The

“social brain hypothesis” suggests that the human amygdala (a mass of nuclei located deep within the temporal lobe of the brain) might have evolved partially to deal with an increasingly complex social life.²³ It is important to move past the idea that the brain passively transmits impressions. The brain is fully engaged in the environment around it, actively participating in every event with which it comes into contact. Research into biological systems by artists provides the ever-essential realization that making or experiencing art is part of the same life system as any other field of study.

This reminder posed by neuroaesthetics is particularly important when discussing interactivity, because linear or reductionist cause-and-effect models would lead to many bogus assumptions about how we experience the world. There are many contemporary examples of cross-pollination between neuroscience and art that show it is no longer necessary to plot scientific ways of understanding interactivity *against* aesthetics. In the projects that express both disciplines, the brain points us towards a new aesthetic by manifesting the vastly complex ways in which its universe of electrochemical activity works—resulting in emotions, ideas, and actions. Ultimately, it is the combination of objective functions and intersubjective moments, mixing the activity of the inner world with external active experiences, that produces what we call the human condition.

The Brain Spread

The brain has historically been considered the seat of human comprehension, with its chief activity being to ascertain its own nature. The ethicist concerned with worldly resources looked to the brain's rational intellect to search for freedom; the brain scientist looked at the brain to know the mind; and the artist accessed intuition supplied by the brain in response to the body's sensorial attributes. From each of these perspectives, in some combination of brain, body, and expression, a concept of the fully formed person emerged. But such isolated perspectives on the world no longer seem adequate. The ethicist now reaches beyond universal claims to apply action and change in the world; the neuroscientist reconsiders brain functioning to include both the internal body and the external body; and the artist collapses the aesthetic distinctions between idea and form. Transformed from thing to actions, the mind from both a scientific and philosophical perspective now resides in no particular singular place. Descartes' hold on the western tradition of the separation of mind and body, or thought and action, is losing its grip.

The brain is usually defined anatomically, as a physical part in service to both thought and body. Its function is generally considered to be a kind of centralized processing facility, its purpose being to keep track of things by controlling actions and thoughts. It is a common scientific understanding that the brain's primary function is to extract biologically relevant information from sensory input.²⁴ But new knowledge of its own material development and functionality suggests new possibilities. The brain may provide a centralized location for cognitive processing; but it also possesses characteristics of a

dynamic entity, with the potential for expressing an array of actions that respond to its own needs, for survival and growth. In this way, just as human biology can be understood as many interlocking systems working together to develop consciousness—with every organ, every cell, every biochemical pulse expressing that energy—the brain is far more than just a service station for the rest of the body or an isolated center of thought and reason.

Neuroscientists believe in a kind of amorphousness of the brain. The chemical neurotransmitters momentarily shape and endlessly reshape the physical brain throughout a lifetime. The plastic nature of brain synapses—the spaces between neurons—for instance shows us that the brain and the self are in constant flux. In *The Synaptic Self*, Joseph LeDoux describes how synapses are the channels through which we think, act, imagine, feel, and remember, as well as the means by which our most fundamental traits, preferences, and beliefs are encoded.²⁵ The brain, however, can be understood as more than simply a catalog of encoded behaviors, or a device to call out bodily instructions. Material functioning *by itself* cannot be considered consciousness, because there is nothing in the reduced elements that answers to the concept of a self. It is only in the application of the *brain to an action* that the potential of its function is *rendered*. As a thing in itself, the brain must have direct connection to experience. This connection can be found in an endless array of patterns that the brain and the world make together. Through such modern technology as electromagnetic scanning we can finally see patterns of biochemical processes and how they relate

to the kinetic self at the full-body scale. Here, the brain is a temporal map of its own activity.

As a simple example of the brain's temporality, the patterns of chemicals that surge through the brain cells awaken different functionalities at different developmental stages of life. The focused use of these cells changes the physical condition of the brain, altering its potential for future adaptation. More functioning either creates more nerve endings to accommodate the load or lowers the threshold potential needed to jump synapses. In either case, function reshapes the formations of thoughts, and ideas are constantly morphing, pushing the physical boundaries of the biological matter that contains them. The generation of new neuron endings is a neuroregeneration of axonal sprouting that accompanies functional reorganization in adults over a lifetime, even where substantial degeneration may have occurred due to age, illness, or trauma.²⁶ Signals from the sensory receptor cells, furthermore, remain both *specific* to individual physical parts of the brain and *generalized*, available to other parts of the brain. When the neuroscientist breaks the brain down into distinct parcels, such as sensory or motor functionality, she will always offer a caveat, describing all the ways in which the brain—broken down into a collection of parcels and identified to have discrete functionalities—does not neatly fit into any finite, clear-cut functional category.

Because of the neuroscientist's caveat that scientific study doesn't always provide clarity toward an understanding of the brain, we have to look to other modes of inquiry to find meaning. Materialism in neuroscience holds that mental

phenomena are identical to neuronal phenomena.²⁷ Type materialism in philosophy, however, is more generalized: it holds that the only thing that exists is matter.²⁸ Implicit in this stance is the assumption that management of consciousness is not part of a transcendental experience, one that offloads the qualities of experience to another being, power, or location. We must look to the properties held within the system, such as the brain or the body, to uncover some surprising ideas about the uncertainty of matter. Studying the aspects of matter can be useful as a way to find connections between, for instance, an individual cell and an entire organ; but the same study can also reveal differences, decenterings, or slippages in the shift from that cell to that organ. Both the categorical and biological systems work in conjunction with these slippages. The understanding we gain from materialism is that things still work despite the apparent contradictions.

Qualia or the subjective quality of human experience is the philosophical way of describing this slippage between the scientific qualities of all that is “immediately apprehensible in consciousness.”²⁹ This slippage can be identified, for example, in the time it may take for a sensation from the skin to change to an electrical pulse. As a result, in contemporary scientific materialism there exists no necessity to distinguish between the physical brain and its functionality. The basic proposition in material neuroscience is that the properties assigned to the brain are also among the properties that make up the thought and interaction of mind. In other words, the brain and the mind tend to be used interchangeably. This in turn makes the neuroscientific explanations of the distinction between mind and brain

increasingly elusive. If aspects of the surrounding world define the mind, we must subsequently accept that the brain should be afforded, at least partially, the conceptual and contextual territory given to the mind. Is it possible, with all that we understand from neuroscience, to free the brain from the exclusivity of reductionism by looking to the contingent nature of its functionality?

If the brain works with the similar-reciprocal pattern of distribution, as does the rest of the body, it can be reasoned that the action of experience is a reciprocal exchange between the parts of self. This exchange further challenges the autonomy of individual people and things, and brings their related systems to our attention. This search for wholeness of the self—the reciprocal patterning of the kinesthetic participation in the aesthetic experience—is an act of relocating the brain as a cognitive engine to a direct part of cognitive action upon the world.

With all the confusion between brain and mind, the concept of brain has been left behind in the contemporary attention to the mind and body. We still think of it as an archaic binary machine. It is actually much more fluid and dynamic. A shift from the traditional concept of the brain provides a fresh perspective on how a person utilizes interactivity. This shift must include an erasure of the traditional expectations of the brain as a computational engine for the body and a relocation of its essential functionality to the whole self. Placing the brain under erasure, ~~brain~~ provides a vehicle for recovery from the mistake of the dual identity of the self as thought and body. Using a Heideggerian model, erasure of an idea expresses the problem of presence and absence of meaning in its own definition. “Brain” is not wholly suitable for the concept it represents.

Continental philosopher Jacques Derrida extends the problem of presence and absence to include the notion that erasure marks not the loss of presence, but rather the potential impossibility of presence; ~~brain~~, in other words, marks the potential that meaning has never been exclusively attached to the word or term “brain” in the first place. The challenge of this erasure is to extend the notion of the ~~brain~~ as a material action. Through action, the ~~brain~~ is both an organ and a function, which reaches away from itself through energetic forces of thought. Within its very definition, ~~brain~~ carries the lack of its own finitude. Because of the contingent nature of this action of spreading beyond itself, ~~brain~~ cannot be a freestanding entity, and an understanding of this brings us to the very problem of presence and absence of meaning in language. This lack of proper or precise meaning can be extended to the idea that the brain alone does not provide enough signification to explain its relationship to the rest of the body or to the larger world.

Analytic philosopher Mark Rowlands argues for an externalism holding that the mind is “not only the result of what is going on inside the nervous system but also of what is outside the person.”³⁰ All parts of cognition, in other words, must be larger than the body of the subject. According to brain philosopher Andy Clark, “cognition leaks out into body and world.”³¹ ~~Brain~~ is the materiality that cognition rides upon. Such cognitive processes as belief, memory, and learning *depend upon* a dynamic causal coupling between the person and her environment. Cognitive functioning is tied not only to material properties of the body but also to its own penetrability, to its ability to absorb and transmit beyond predefined

boundaries. Externalism claims that the brain and nervous system are insufficient separately or together to produce conscious experience—that environment and action are more than contingent causes, are part of the essential matrix of autonomous acts. This calls for at least a partially extracranial description of the ~~brain~~.

Another way of understanding the ~~brain~~ is through a phenomenal externalist view that psychologist Riccardo Manzotti calls the *spread mind*.³² Manzotti questions any material separation between subject/observer and object, because what we consider objects and subjects/observers are merely two incomplete perspectives on and descriptions of the same physical process.³³ Objects are no longer autonomous as we have thought them, but are processes framing our reality. In this model, the interoceptive and exteroceptive dimensions of the body-self are mediated by the physical action of thought, creating a *spread brain*, contingent upon our senses but extending well beyond the skin.

Manzotti claims that there are not two physical phenomena in the observer-object relationship but rather one phenomenon that encompasses both, and which takes place in the neuro-collective of the brain. If either the observer or the object moves, the other will also be observed as moved. This suggests that there is some very tight coupling, as one produces the other. Manzotti builds an interesting argument on the assumption that it takes *time* to observe. At time zero, there is no object yet.¹⁶ From the observer's perspective, the image from the object creates the spatial and temporal opportunity for the observer to participate

visually with the object in the general act of observing. With the observer in just the right place at just the right time, *seeing* takes place.

It is because of the existence of the observer at that moment that the object becomes activated. So the object and the viewer together complete the act of seeing when they confront each other. This relationship of seeing is one that is set in time—from the time it takes for light rays to bounce from the object to the human eye and then for knowledge to form in the consciousness. Because we too travel within time, seeing—though it takes place in discrete buds of entanglement—leads to the sense of a whole experience.³⁴ And although Manzotti's argument supports a phenomenological experience that happens within a localized brain, it is those physical processes that begin in the external world and are gathered up in formation that produce a contingent ~~brain~~, one in which the function of brain optics is extended by light and transfers to the surface of the object. The experience of spread ~~brain~~ is a way for the world to take place in ways which we can comprehend, and to take place thanks to our physical structure.

The ~~Brain~~ as Aesthetics Form

The neurological understanding of the ~~brain~~ can reasonably be applied as an aesthetic model for critiquing art that involves bodily participation. The neurophenomenology of action and response requires examination of the material aspects of how neurobiology expresses itself in time and through action, providing a methodology for understanding a key aesthetic of interactive

installation. The philosophical importance of looking at things from a neurobiological perspective offers an escape from the old traps set by the role of mimesis in aesthetics. Aesthetic experience does not need to be an imitation of an action, as Aristotle first argued for art, but can exist as an experience that holds a reality unto itself. In other words, if art is simulated within itself, then there must be another experience that renders art as a more authentic truth. The notion of mimesis involves a framing of reality: what is contained within the frame, it suggests, is not “real” or authentic.

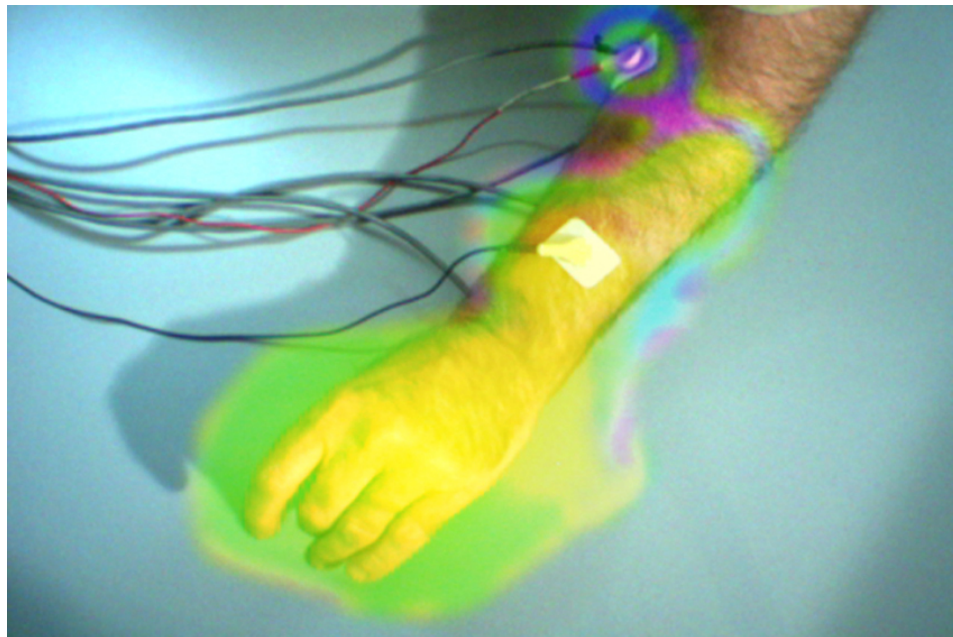
This is a problematic concept for an aesthetic like that of interactive installation, which is driven to expose the authentic experience of itself. Interactive installation also works upon the assumption that the ~~brain~~’s activity is neither a beginning nor a reduction of an aesthetic experience, but rather a process that can be located on many biological scales of human expression. The aesthetic experience can, therefore, offer another connection to the patterns of ~~brain~~, one that comprehends embodiment as a gesture of authenticity. Interactivity is best perceived through practice, and due to the kinesthetic nature of the interactive experience, the action calls upon the ~~brain~~ to work within the physical construction, or embodiment, of being. These distinctions of interactivity lay claim to experience as an act within the nowness of time, with the authenticity emerging at a particular temporal location.

Interactivity is a relational situation—requiring, by its very nature, two or more entities connected through some sort of action. For the cognitive neuroscientist, interactivity is an action where a sequence of brain regions is

activated jointly in a particular causal sequence, allowing an activity in one location of the brain to be available to the brain as a whole.³⁵ The ability to function in a scalable way throughout the body is thus built into the neurostructure of the brain, because the brain regions and their substructures are both maps of particular events and systems of dynamic activity.³⁶ Functioning ~~brain~~ depends, therefore, on a constant and consistent comparison of a variety of patterns that are present in an experience. This multiplicity of event sequencing is also found in interactive installation, with some projects illustrating this connection more explicitly than others, taking further cues from contemporary common knowledge about the biological roots of our own behaviors.

Two contemporary art projects that critique the ~~brain's~~ explicit relationship to the body put forward interesting propositions. The aim of “The Einstein’s Brain Project” (EBP), an ongoing series of individual events produced by Alan Dunning and Paul Woodrow, a Canadian artists’ collaborative, is to inspire visualization of the biological state of the body through the fabrication of environments.³⁷ EBP comprises multiple installations using technological interfaces to measure and direct the output of the human body in response to virtual environments, constantly being altered through feedback from a participant’s biological body. “The Einstein’s Brain Project” marks an artistic re-evaluation of the “stuff” that makes up the world—stuff many times too small or subtle for the human eye to perceive. The project is actually a series of projects that began with an installation at the 1976 St. Petersburg Biennale, in Russia, and ran its course in 1997 at a variety of media events in Italy, Australia, Canada,

England, and other locations. Some of these projects involve physical performances and some use only virtual representations, but as a group of works they have a focus on the neurological processing in the brain as both a real and metaphorical interface between bodies and bodies and larger worlds. Starting with performing bodies, data from the internal processes such as heartbeats, sweating, and bioelectrical fields are used to overlay a dynamic graphic back into the body, creating an inside/outside flip of electric processes.



Alan Dunning and Paul Woodrow, *The Auratic Body*, 2004. From “The Einstein’s Brain Project.”
Performance and Technological Interfaces (film still).

The core of EBP is a discursive space that collapses distinctions between the constructed human body and posthuman forms by refocusing on the auratic intensities of the techno-body, rather than its biological aspects. As Dunning and

Woodrow describe their intentions for the project:

In producing systems to examine bioelectrical fields, the project has generated visual forms and shapes directly out of the human acts of living, acting and thinking, and projected these outside the body. This representation is the outcome of many lines of inquiry into mapping the dynamic body. The project has pursued two main themes: (1) that the body's electromagnetic energy is in constant interaction with external electromagnetic fields, (2) that the world is a construct sustained through the neurological processes contained within the brain.³⁸

The use of technology as a kind of body prosthesis, as Marshall McLuhan pointed out over forty-five years ago, exposes the mimetic forces of both materialism and the symbolism of information systems.³⁹ In particular, EBP removes mind-body polarity by exploiting our biological properties as the point of negotiation between ourselves as host, and our environment. In this work, the ~~brain~~ is both part of a physical spread of energy fields and an action upon the brain; it suggests a body so enmeshed with the external world as to be inseparable from it. The energy fields of EBP also identify the energy fields of the viewer—an ontology of energy that Dunning and Woodrow share with Manzotti.

EBP is raw information constantly transformed by the interwoven acts of the viewer's participation.⁴⁰ Furthermore, the project builds the case that to be alive we must be active in the world. As humans, we engage with our surroundings, and in doing so, our own potential rises through our own enaction. The energy fields do not build without bodily movement. Being is a moving target—not a common body or an organized collective but rather a community of performer, technician, spectator, and technological device that all activate through

action.

In the deconstruction of a singular autonomy, the existence of another becomes the necessary condition for creative freedom. According to Dunning, the artist is explicit about a shift in the traditional body through the application of energy fields as an aesthetic medium. It is worth quoting *in extenso* his perspective on the body as a site of self-destruction:

In the areas of bioscience and neurology, it has now become possible to fabricate many complex models and simulations of the body and brain, which were once thought of as impossible. Technological invention has not only influenced the way in which the body and brain are visualized but, what is perhaps more important, it has predisposed the way in which the body and brain are conceptualized.... More recently the body has been positioned at the point of intersection of many discourses, cultural, scientific, and artistic, and consequently finds itself subject to equivalent processes of deconfiguration. The body has become a site of self-destruction—no longer a stable physical entity, but an indeterminate mass of fluctuating data in continual transformation that destroys itself even as it is remade.⁴¹

The model of representation that Dunning and Woodrow deploy stems from the concept of cybernetics used in the second half of the twentieth century. The augmented human that cybernetics first introduced in the 1920s has come back into contemporary interest through recent understandings of cognitive functioning based on the material properties of the human body. The hybridism that cybernetics imposes provides a multiple reading of what is coherent in the external world. Therefore the spread ~~brain~~ as previously defined continues this discourse, by reaching across conscious acts and actions without particular affinity to separate living and nonliving entities. This spread ~~brain~~ is part of a new

taxonomy for the second wave of cybernetics that considers living systems a subset of all systems. Although highly problematic in its structuralist perspective, it does introduce a repositioning of anthropocentrism for the machinic-biological interface. Another useful shift of second-generation cybernetics is a focus on an observer dependency in all systems. As part of self-reflexive philosophy, we are drawn to an awareness of individual action as it places a mark upon the larger system. This is where EBP fits historically—the brain is constructed and reconstructed by an individual interacting with the environment.

Dunning and Woodrow also explore this cybernetic spread of overlapping systems of bodies and worlds that are not amalgamations of solidity, but rather can be seen in a closely knit combination with energy. The energetic form emerges only through the action of artistic performance.

It is this multilayered flow of EBP that connects many performative works. In an event called *The Shape of the Real*, scientific data from a technologically prepared performing body pushes the coordinates of a computer graphic mesh into endlessly morphing graphic shapes. Complex forms, built carefully over hours, days, and even weeks, contain layers of retrievable activity that serve as a way to build up the body as bioelectric patterns over an extended period of time. Spectators also impact the graphic patterns of the performing body, because their presence further alters the recorded data. The final data are taken from both performer and spectators—distinction between the bodies becomes insignificant.



Alan Dunning and Paul Woodrow, *The Shape of the Real*, 2003. From “The Einstein’s Brain Project.”
Performance and Technological Interfaces (film still).

Dunning and Woodrow refer to the data as “dérive mirrors.”^{42, 43} “Dérive mirror” is a term coined by Damasio to indicate the continual moment-by-moment construction of the self in relationship to time. In *The Shape of the Real*, Dunning refers to its images as an auratic flow of consciousness. The term “auratic” traces back to Walter Benjamin, who defined it in 1936 in his *The Work of Art in the Age of Mechanical Reproduction*: “that which withers in the age of mechanical reproduction is the aura of the work of art.”⁴⁴ What Benjamin described is here in the Dunning and Woodrow work the shift of the locus of the auratic object’s “unique appearance” to that of the multiple. It has moved from the object itself to its creator, or rather artist. In the ancient periods of many cultures, an object was perceived as having an aura because it was thought to possess magical or holy qualities. As societies became more secular, the uniqueness of an

object was increasingly associated with its creator or the artist who conceived it. In the age of mechanical and electronic reproduction, a further shift has taken place: the locus of the "unique appearance" of an object is now located within the perceiving crowd. The object is not auratic because it is perceived as having intrinsic spiritual or magical features as supported by historical readings, nor does it appear special because the object is created by an artist as Benjamin first argued. Dunning's object is auratic because it is perceived as the center of hundreds of other gazes. So although Dunning and Woodrow are suggesting a qualitative relationship with Benjamin's understanding of appearance to its contingency to society at large, *The Shape of the Real* performs this relationship through a transitory and collective understanding of objecthood.

Dunning is careful not to call it scientific data but rather the material choices available to the artist. Dunning and Woodrow's aesthetic deployment lies squarely in a nonreductionist understanding of the performative. In other words, they do not see the performance as a singular representation but rather as a process of multiplicity where human bodies are made visible. Dunning and Woodrow render the aesthetic of becoming one subject by which spectatorship allows the *dérive* mirrors to emerge.



Guy Debord, *Naked City* (detail) (from “Maps of the City” collection), Paris, France, 1957.

Dunning and Woodrow nod to Guy Debord, whose collage *Naked City* consists of randomly collected fragments taken from a map of Paris and assembled to explore a structurally “unintelligent” view of the city.⁴⁵ The *dérive* in this way is a situationist technique for a noninstrumental or an undirected navigation of a city. Dunning argues that *Naked City* produces a kind of aura of a city—a fragmented body made up of fragmented bodies. It is a world of spontaneous perception between apparently unrelated items, where the spectator

finds creative ways to connect the body to the environment. It is a process wherein the city is altered by the individual experience as embodied but ungraspable. In Dunning's words, "the spectator is forced to search for disappearing and lost ghostly bodies."⁴⁶ Debord's performative can be understood as the spread between self and group, a performative action or spectacle action of the individual, where this very realization becomes an aesthetic point of departure for interactivity. Dunning and Woodrow see this performance between the singular and the group as an aesthetic feedback loop binding together the fragments of experience. The loop is used to develop a coherency in experience by which the spectator can derive a sense of wholeness from the experience.

Debord, as a post-Marxist theorist, is inclined to identify his own work with revolution—a move away from the debilitating modernization of both the private and public spheres of everyday life today. *Naked City* points to an engagement in a class struggle, reclaiming individual autonomy from the spectacle. Debord's artistic tendencies exhibit a decentering of the power of economic forces. Political uprising is arguably an essential aspect of how and why Debord developed his theory of the spectacle. What then, might be Dunning and Woodrow's equivalent? Dunning and Woodrow's work exists in the rarified environment of a research facility, not the streets of Paris. Debord's decentering of economic forces is replaced by Dunning and Woodrow's engagement with the fragmented body. But the new fragmentation is devoid of any political reference to the contemporary moment that this could imply. Although their work may be a critique of the consumariat, Dunning and Woodrow do not provide this argument.

The question remains if this is an equal enough exchange for Dunning and Woodrow to be able to claim the same aesthetic intentionality as Debord. It may be that Dunning and Woodrow are far more modernist in their application of the body than even Debord intended to be in his.

Dunning and Woodrow's spectator comes away from the artwork with two concepts to ponder. One, it takes time to observe. The very act of seeing something belongs to a long process of bodily calculations that are interconnected with time. Seeing unfolds at the rate of living and so can never be totally separated from the unfolding of experience. Two, the spectator realizes that all observation is a form of interactivity, because it works as a way to tease out traces of the past and overlay them with the current moment. With this understood, there can be no longer be passive viewing in art. There is no distinction between the spectator and the viewable object. This puts the work of Dunning and Woodrow squarely within the neuroaesthetic discourse of the posthuman, where cognitive systems can be easily exchanged with the systems of worldly interaction.

This approach to interaction hinges on the cognitive processes of the spectator through an aesthetic interconnection between technological effect and affective human response. The artworks of Dunning and Woodrow seek to expose how this aesthetic interconnection creates an engagement with interaction, while suggesting a new forum for addressing the philosophical problem of the relationship between body and mind. But their project retains a modernist concern, because it treats the body as an object without political context. Interaction works as a mechanism between the body's functionality and the

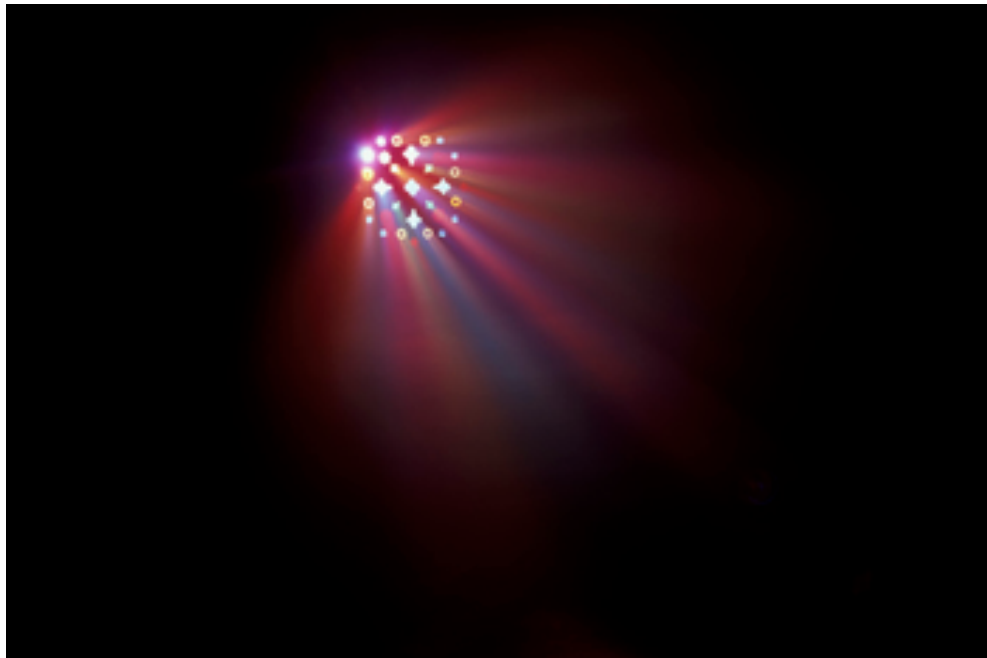
technological extension. This aesthetic interconnection between technology and human cognition has been referred to in art technology circles as “affective aesthetics.”⁴⁷ It introduces the application of emerging technologies to interactive artworks, via cognitive feedback loops, to engage and dynamically activate affective responses in the participant. “Affective aesthetics” is a term used specifically by Dunning and Woodrow to mean the self-reflexive positioning that *dérive* mirrors provide within the spectator’s brain. Dunning understands the source for internal images as coming from the internal structure of the brain:

[T]he images in the consciousness narrative flow like shadows along with images of the object for which they are providing an unwitting unsolicited comment. To come back to the metaphor of the movie-in-the brain, they are within the movie. There is no external spectator . . . the core you is born.⁴⁸

From this core we can think of all experience as a kind of shift or decentering, where a moment begins to spread the ~~brain~~ out, and among everything else in the world that surrounds it. Shortly after the thought of self arises in any experience, there always comes a dispersal of that energy. In the case of Damasio and Dunning and Woodrow, it does not particularly matter if the spark originates in the action of the brain or the action of the larger world, as the dispersal of one to the other is so swift and blended. What does matter is that the spark activates both time and directionality. The ~~brain~~ is bidirectional. In the case of EBP, the first mark of the movie-in-the brain becomes a visible trace upon the performer’s body. This overlay turns quickly into the spectator’s brain as the

action of relations. The brain continues to spread back out, and the movie-in-the-brain becomes once again the movie-in-the world.

Another artist who uses Damasio's movie-in-the brain concept is Melvin Moti. Moti's movie-in-the-brain, however, starts in the brain and appears to remain there, because there is a lack of anything outside of itself to spread to. Moti takes the process of a movie-in-the-brain quite literally, and although he is explicit about using both visual and conceptual materials too subtle for the senses to perceive, he would say that there is a complete theater experience that occurs in the brain's processing of the material.



Melvin Moti, *The Prisoner's Cinema*, 2008.
35mm film with sound (film still).

This idea is most apparent in Moti's film installation *The Prisoner's Cinema*. The term "Prisoner's Cinema" refers to the nonstimulated phosphenes, or the internal varicolored play of light, that occurs after gazing into a visually unmodulated and virtually unchanging environment for long stretches of time.⁴⁹ Experienced by prison inmates, pilots, and long-distance truck drivers, these apparitions can be scientifically explained as a phenomenon generated internally—not by a synchronous outside world but by the processing of the brain—perhaps by the very action of the brain's chemistry moving within the skull. With no external stimuli, the brain fills the space with its own behavior. Neurophilosophers explain this as the brain's reaction to an undersupply of visual stimuli.

Moti's work targets the spectator's mind as the locus for all the patterns that make up our experiences. *The Prisoner's Cinema* uses projected-light to simulate the kind of visual effects that, according to studies, occur within the stimulus-deprived brain during Prisoner's Cinema. Prisoner's Cinema as defined in science is neither a visual phenomenon, passing through the optic system, nor a compensatory phenomenon, gathered up by other sensorial systems and transmitted to the brain. It describes instead how light is rendered upon the brain, by the brain itself, without the activation of the optic nerve or any other system.

Moti claims that the experience of the entire world is also held within the processing of a single brain. This processing introduces the viewer to the familiar patterns that play within the brain when a person is deprived of any external sensory activity. In this way, the focus of Moti's installation takes place primarily

within the mind. The viewing of the film therefore becomes an external explanation of that experience, and not an extension of internal mechanical processing. Moti's work suggests that when left to itself, the mind creates a world of knowing by accessing everything it has collected and archived through past experiences.

If we understand ~~brain~~ as being without finite internal and external distinctions, it is easy to see that the energetic forces of the world can play upon the internal functioning of the brain in an influx of patterns. It appears that we need to make narrative with those patterns, in an attempt to make our apprehension of experience into a whole. Like Damasio's notion of the "movie-in-the-brain," the system puts together a context for all the brain's activities.⁵⁰ To this point, the ~~brain~~ supplies an endless stream of material parts, where the narratives are deeply rooted in our bodies. Damasio argues for the possibility of a neurobiological approach to self-representation that can be found in such an internal narration.

Damasio breaks the problem of consciousness into two parts: The "movie-in-the-brain" kind of experience (in which a number of sensory inputs, or a memory of inputs, is transformed into the continuous flow of sensations of the mind), and the self (the sense of "owning" that the movie comes to be part of the self). The "movie-in-the-brain" is a nonverbal process, and, as Damasio argues, language is not a prerequisite for consciousness. The key issue to Damasio is that brain cells represent events occurring somewhere else in the body—as if the cells of the body have a kind of intentionality within them. Brains are not mere "maps"

of the body; they also represent what is taking place within that topography. Indirectly, the brain also represents whatever the organism is interacting with, since that interaction is affecting one or more parts of the body. So when an event occurs in the brain cells, it also occurs throughout the body. This is both a distribution method and a means by which we can see the whole system working together as a unit—what Damasio calls a first-order narrative.

Damasio argues further that there also exists a second-order narrative: one's relationship to other people. The second-order, relationship narrative is operating at the same time as the first-order, internal narrative. We create these multiple narratives while the “movie” is playing, developing a sense of self created *by* the movie. The thinker is created by the thought. In this manner, the spectator of the movie is part of the movie.⁵¹ Moti's work with non-stimulated phosphenes encourages his audience to take their own meditative role in art by placing the movie squarely within their own body chemistry and onto the internal narrative. This fits with Damasio's theory that consciousness has evolved to adapt to multiple experiences and interpretations.

Damasio's first layer of consciousness explains core consciousness as the simple sense of self in the present. *The Prisoner's Cinema* internalizes perception as an awakening of the clear mind. It is within this clearing of the mind, the work suggests, that a complete experience within the brain's structure occurs. And it suggests that, as a pattern, this experience can autonomously generate the same patterns found outside its direct purview. The desire for brain stimulation is already strong by itself. In *The Prisoner's Cinema*, it is the lack of mental

stimulus that provides the brain with the ability to spontaneously create experiences.

Along with core consciousness, Damasio claims there is another cognitive process, which he calls “extended consciousness.” This is where more complicated patterning occurs as an act of awareness of both a past and a future with respect to oneself and the world. The narrative created within the first layer of consciousness is where the *here and now* can take on deeper meanings by overlapping them with life experiences. This is perhaps where introspection begins to take on shape within consciousness.

Damasio describes extended consciousness as an event in which the subject has a more elaborate sense of self than with its first or core conscious event. Extended consciousness evolves over a lifetime of individual experience, placing what core consciousness produces from experience in a broader relationship with others and within the extended time frame of lived past and anticipated future. Extended consciousness, he says, “still hinges on the same core ‘you’ (the fleeting, momentary sense-of-self known in core consciousness), but that ‘you’ is now connected to the lived past and the anticipated future”—an autobiographical record reactivated when autobiographical memory is accessed.⁵²

Damasio goes on to say that autobiographical memories are artifacts, objects that generate a pulse of core consciousness or a sense of self-knowing. Extended consciousness thus depends upon two abilities: one is to learn and retain records of myriad experiences, and the other is to generate a sense of self-

knowing by reactivating those records in such a way that they can be known to us. Core consciousness, Damasio says, provides a rite of passage into knowing, and extended consciousness builds on that capacity, permitting levels of knowing that can sustain human creativity. The capacity with which consciousness extends to creativity allows us to transform and combine images drawn from that “repertoire of patterns of action stored in memory, to invent new ways of doing things and make new plans for future actions.”⁵³ For Damasio, creativity and consciousness are intimately linked. If we take away consciousness, creativity vanishes. If we take away creativity, extended consciousness becomes chaotic fragmentation with no apparent cohesion. In this way, the act of creation that the spectator brings to these projects may be framed as the aesthetic act of binding together the fragments that can never be completely bound.

The brain spread is one part of the realization that the current boundaries of body parts do not adequately explain the functionality of those parts. Parts must instead be understood within the whole system in which they live. Neurons throughout the body, as an example, are now known to perform advanced calculations—actions it was previously believed only the brain could perform.⁵⁴ This realization forms part of a critical shift, away from what were originally considered the most important aspects of interaction, such as the edges of objects that touch or overlap.

Relationships of things to things, we have now discovered, are instead multidimensional and constantly shifting in time and space. Within the human body, the situation is the same: at any given time, which of its many zones

become the sensitive zones of interest is navigated by the body. These are the pathways for how complex receptive fields of art rely on an embodied understanding of experience.

Chapter 3: Towards a Behavioral Aesthetic

The Biological Modernist

Chapter 2 reviews calls among theorists for a reinvention of our understanding of the brain's relationship to embodied systems. It lays out the claim that the brain is a biological site of intersecting possibilities that activates and is activated by the things it comes in contact with, things which therefore alter it in substantial ways. The outcome is a reinvention of the understanding of the brain as a biological spread and a challenge to the distinctions of interiority and exteriority of embodiment.

The interactions between the brain and the body are more than a series of contingencies to other body parts—they are a dense intersection of what, perhaps in more general terms, Maurice Merleau-Ponty calls “the field of perception.” This field creates a dynamic weave within which human consciousness assigns meaning and which affects how we experience every physical aspect of life. For instance, we may understand fear as an abstraction, but it is not until we are engaged in an act of fear that we *feel* it. At a moment of danger, biology triggers what is commonly called the “fight or flight” instinct. This is how the body induces us to take irrational (or pre-rational) actions to minimize risk.⁵⁵ It is *within* the actions that the body enacts, prompted by the instinct to fight or flee, that we find the emotion itself. So first there is a fundamental instinct, then an action of the body, and then finally, the emotion of fear rises to the point where it

takes over as the driving factor of thought and behavior.⁵⁶ Acts of embodiment must be engaged in order for us to feel the full force of emotions.

Merleau-Ponty writes about emotions from a more generalized perspective—the balance of relationships of the self to objects, to others, or even to oneself. This sets a relational stage of perception to things, and retains an ongoing embodied relevance to cognitive science. In this way, the body is not dissimilar to any object in this larger field of consciousness. The body is a self-organizing filter for the whirling potential of everything it is exposed to. And so every part of humanness is also part of everything that the body processes, because without that processing, our need to be active within the world would not exist. Embodiment is an opening up of possibilities rather than a grouping of teleological distinctions. At every site where material is exchanged between cells, or where one lobe of the brain shares functionality with another, an endless array of negotiations is constantly under way. And these negotiations are nourished by the search of each participating element beyond its own formalities of structure and function. Only within that extension, by each element *beyond* its own form, can we find meaning in the world. From this idea, it is fairly easy to surmise that reducing any part of embodiment to its material connectors only—while overlooking its possibilities for invention—is a mistake. The human body's effect on its own functionality is far more than the sum of the individual functioning of its parts; not accounting for intra-element creative exchanges is an ongoing error that science has too often made in the quest for absolute truth.

The artist has a critical part to play in unifying Merleau-Ponty's field of possibilities. Making art exposes the evidence of intention in ways that shift perception away from everyday observations toward critical reflections brought on by aesthetics. Art is also a perception that spreads artistic intention through action that provides an entry into the process of the artist. It is with the invention of Modernism that the artist becomes aware of this potential for personalizing experience. The modernist claims self-importance in the rendering of a story that exposes a personalized process of invention. This is a critical shift from art as an object of appreciation, to a process.

The experience of art as rendered through the body's senses has become more than an exercise in imagined narration. It also provides us with a guide to how the biological functionality of consciousness cannot be seated solely with the artwork. It takes the viewer's own perspective to formulate a complete union between the artist, the object and their own perception. This can be traced back to Roger Fry's promotion of Post-Impressionism as a breaking free from the naturalism of Impressionism in the late 1880s: in Post-Impressionism there is an independence of artistic styles for expressing emotions rather than simply optical impressions in art. The individual point of artist view also requires the viewer to participate in a new way.

It may be Paul Cézanne who first shifts the perceiver's epistemological habits of authorship from the canvas to the viewer. His work lays the foundations of the transition from the nineteenth-century conception of artistic endeavor to a new and radically different world of art in the twentieth century. His desire to

unite observation of nature with the permanence of classical composition exposes the juncture between static form and process. His expressive brushwork breaks down the distinction of individual objects or entities and works to create a world of artist's imagination where a grouping of strokes reconcile themselves within this setting. In particular, Cézanne's intense study of his subjects through the intentionality of a searching gaze exposes the viewer to the struggle and complexity of human visual perception.



Paul Cézanne, *Dish of Apples*, ca. 1875–77. The Metropolitan Museum of Art, New York. Oil on canvas.

Cézanne ignores the traditional laws of perspective, allowing each object to be independent within the space of a picture while its *relationship* to other objects takes precedence over its “correct” *individual placement* according to traditional perspective—and therefore to some extent over the individual *identity* of each object. Cézanne thus explores the geometric simplification that removes rigid and singular edges of objects, a tendency that first began with the free brush strokes of Impressionism.



Pablo Picasso, *Still Life with a Bottle of Rum*, 1911. The Metropolitan Museum of Art, New York.
Oil on canvas.

This exploration finds its way to fully breaking form and meaning in Cubism. Picasso and other Cubists dismantle altogether the illusion of wholeness of the subject, suggesting a loss of a singular truth within a singular and whole world. Time, and the artist's process, are made visible. And once the artist has broken the hold of the singular illusion of form, the viewer participates—must participate—in the artist's intention and process. It is here that we discover the other invention of Modernism—the shift of viewer from a passive state of observation to a participatory engagement that creates a shared dynamic of intersubjectivity. The viewer must now take a certain amount of intellectual authorship in binding together the aesthetic experience between form and content.

The critique of intellectualism in Merleau-Ponty's *Phenomenology of Perception* is directed towards the idea derived from rationalist Cartesian discourse that our consciousness, as a wholly constituted being defined by the cogito, judges everything in the external world by rational reflection:

Perception becomes an “interpretation” of the signs that our senses provide in accordance with bodily stimuli . . . but judgment also, brought in to explain the excesses of perception over the retinal impressions, instead of being the act of perception itself grasped from within by authentic reflection, becomes once more a mere “factor” of perception, responsible for providing what the body does not provide—instead of being a transcendental activity, it becomes simply a logical activity of drawing a conclusion.⁵⁷

In Merleau-Ponty's account of visual perception, empiricism is bound within sensory experience. The modern artist exposes this enigmatic ontology of the chiasm and the flesh where the artist's body has the capacity to be both

perceiving object and subject of perception with a constant oscillation. The modernist artist creates a kind of organization of this effect—from her own body to the body of the artifact and onward to meet with the body of the viewer. It is a meeting of bodies by proxy—mediation from the body that builds the art to a body that completes the cycle by observational experience. Merleau-Ponty goes on to consider the exploration of the body both as an exploration of body-parts and as an act of invention:

I can identify the hand touched in the same one which will in a moment be touching. . . . In this bundle of bones and muscles, which my right hand presents to my left, I can anticipate for an instant the incarnation of that other right hand, alive and mobile, which I thrust towards things in order to explore them. The body tries . . . to touch itself while being touched and initiates a kind of reversible reflection.⁵⁸

Merleau-Ponty refers to this phenomenon as “drift” between two flawed and equally unsatisfactory alternatives—what he calls “empiricism” and “intellectualism.” The modern artist supports this notion by creating a realm where empiricism and intellectualism are impossible to separate through the aesthetic experience of looking at a non-representational image. And with the shift of authorship in, for example, Cézanne or Picasso, the viewer can begin to enjoy the freedoms that come along with the opening of participation in art. The act of art appreciation partakes both of the everyday actions of the body and of an abstraction of thought.

A Post-Biological Reflection

In biological humans, behavior is controlled primarily by the endocrine and the nervous systems. Hormones and neurons make up these systems of chemistry and these, in conjunction with their environments, create the actions and mannerisms of the human organisms. It is the response of these systems to various stimuli or inputs—whether internal or external, overt or covert, voluntary or involuntary—that when bundled together form a coherent sense of biological action in the world. Behavior can be regarded as any action of an organism that changes its relationship to its environment. So it is behavior that provides outputs from the organism to the environment.

A behavioral cusp is any behavior change that brings an organism's behavior into contact with new contingencies that have larger consequences than the event itself.⁵⁹ A behavioral cusp is a powerful type of behavioral change because (1) it provides the learner with opportunities to access new reinforcers, contingencies, environments, and related generativeness that surround it; (2) it competes with existing archaic or problem behaviors that it comes in contact with; (3) it impacts the people around the learner; and (4) these people agree to the behavior change and support its development after the intervention is removed. The implications reach far beyond the field of developmental psychology. Generativeness describes the ability of the receiving environment to regulate novel responses, functions, values or response products derived from the original cusp response. For a behavior, it is the ability to recombine or merge into more

complex units, or the ability to contact environments. The behavioral cusp of an interactive activity is therefore the location where change in systems can occur.

As used in computer science, “behavior” is an anthropomorphic construct that assigns “life” to the activities carried out by a computer, computer application, or computer code in response to stimuli, such as user input. Also, “a behavior” is a reusable block of computer code or script applied to an object. The evolution of the biological toward the mechanical is a development of survival: the vessel of the body is extended in material form, and thus in its expectations for survival.

Behavior in an art object suggests that we consider both the physiological and physical implications of identification. Behaviors therefore reflect both the intellectual attributes of the condition of being, and the post-biological situation of the machine. Behaviors are the conditions in which any action may be critiqued for the ability of an object to work within, relate to, and expand from the site in which it is located.

When we attempt to consider our own bodies as the site of our identity, there are situations of embodiment that show us describing a site of activity is not a simple task. Identifying what creates a single person is not as easy as identifying a collection of biological parts that are human-centric. According to Dr. Lita Proctor, coordinator for the Human Microbiome Project at the National Human Genome Research Institute, the task of isolating human biology from other forms

of biology is impossible. He notes that within the body of a healthy adult, microbial cells are estimated to outnumber human cells by a factor of ten to one.⁶⁰

These internal microbial communities are more than coexisting with the body they inhabit: their influence upon human development, physiology, immunity, and nutrition—to list a few—are inexorable. So the task of identifying what it is to be a biological form—what can be assumed as the starting place of human form—is not as clear as it may have been thought. Instead of examining the genome of an individual bacterial strain that has been grown in a laboratory, the metagenomic approach allows analysis of genetic material derived from complete, multi-biological microbial communities harvested from a single person.

The Body Form



Archer Matt Stutzman competes in the individual compound open bronze medal match, 2011 Parapan American Games, Guadalajara, Mexico, 2011.
Photo credit: Olympic Games.

Documented in the above image, archer Matt Stutzman prepares to release his bow at the 2011 Parapan American Games. Stutzman competes while aided with prosthetic devices. His attention, his focus towards his goal is all that exists at this moment. But the back story of how everything that was put into play to make this moment possible reminds us that the human body is a situation—it exists within a complex array of biological and mechanical developments that has shifted our contemporary perception of body from the exclusivity of a material identity to its action or purpose within the world. It is a phenomenological

perception of embodiment with a new twist—one where organic matter no longer has a singular hold or claim on life. The body has spread out into the technological forms of invention. Matt Stutzman, his wellness and his success, reminds us that the biological meshing with the post-cybernetic is well underway.

To talk of the concept of “health” is usually to talk about maintenance and sustainability of the body. But if the body is transforming itself, how are we to examine the functional and/or metabolic efficiency of the “health” of that body? According to the World Health Organization, the main determinants of health include not only the person's individual characteristics and behaviors, but also the surrounding physical, social, and economic environments. To sustain health is to keep a balance within all of these systems. Health has always been part of a human intervention, an evolution that included a constant re-adjusting of the relationship to our embodied selves, surviving within an ever-shifting world.

In consideration are these: what constitutes health? Where is the wellbeing of a “whole” or “complete” person situated? For instance, Western medicine separates mental and physical health—in this system you can be physically fit but mentally maladjusted. As consumers within a health industry, we are required to identify ourselves as attending to either a physical or a mental issue of health. Yet in all its aspects, health—or the lack thereof—is a function of the body's moving about in relation to the larger environment in which it is embedded. Either the parts are moving or they are stuck. They are arguably all mechanical parts—some at a very small scale, but all having the functionality to somehow connect and relate to each other. Even the biochemistry that moves through brain cells to

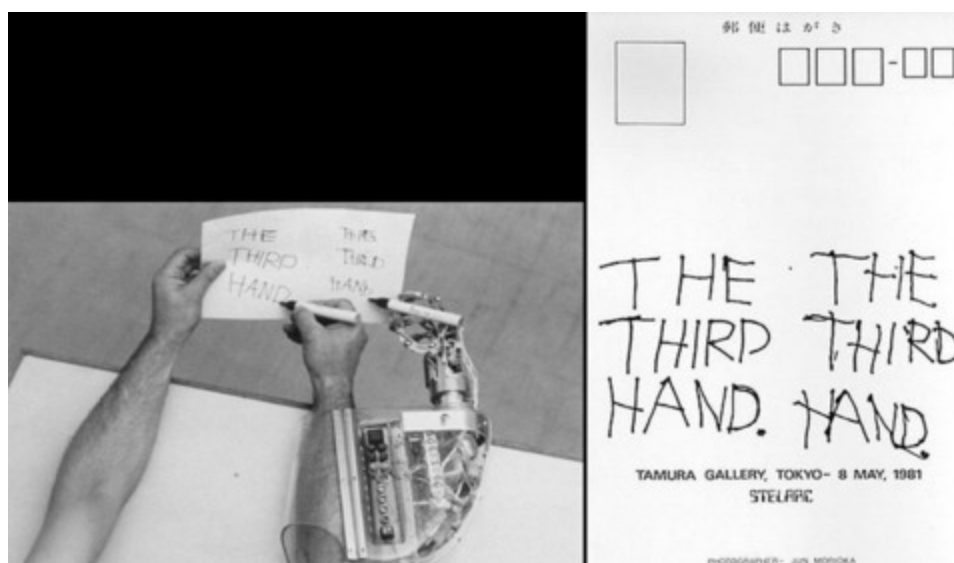
create cognitive functioning is movement-based, a displacement of energy from one neuronal ending to another. Mental health is a balanced flow of this biochemistry through the receptors available. The parts are always in flow—always in migration, but not always in balance.



Stelarc, *The Third Hand*, created and performed 1980–98. Performance still.
Photo credit: Stelarc.

Stelarc understands the body as a flexible extension of the brain's functions, and considers adding technology to our bodies as a logical next step in an evolutionary track. In his performance *The Third Hand*, his body is part of a control system: the motions of the work's three arms are controlled by the electrical signals of his muscles—typically from the abdominal and leg muscles—for independent movements of each hand.

The result is that one part of Stelarc's body is in control of another part—the original body is an extendable entity, which can enrich its own functionality through added technology. This illustration suggests that the Third Hand can assist in the evolution of a built-in obsolete functionality of the original body. Through invented forms, the augmented body moves beyond a first wave of original health and into a domain that the World Health Organization would categorize as a Health Lifestyle: the aggregation of personal decisions—decisions over which the individual can participate. In this way, it moves away from the biomedical realm where all aspects of health, physical and mental, developed within the human body are influenced by a genetic make-up that interacts with a world in which we have only secondary control. Such a singular track, Stelarc may very well argue, limits our creative potential.



Stelarc, *The Third Hand*, created and performed 1980–98. Performance still.
Photo credit: Stelarc.

Stelarc's body can also be understood from a neuroaesthetic standpoint. The work of philosophers such as Francisco Varela, Evan Thompson and Alva Noë claims that an embodied mind denies a separation of mind and body, because reason, imagination, and the perception of meaning are part of embodiment to begin with. Reason and emotion, furthermore, are always tied to the kinetics of experience, binding aesthetics to science and vice versa. In other words, experience and cognition are bodily mediated and part of the same bundle. In the case of *The Third Hand*, it is Stelarc's nervous system that controls both thought and muscle action. The flow of possibility for the body is multiplied by the evolutionary potential of invention and an expansion of the concept of body.

Synthetic Biology

Our understanding of biology is now merging with the principles of engineering to bring us synthetic biology. Re-engineered engineering, where the software is a genetic code made in the laboratory and becomes the software that builds its own hardware—has become the new cell. So rather than cut existing DNA out of an existing strand, the DNA is made by a machine and can be spliced into an existing biological form. These constructed DNA segments are called biobricks. Biobricks are a new unit of measure for life. 10,000 years of genetics has taken us from gathering seeds to genetically manipulating DNA. Both spreading life forms and creating new forms, the new cell provides another way to see the post-biological human take new form.



Ionat Zurr and Oron Catts, image from *The Tissue Culture and Art Project*, 2008.
Photo credit: Zurr and Catts.

Looking at these issues from a cellular level is another way we are re-inventing ourselves. *The Tissue Culture and Art Project* by artists Ionat Zurr and Oron Catts, explores the use of tissue technologies as an aesthetic medium. Zurr and Catts say they are investigating relationships among the different gradients of life through the construction or growth of what they claim to be a new class of object-being—that of the “Semi-Living.” They write about the work:

These evocative objects are a tangible example that brings into question deep rooted perceptions of life and identity, concept of self, and the position of the human in regard to other living beings and the environment.⁶¹

The Tissue Culture and Art Project presents a novel way of thinking about evolution and the building of new wet-ware territories: as a way to build a long-term evolutionary trajectory of health.

Another interesting situation that the biological system faces is the ongoing turf war between other biological systems of the body. Many infections, even those caused by antibiotic-sensitive bacteria, resist treatment. Continued misuse and overuse of antibiotics has resulted in the evolution of drug-resistant diseases. This paradox has vexed physicians for decades, and makes some infections impossible to cure. Using antibiotic treatment alone may not be the solution. Bacteria become starved when they exhaust nutrient supplies in the body. When starved cells stop growing, those targets are no longer active. This also produces antibiotic resistance, which reduces the effectiveness of many human-designed drugs. And so it is now believed that providing nutrients to the bacteria in conjunction with the proper dosage of an antibiotic creates enough movement or action within the body to trigger better overall health by keeping the bacteria satiated—allowing the cells to thrive enough to be effected by the antibiotic. So antibiotics should not be seen as an external machine, a way to clean house, but as an internal cooperative prompter that re-stimulates the body's bacterial adversaries/tenants by joining forces with them.

In a similar re-evaluation, we can no longer look at the mechanics of cybernetic development as mere extensions of, or replacement parts for, the “real thing.” Artificial limbs and artificial organs become functional and real in their application. Material transformations of bone, skin, and organs create a wider net

cast over ideas of gender, age, wellness, and survival. The introduction of cells grown in Petri dishes has become a means to heal the body by providing it with a new functionality.

This meshing of different biological systems brings to light questions not only about what the body is, but about what constitutes life itself. Artificial intelligence, technically enhanced prosthetics, and the new frontier of wet-ware all distinguish the contemporary moment from the last century of technological innovation and integration. In our post-biological and post-cybernetic moment, many substantial distinctions between living organisms and the technology that they invent or consume have inevitably collapsed.

The Chilean biologists Humberto Maturana and Francisco Varela endeavored to accurately define life when they first formulated a theory for distinctions of living systems in the early 1970s. This work was influenced by the “systems” approach to theoretical biology and developed out of Maturana’s study of the nervous systems in animals. The theory of autopoiesis is their contribution. Autopoiesis (a self-producing system) describes a closed system that is autonomous, yet interactive with and responsive to its environment. When stimulated by the external environment, a living system will reorganize itself internally, but always retains an order that makes it unique, reflexive, and self-perpetuating. This, Maturana and Varela contend, is the only true definition of life, as it elucidates the *manner* in which life functions as a self-propagating system, and does not merely describe the *presence* of certain parts or common mechanisms such as arms, organs, or even a brain.



Ionat Zurr and Oron Catts, image from *The Tissue Culture and Art Project*, 2008.
Photo credit: Zurr and Catts.

We can see that Zurr and Catts's *Tissue Culture and Art Project*, discussed earlier, does just this: it functions as an autopoietic system according to Maturana and Varela's definition. As the work propagates cells for growing the "semi-living," any distinction between original cells, and cells constructed *in situ* by the work, is blurred. The voo-doo doll is developed in a glass womb. So if autopoiesis defines the system that creates life as something that does not need to be made of original carbon cells, perhaps the usefulness of separating synthetic life from carbon life becomes obsolete.

Philosopher Donna Haraway foreshadowed this turn of events in her 1991 *Simians, Cyborgs and Women* when she claimed her preference for the cyborg over the goddess. In the chapter "A Cyborg Manifesto," she notes that goddess embodiment seemed to be given, organic, necessary; and female embodiment seemed to mean skill in mothering and its metaphoric extensions. The Cyborg, in contrast, can finally free herself from this service to bear and sustain such otherness rather than to sustain herself.⁶² Haraway's move away from the myth of the female body, and towards synthetic feedback mechanisms, raises many questions about the post-gendered body—its function and its ecology within a larger system of being. Is health the sustainability of a biological status quo or does it have transformative power—an ability to evolve in the face of say, life-threatening adversity?

Organic matter no longer has a singular hold or claim on life. The post-body aesthetic provides a new philosophy for what constitutes a whole and healthy body. It also challenges our ideas of what functionality means in the

actions of subject and object. Actions are whole and complete gestures, driven from intentionality to activation and feedback. They are also always part of many other actions that come from other subjects and objects. The distinguishing of life actions from non-life actions no longer provides any useful insight in critiquing aesthetics; rather, the discussion has relocated, to the adaptive possibilities of technological integration and physical transformation.

Chapter 4: The Autopoietic Aesthetic

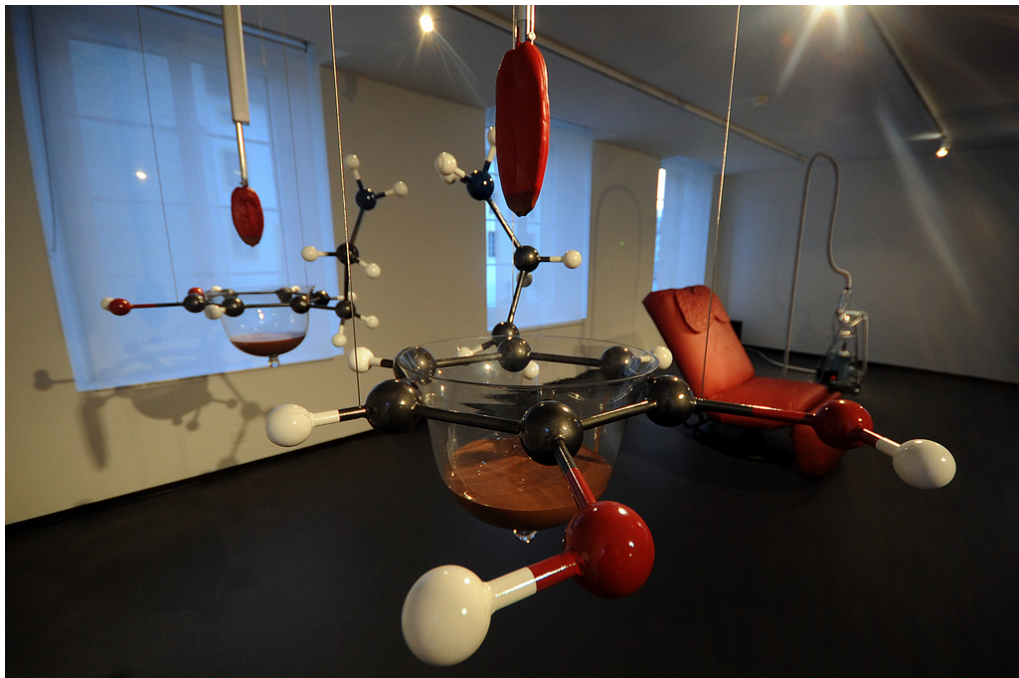
Preamble

Autopoiesis is a system of self-creation. While autopoiesis can refer to biological systems that self-reproduce, autopoiesis also applies to non-biological systems that possess the characteristics of self-sustaining processes, in most cases by the use of internal feedback controls. In biology, the autopoietic exchange is observed in systems from the co-evolved genomes of mitotic divisions in the eukaryotic cell⁶³ to the reward-anticipation potentials of holonomic brain theory.⁶⁴ In artificial life systems such as the code for robotics⁶⁵ or the ecosystems of virtual modeling in artificial chemistry,⁶⁶ we also see the persistence of the autopoietic functionality.⁶⁷ When autopoietic systems overlap or blend with each other, they create new typologies according to their behavioral characteristics. Both transformative and destructive, these independent systems also become agents to and within other apparently unrelated systems. Autopoiesis is a new way to conceptualize our relationship to everything we come in contact with. This blending also produces a larger complex second-level union of interaction that involves how we relate to an artwork and how we can critique those aesthetic experiences.

Inherent in this structure is the re-evaluation of the idea that aesthetic experiences are singular events. No longer does an object stand alone in the world; nor does an aesthetic experience belong only to an individual human. The

aesthetic experience is now always autopoietic. In addition, autopoiesis exposes a common ancestry of all people and machines who participate in exchanging and merging life events. This ontology rejects both the Kantian view of aesthetics, according to which aesthetics is non-conceptual and incapable of giving rise to knowledge, and the mind/body dichotomy that underlies it.

Organ Distribution



Ken Rinaldo, *Enteric Consciousness 2010*. Installation detail.
Dopamine dipping from a robotic tongue.
Photo credit: Nicolas Nova.

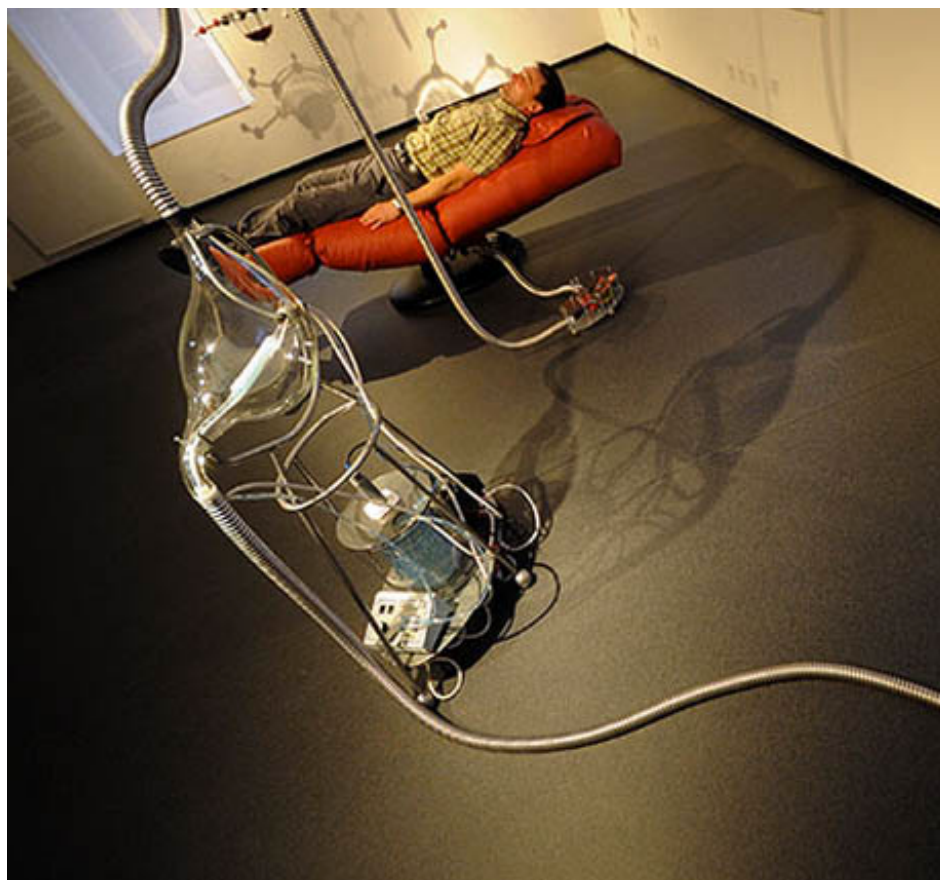
A stunning example of an autopoietic union between people and machines can be experienced through the installation artwork of Ken Rinaldo. In the

multipart installation *Enteric Consciousness 2010*, we see a group of large robotic tongues controlled by an artificial stomach that fills with the living bacteria *Lactobacillus acidophilus*.

The enteric system is the neurogastroenterological autonomous functioning of the stomach. In the enteric, that is a subdivision of the autonomic nervous system, cells are a transient component to both the stomach lining and the spinal cord. In other words, the enteric permits components to be shared with other parts of the body. Through the function of the enteric, the brain is directly connected to some one hundred million neurons of the spinal cord via the intestinal lining of the gut—a kind of re-distribution of the brain, spinal cord and stomach. Rinaldo uses this understanding through an artificial stomach that extends the electrochemistry of the human body—from the human brain as a neural crest, into the neural crest of the stomach, and into the total body ecology of the installation. At the same time, the robotics deliver chemicals found in the human body to the artificial stomach, triggering performative events for the interactant to engage with and thus to transform the installation as a whole.

In one section of the installation, *Enteric Consciousness 2010* is host to large robotic tongues dipping in and out of bowls of melted dark chocolate, drip-feeding an artificial stomach with squirts of dopamine stored in the robotic tongue. In the human brain, the chemical dopamine is known to create feelings of enjoyment and even addictive pleasure, while in the stomach it has an emetic or forceful expulsion effect and can cause severe constipation, literally stopping the flow of activity in the lower intestines. The body's response to chocolate is

similar as well. So the dual use of dopamine and chocolate is an aesthetic reflection on the enteric system, refocusing attention from the chemical dopamine, the tongue, or even the stomach as singular objects to the behaviors of the entire system. Meaning becomes contingent on these dynamic situations, rendering either pleasure or discomfort through the acts of chemical distribution. Furthermore, there are a variety of ways in which Rinaldo's installation can change meaning—the system in play refers to both pleasure and discomfort, implying that sometimes, these outcomes can be a shared experience.



Ken Rinaldo, *Enteric Consciousness 2010*. Installation detail.
Photo credit: Joana Abriel.

In another area of the gallery, a twist to the robotic system is introduced when a viewer takes the initiative to engage in the installation by sitting in the red chair. The viewer—now the interactant—participates to create a complex and dynamic feedback loop. When an interactant sits in the chair, the dopamine becomes a trigger to initiate the physical pleasuring of the human. The artificial stomach first controls and activates the robotic tongue and second, if the bacteria within the artificial stomach are healthy and reproducing, the robotic tongue-chair senses the presence of the interactant and reclines and delivers a fifteen-minute massage. If the bacteria is not healthy, it severs the potential for the system to loop and the chair does not move. When the interactant leaves the chair the robot tongue returns to an upright position and the installation resets and awaits another interactant. The aesthetic impulse of the viewer is to interact—by sitting in the chair— hence prompting the autopoietic system into motion. The conduct of each organism corresponds to a description of the behavior of its partner. The outcome provides the potential for a pleasurable experience to the body but does not always provide this outcome.

This installation is full of experiential feedback loops. The massage helps reduce stress-hormone levels, which in turn can actively reduce the incidence of intestinal disorders in the human gut. In this way, the installation strongly implies a medicinal relationship of pleasure to body to the aesthetic pleasure of art. Another loop is the installation's embodied self-awareness; it initiates its own activities through the expressed relation between perception and action. As Alva Noë reminds us:

For perceptual sensation to constitute experience—that is, for it to have genuine representational content—the perceiver must process and make use of sensormotor knowledge.⁶⁸

Embodied knowledge must be active, Noë argues. This involves an aesthetic sense in action—the pushing out from sensorial parts and the soaking in of contingent parts. Furthermore, Noë presents the argument that normal vision depends not only on the movement of the body relative to the environment, but also on the self-actuated movement.⁶⁹ So we must *do* to know.

Rinaldo's installation positions the interactants to consider their own embodied behaviors. This self-actuated feedback loop is the one that is created through the extension of the body with the mechanical devices, the smell and taste of chocolate, and externalized dopamine triggers. As the interactant lies in the chair, her body expands and contracts, claiming prosthetic identity, and altering physiological identity.

According to Rinaldo's own description:

As well as interacting with the mood-altering chemicals in food, the enteric nervous system also communicates with the *trillions of bacteria* that live alongside them in the gut, digesting our food and boosting our immune systems.⁷⁰

Rinaldo sees the robotic tongue and the massage chair not merely as mechanical trigger devices but as ways to support the enteric nervous system itself in an act of self-awareness. As the brain spreads down away from cranium through the spine and into the gut, the interactant experiences the

phenomenological play of ideas as body. The experience is a bringing forward of our chemical consciousness, an undulation rippling up and down the central nervous system in our own internal massage. The brain of the gut radiates back up the nervous system and fills our senses.

Within each human body, the living bacteria *Lactobacillus acidophilus* outnumber human biological cells by ten to one. They are, unto their own, an autopoietic network: an entirely non-human and non-hereditary adaptive technology, seamlessly and symbiotically incorporated into our bodies to metabolize nutrients, regulate fat storage, and even train the developing immune system. When the bacteria in Rinaldo's installation are introduced to the artificial stomach, we can see these bacteria also reach beyond the behaviors of their own workings. While sustaining the integrity of their own system, they couple and negotiate with both the artificial stomach and the massage chair. Then we feel the experience *of* ourselves. Just as the digestive state of our enteric system determines the circuitry of our own neurotransmitters and receptors, so the digestive state of the installation controls the symbiotic relationship within the autopoietic exchange.

Varela originally proposed the following question: to what extent can human social phenomenology be seen as a biological phenomenology? Rinaldo's work addresses this question by creating an environment where our organs no longer belong only to a singular functionality, and the self-realization of an external circulatory system becomes an aesthetic pleasure. In this way, autopoiesis surpasses the realm of a historical biology and reveals

aesthetics as a process simultaneously autonomous and dependent. To adequately understand living organisms in this paradox, Varela and Rinaldo both claim that living systems are self-producing machines. This leads to the observation that living beings are structure-determined systems. This concept may be difficult to reconcile with our historical notions of artistic creativity; but it is essential in the critique of the post-biological aesthetic, because what once determined beauty in the object has transformed our relationship to our own selves. Consequently, the self-producing machine challenges us to rethink our assumptions about “creativity” and how it works. Creativity may be uniquely human but it depends on individual agency. So in the autopoietic understanding of Rinaldo’s installation, creativity cannot rise for the interactant without the mechanical devices that make up a large component of the interactive event.

Vague Organ

An autopoietic understanding of individual parts of the human body fits neatly into their physiological functioning. The gallbladder and the liver, for example, conduct a relationship: each looks to the other for its own functioning. But in human evolution, the role of the gall bladder as a biliary vesicle for the liver has become superfluous for the function of digestion. The removal of this organ in humans is usually easily tolerated, with the liver taking over the emulsification of fats. There are many organs where evisceration does not kill or

severely alter the overall success of the functioning body. As a profound example, it is not unusual for lobectomies to be executed on portions of the brain for the control of severe epilepsy. Reassignment of brain functioning to other parts of the brain after the removal is more common than previously imagined. The brain shifts the process to other neural pathways, or creates new ones, to accommodate the altered load. This is a procedure that is done on a smaller scale every day to accommodate a myriad of functional changes like fever, stress, or depression. The reassignment of functions within the organs appears to be far more fluid than once imagined, making organs and their functioning ambiguous and elusive.

The interactive sculptor Simon Penny produces works that hint at the elusiveness of body organs. Penny and his team build structures that emulate human non-speech vocal sounds, developing lung-like machines, larynx-like devices and vocal-tract-like structures; but the structures focus on the functionality rather than the forms of particular organs. In his *Phatus Project*, there are assemblages of disquieting devices that laugh, cry, moan, rage, and sigh. The relationship between the embodied nature of affect and the structure is critical: emotions are, in some sense, of the body first and of language second. And this is an important aesthetic focus for Penny. The creation of sculptures that act as primitive sound machines draws us towards a reflection on paradigms of our own embodiment, without the abstraction of language.



Simon Penny, Objects (mechanico-pneumatic voice synthesis machines) from *Phatus Project*, work in progress, 2010–12.
Photo credit: Simon Penny.

Phatus Project involves prototype lung/bellows machines, and microcontroller-based electromechanical process control systems. Twentieth-century research, Penny claims, has been preoccupied with communication through semantic means, largely ignoring aspects of human vocalization.⁷¹ Bodies and body parts hold multiple meanings that offer alternatives not only to language but also to full-body expressions, suggesting a scalable aspect to the autopoietic exchange, surpassing the realm of biological functionality.

Applied to the autopoietic aesthetic, Penny's experiments engender a fundamental dialectic between human bodies and mechanical systems in motion. The interactant in *Phatus Project* moves the bellows and pushes the arm-like extensions, enabling the sculptures to displace air and fluids. The sculptures are not easy to move: it takes muscle and power to squeeze and push. While accomplishing the task, interactants are often found grunting and wheezing themselves. The sculpture grunts and wheezes back, and there ensues between the two a relationship of pre-verbal communication.

The robotic artworks created by both Rinaldo and Penny have the intentionality of an aesthetic developed from post-biological or hybrid art. It is important that these artworks are not critiqued as a simulation. Penny's sculptures are not models of particular organs. They are vague by design, allowing them their own place in the world. It is within the acts of pushing and pulling, with our own body forms, that meaning emerges and a fresh act of participation is created. Rinaldo's installations are not meant to explain how chemicals travel through the enteric system. They are aesthetic objects that when engaged with an interactant, create essentially the only experience of their kind.

Emergent Behavior

Applied to aesthetics, autopoiesis replaces an external *objective view of art* with an internal relativistic understanding of *experiencing art*. To a degree, the observer and the art object become co-organizers in an evolutionary system of patterns within the interactive artwork, creating an aesthetic or heightened appreciation of the ever-present phenomena of emergence. Heidegger's possibility of *always becoming* is at work in this relationship between interactant and artwork through the temporality of situations and historical character of a coming into being. Placing aesthetics within a phenomenological ontology challenges the established relationship between viewer and object, a relationship which often keeps high art in a developmental stranglehold. For Heidegger, beings are not originally constituted in an individual consciousness. On the

contrary, the starting point for every being is *Dasein*, an active bringing-into-being, which includes the phenomenological locators of history and the embracing of temporality as *Dasein* experiences provided by Penny's and Rinaldo's installations. The interactant is always a participant and, as such, can never sustain a singular finality of form. The implications of this ontology suggest many pressure points between contemporary aesthetics as opportunity for social rupture, with autopoiesis as a system of negotiations. How we come to an event and what constitutes aesthetics are, in large part, the questions interactive artists are exploring with their interactants.

The autopoietic aesthetic arises, then, from interaction within an art system. This may include multiple self-propelled entities, such as mechanically driven devices and other human participants, each of which is in negotiation to elicit aesthetic expression. Expression can occur through a variety of systems created by the comingling of mechanical and biological forms. The implicit order of an autopoietic aesthetic is the relationship between the external coherence of a phenomenon, and that which is *imagined* as external—in social terms, as the “other.” This relationship of negotiation creates a kind of arena in which a variety of systems of thought and action may potentially communicate, cooperate, and engage in both conflict and negotiation.

The autopoietic aesthetic arena can be understood, therefore, as a dynamic multifunctional set of systems with a variety of ways to create ideas and experience the world. The arena is implicitly process-driven, performative, and highly experiential, because it is built on models of consciousness with properties

that focus on the entire thought process rather than on a singular outcome. This arena constitutes a topological domain that shifts the subject of contemporary aesthetics from a *thing* to a *situation*—from an object to an intentionality. Without the need to distinguish life from the mechanical, physical, or virtual, autopoiesis deploys a design and purpose found in human action that is always coupled to an extrinsic system. As such, the autopoietic aesthetic arena is a fundamental shift from the traditional notion of aesthetics, in which aesthetics functions solely as the object of human appreciation. It applies a new understanding of aesthetics as a comingling and an inherent function of systems that possess a multitude of purposes and outcomes. Aesthetic appreciation rises when we involve ourselves inside the processing of the system—a journey to immerse ourselves within the system, and to *feel* our participation in an aesthetically designed emergent function.

As it becomes increasingly difficult, and perhaps less relevant, to distinguish between the biological and the mechanical, an autopoietic perspective assists in the unification of these distinctions. From an autopoietic perspective, a form is not evaluated only on its material properties, but also on the basis of its functionality. The autopoietic process involves individual entities negotiating a *self-propelled exchange* between demarcated systems, usually undertaken to provide each participant with some sort of self-sustaining or evolutionary opportunity. For instance, the interactant enjoys the play of system participation in Rinaldo's installation. This creates a sustaining interest in the work and feeds input to the artwork, which in turn keeps processing the tasks of its design to

distribute dopamine. The pre-designed objective of the installation is to sustain a level of its own activity—that is to create potential for the massage chair. The interaction from the interactant affords this as a kind of probe or stimulation. The choices available within each autonomous system tend to be, at first evaluation, merely self-serving and leading to a solipsistic epistemology. Autopoietic systems must interact, however, in order to survive, and in doing so they must form a kind of negotiated space with others. This is a key element to the power of the autopoietic aesthetic. It is both autonomous and able to involve or even entice other systems to engage.

A self-organizing mechanical system has a self-purposefulness when it is intentionally designed with the foresight to sustain its own functioning. In this way, machines and people both have properties of self-motivation and self-action. Built on the ethical premise that humankind cannot own living systems, autopoiesis always assumes an equal exchange, in which the autopoietic artwork secures for itself (a living system) “the crucial qualities of autonomy and individuality.”⁷² In her own argument for autopoiesis, Hayles reminds us that it was part of Mantura’s original use of the term that we would see all individual people as equals. Following this thinking, the exchange between a participant and an autopoietic work of art should be considered an equal relationship. Autopoietic artworks are therefore positioned as part of a larger system of evolutionary forms that struggle to coexist, not thought of in terms of a relationship where one takes from the other. This struggle can be observed in any interaction—with

imperfections of equality, but one that Mantura argues is far more equal than that of the Enlightenment Subject.

In *Autopoiesis and Cognition*, Varela refers to both biological and mechanical forms as he argues for autopoiesis as a living presence:

Autopoiesis in the physical space is necessary and sufficient to characterize a system as a living system . . . hence, the biological phenomenology is the phenomenology of autopoietic systems in the physical space.⁷³

The physical space that Varela describes is also found in the autopoietic unity of what he describes as a *living machine*.⁷⁴ When we, as observers of art, interact with an autopoietic machine, we see both its functioning and an exchange response, which acts as a register for presence. The exchange is both an instrument and an outcome. Built into the outcome is a functional quest to reach beyond one's own sense of autonomy in order to search for a more complete experience. This exchange also moves the aesthetic experience away from the imperializing gaze of high art towards an exchangeable negotiation between participants.

In the search for authenticity in the aesthetic experience, autopoiesis operates as a solitary state that looks to itself as a trigger. *If* a system refers only to itself, how does it interact with anything but itself? The key to unlocking the meaning of autonomy, in this case, is to re-conceptualize the notion of “interaction.” The function of self-reproduction in a biological autopoietic system

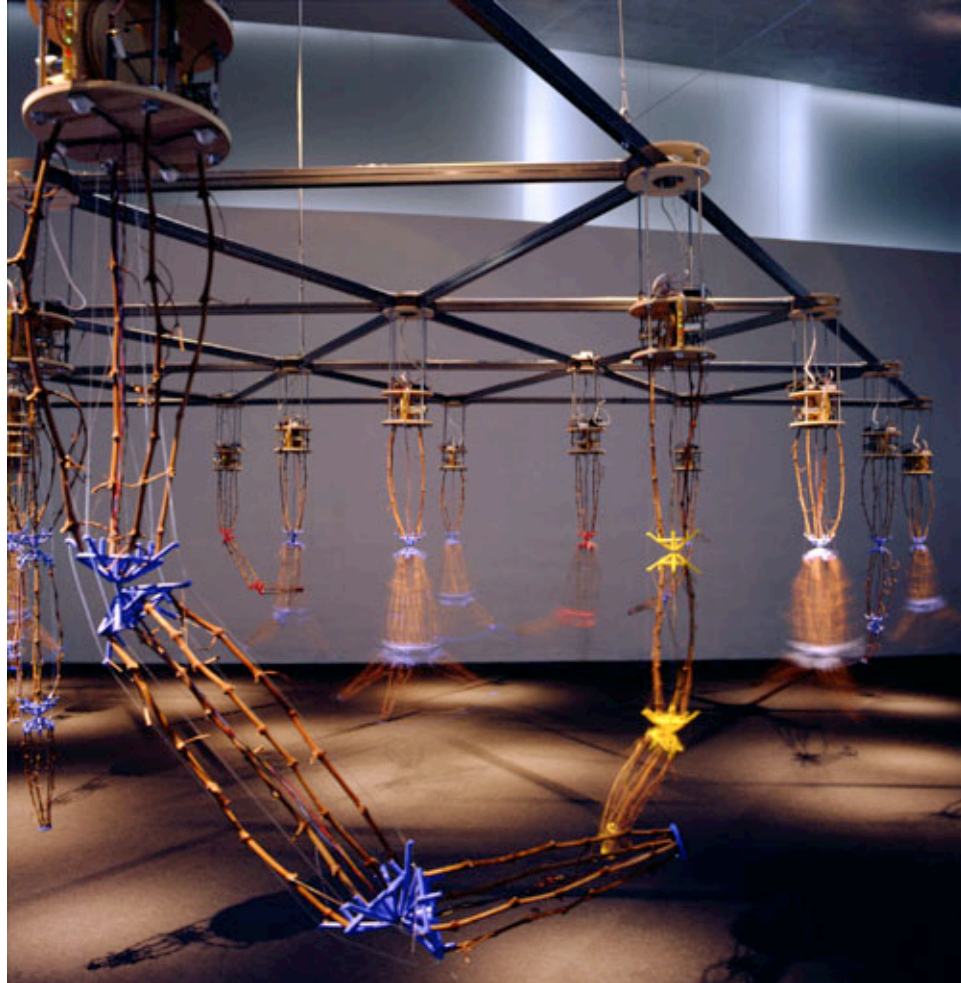
necessitates interaction; in a flower, for example, structural elements of the stem must interact for the flower to grow tall enough to catch the sun. In order for this flower to sustain life, it must also grow tall enough to catch the wind and lure the bugs that will use their locomotive abilities to carry the pollen away. Built into natural autopoiesis, then, is a state of negotiated action between agents. In the case of the cell membrane that makes up the flower stem, it is a permeable structure that holds the structure together and shares in a thermodynamic exchange of matter and energy with both neighboring cells and the surrounding environment. In order to sustain its own autonomy, its permeable cell wall participates in an arrangement of interaction with the world while fulfilling its self-sustainable needs.

An aesthetic autopoietic system, therefore, is a focus on the process rather than the form of the object. The aesthetic autopoietic system also positions the art observer as part of the evolutionary emergence of everything that is part of our own identity. In a similar process and in the action of experience, we are both an autonomous self (unique in form and character) and an interlocking self (created by relationships) through the effects of engaging with interactive art. Art, like life, can be viewed as an endless search for exchange. Acts of exchange allow moments of consciousness and the reflexivity of introspection. In neuroscience, one can detect that it is *gesture* that leads to a kinetic resonance in each individual brain cell. In the search by one brain cell seeking to make contact with other brain cells, we find a compulsive need to create ordered relationships. The single cell's search is not unlike the ways individual people gesture within the larger human

social sphere. Through a physical gesture, the excitable cell resonates outward into the larger primordial openness of the lived world. This is what neuroscientist Daniel Dennett calls the *qualia*, and what phenomenologist Merleau-Ponty describes as the *Lebenswelt*. At the same time, each cell receives life force from the larger social sphere. If we can accept this phenomenological exchange of human experience, existence may be essentially perceived as co-existence. Interactivity becomes the choice and the aim of this coupling, and works as a trigger to awaken consciousness.

Interactivity, therefore, is both an instrument and an outcome: it is a desire to reach beyond one's own sense of autonomy in order to establish contact with the general condition of reality. Interactivity is also part of the mechanics of self-sustainability. It is the aim of coupling, and works as a trigger to awaken a system at the levels both of individual introspection and of a whole world relationship. Perhaps we have come to a historic moment that rejects distinctions between the life of the viewer and the life of the artwork. The life of the mechanical and life of the biological can appear the same, but particularly when viewed from within the dynamics of autopoiesis. Biological and mechanical life have already transformed in a variety of ways. From this post-biological position, a new symbiosis of interactivity in art has emerged.

Investigation



Ken Rinaldo, *Autopoiesis*, copyright 2000. The intra-action of robotic arms connecting with each other through a closed software system.
Photo credit: Ken Rinaldo.

The installation *Autopoiesis*, an earlier work by Rinaldo, is a collection of intra-active robotic arms that connect to each other through a closed software system. In this artwork, autopoiesis refers to a system which can be considered part flesh and part machine. Robotic arms built from twigs and mechanical parts

stay busy communicating with each other through a distributed computer network. When multiple robotic arms interact, they do so in ways analogous to higher-order, structurally based systems, such as the relationship among neurons structuring cognitive activities. The gesticulating arms of Rinaldo's artwork use telephone tones as a "language" to "communicate" among themselves. On each arm, a series of light-emitting diodes signals the status of information input and exchange among the group. Computer-controlled feedback loops, smart sensor configurations, and randomization algorithms produce and control movement. As in the biological, neural, and growth structures found in evolution, the artwork creates its own internal stasis, the effect of which is a continuous exchange.

The arms need to know where they exist in space so that they do not collide with a visitor in the installation space. For this reason, they track anything or anyone that enters the space. Their domain is defined by the spatial limitation, which they cannot physically extend. Their spatial domain is not unlike that of rooted organic systems, such as a forest of trees or a cluster of synapses connecting the cells of a brain. Their systematic and distributed communication mechanisms provide a complex comingling of resources and information. The individual arms can see and feel through cameras and sensors, making autonomous choices on where to go and how to expend energy. At the same time, the system as a whole is able to strategize, remaining a singular entity that is self-contained and self-motivated. In this context, an autopoietic drive, able to negotiate an improvised coupling with the observer's determinant input, becomes a central agent to the production of aesthetic experience. It is in the essence of its

own need for interactivity that the autopoietic moves beyond homeostasis into acts of investigation. The system works of its own accord: the internal equilibrium of the meta-system is full of adaptive responses that cannot be accounted for at any given time. While control mechanisms function to affect internal steady states, there is always the potential to move into the improvisational unknown of the interactive moment.

All autopoietic systems must move as living entities move through time. At each moment they remain in negotiation with any other systems that they come in contact with. When interactants come close to Rinaldo's installation, the system breaks out of its own repetitive behavior of looking at itself and reacts to something introspectively. The robotic arms inspect the bodies of visitors using on-board cameras and sensors. One communicates with the next until all of them know that there is a foreign body among them. Each arm moves close but is careful not to actually touch the interactant. The robotic instinct is one of invasion and survival. The experience of interaction is one of care and uncertainty. The parts as a whole—human, machine, software, and triggering devices—comeingle in a state of uneasiness. The machine can be described as a unique independent entity, as can the human observer.

Through the interaction of the viewer/participant, the artwork, as evidenced through the software systems, evolves, producing unexpected, emergent behavior and emotive sounds. From the perspective of systems critique, the viewer/participant opens the closed system with her/his interactivity, thereby challenging the notion of an insentient machine.

Rinaldo's artwork is generally placed within the movement of generative art, a system-oriented practice in which the common denominator is the use of living systems as a production method. Unlike many art movements that have focused on natural form, generative art relies upon the "structurally coupled relationship of a self-sustained internal processing and an external mechanical functioning of the artwork."⁷⁵ Rinaldo references aesthetics within a biological schema. His aesthetic systems behave in ways that alter how we physically interact with them. Although the closed system of *Autopoiesis* can be experienced as complete within itself, the observer/participant can also alter this system. This physical interaction, in turn, enfolds the observer/participant within the totality of a new sensory-motor system that is a hybrid of both the mechanical autopoietic system and the open potential of a biological system. In this way, a seemingly closed system can acquire permeable boundaries, opening up to the larger phenomenological world. When stimulated, this artificial "living" system will reorganize internally, making itself unique, reflexive, and self-perpetuating—all in response to the diverse actions of the given observer. As illustrated by Rinaldo's work, an autopoietic system is a closed system with permeable boundaries that functions as an autonomous being. This type of system becomes an operationally open "life form" when coupled with its phenomenological environment through interactivity. As both a closed system and an open life form, the mechanical and structural elements of *Autopoiesis* mimic biological processes, making those processes, in turn, the subject of aesthetic reflection.

In describing the biology of cognition, Maturana begins his introduction to a description of autopoiesis by saying that:

The space defined by an autopoietic system is self-contained and cannot be described by using dimensions that define another space. When we refer to our interactions with a concrete autopoietic system, however, we project this system on the space of our manipulations and make a description of this projection.⁷⁶

According to both Maturana and Varela, autopoiesis is a homeostatic circular system. A self-sustaining property of autopoiesis is built directly into Rinaldo's installation within the physical and technological elements. Each is configured to allow communication with and for the other, using only rule-based procedures provided in software. The system of arms in Rinaldo's installation functions to communicate with itself; the movements that emerge from the arms of the sculpture are outcomes of an action set upon an interior processing against the events of external negotiations.

Farm Fountain by Amy Youngs and Ken Rinaldo is another installation that focuses on a homeostatic circular system. This work also highlights a transition from biological autopoiesis to a mechanical or hybrid system.



Amy Youngs and Ken Rinaldo, *Farm Fountain*, copyright 2009. Based on the technique of aquaponics, the plants and bacteria in the system serve to cleanse and purify the water for the fish.

The installation is both a sculpture and a system for growing edible and ornamental fish and plants in a constructed, indoor ecosystem. Based on the technique of aquaponics, this hanging garden fountain uses a pond pump, along

with gravity, to flow the nutrients from fish waste through the plant roots. The plants and bacteria in the system serve to cleanse and purify the water for the fish. The hybridist forms of Youngs and Rinaldo impose another kind of challenge to our notion of any absolute autonomy. Although the viewers' location is outside the paradigm of utilization and service, they find themselves in a relationship of exchange that fosters appreciation for the system's life-producing bounty. The interactive elements are part of a self-enclosed environment.

In his forthcoming book *Green Light: Toward an Art of Evolution*, George Gessert describes the "slow art" of plant breeding, and how we create new life that takes into account a combination of what we know about ecology, aesthetics, and ourselves. The eco-artist has been part of the hybridization of plants for thousands of years, but its results were first exhibited as fine art in 1936, when the Museum of Modern Art in New York showed Edward Steichen's hybrid delphiniums. Since then, bio art has become a genre: artists work with a variety of living things, including plants, animals, bacteria, slime molds, and fungi.

Not only have our plants transformed to answer our needs; we also have evolved to take care of our plants. We have assisted in their transformation and their evolution, which binds us together with them in a most intimate negotiation. In a co-evolutionary bargain struck between a person and a plant, the two parties act on one another for their separate individual interests, but wind up trading favors in the process of exchange. At the most fundamental level, humans water plants, and plants provide food. But plants also provide a kind of companionship through their presence. As a sort of victory over the selfishness endemic to being

human, ethics may provide us a conscious guide that follows such biological coordination in addressing the ever-morphing shape of societal systems. As plants and people sustain one another, society also provides protection for the individual who needs identity to reap the benefits of autotelic growth. Indeed, the evolution of the self is neatly bound up with the security that the collective provides. Similarly, a complex array of chemical negotiations must be undertaken for systems of humans and plants to coexist. The viewer's experience in *Farm Fountain* establishes a cooperation that extends to the physiological experience of the installation. Such progress goes against a simplified notion of the individual's role in relation to the artwork, thereby pushing us toward an appreciation for our relationship to the whole system.

In *On the Origin of Species*, Darwin posits artificial selection as the process that reflects human will. In artificial selection, Darwin argues, nature provides a variety of traits, as in natural selection, but it is humans who decide which will be the traits passed down to further generations. In the process of domestication, human action plays the same role blind nature does, albeit a bit faster. This process of choice constitutes fitness, and, over time, leads to new forms of human negotiation—a cultural modification of descent. It is natural to engage in selection and selection alters what we understand to be natural. By blurring the line separating natural from artificial selection, Darwin opens the door to blurring the distinction between nature and all human actions. As an example, what we may think of as the high-level functioning of our ethical mores can be traced back to the primal skills of human survival.

An autopoietic system's only interest is to make copies of itself without any apparent use of natural selection. We can understand an interaction with *Farm Fountain* as part of the evolutionary process of artificial selection, with its foremost interest in sustaining the health of the sculptural environment itself. The sculpture moves from object to subject, acting *upon* the viewer, getting the viewer to do things it could not do for itself, such as rotate the plant towards the light or trim the dead leaves. The aesthetic system mirrors some of nature's greatest success stories in biological systems and links the interactivity of artificial selection to our larger understanding of evolution.

Farm Fountain posits a model of a domesticated co-evolution. Our genes are the archives of our cultural and natural information, containing detailed instructions on experiences we enjoy. We have spent the last few thousand years remaking our food supply through artificial selection and transforming its usability for our needs. Examples include plants that grow attractive flowers so that we take care of those plants. Plants have been going about their business of remaking us as their caretakers. The beauty of a garden identifies emotions in us and the plants in the garden gratify all our senses. We, in turn, look after them. Through Darwin's artificial selection, *Farm Fountain* comes to reflect human will and nature provides a variety of traits from which humans may decide to select.

The line that separates natural from artificial selection has blurred, and so has our relationship to other forms of life. Living systems, including human beings, exist in a context, and cannot be fully understood apart from that context, with which they interact. This is why human experience is difficult, if not

impossible, to duplicate. Even during well-calibrated cognitive tasks, successive brain responses to repeated identical stimulations are highly variable.⁷⁷ Living systems are multiple causal circular processes that allow for complex evolutionary trajectories. But the function always follows the form.

Change in all living systems functions similarly to the way a biological circulatory system is maintained. An individual cell would collapse if not for the pumping of fluids through its efficient structural wall. Rinaldo, Penny, and Youngs have created art that underscores the role of ambiance or a loose system of negotiation in the structures of sustainability. They produce circular systems that run their tasks with endless precision, but that eventually would cease to exist without participation from the outside. By definition, an autopoietic system will only take on external negotiation as a kind of bargaining chip, for the sole purpose of survival. Although an autopoietic interaction is self-serving, there are collective, advantaged, and generative outcomes.

Neurons in one's brain, for example, have one hundred trillion cellular "robots," and they care nothing about you or your consciousness or your intentions. The more the brain processes external stimuli, the more energy is produced in the neuron and its surrounding material. This, in turn, creates the need for more neurons to handle the load. So the brain adds additional neuronal endings and the cognitive landscape is altered. Another example is how energy is created by the system of *Farm Fountain*. Stimulation from light introduces energy to grow the plants that create the food for the fish that create the fertilizer to feed the plants. Both the neural process in the brain and the generative process of *Farm*

Fountain use dynamic emergent systems, both arising from external stimuli. Each moment will be distinct from the one that has come before. The response of the system emerges in the variety of responses that a participant has to the art. The feedback loop creates a rhythmic, or synchronous, activity between the parts within time and space. The participant's relationship to the art is a part of, rather than a replication of, the emergent systems of all life forms. This process is not mimetic. The emergence is thing-itself.

A similar rhythmic pulse between brain regions has been observed during, or associated with, many neuro-biological functions: these include timing-dependent plasticity of synaptic growth, and a particular chemical exchange in a single lobe of the brain acting as a global stimulus to all parts. According to the dynamical systems view, the neural processes most relevant to an understanding of our overall consciousness are to be found at the level of “dynamical brain signatures,”⁷⁸ understood as large-scale patterns of activity over multiple frequency bands, rather than the structural level of specific circuits or classes of neurons. In other words, a moment of coherent consciousness is the unfolding of multiple synaptic firings, but, also, a dynamic remapping of the entire brain. The dynamical approach emphasizes that perception and cognition are intrinsically temporal phenomena—they happen *in* time, not simply *over* time.⁷⁹ This is important to consider when we compare brain function to the unfolding of interactive art, for the location of experience is dynamic in both space and time. It is the reciprocal pattern between the individual parts and the mapping of the whole—rather than the singular comparative observation between subject and

object—that makes the formation of experience.

Interactive art, such as Rinaldo's *Autopoesis*, suggests that the patterns of interaction serving as the foundation of the phenomenological field are also found within structural patterns of the body. It is the “interactive gesture” of the interactant that relies upon the embodied patterns of action and reaction.

Contemporary artists, such as Rinaldo, appear to intuit these internal patterns and develop artworks with interactive elements that complement these patterns in a way that elicits and engages the viewer's patterns of cognition. This is substantiated by the ability of these artworks to induce sensorial experience in viewers. Through the autopoietic lens, the interactive aesthetic relies less on what an artwork *looks like* than on the phenomenological embodied patterns of action and reaction the artwork *stimulates* between the viewer and sculpture. By such means, experience becomes physically accessible for contemplation and enables us to *perceive ourselves perceiving*.

The teamwork of Rinaldo and Youngs in *Farm Fountain* presents a far more challenging understanding of interactivity, because at first it appears that the “participant” in *Farm Fountain* is merely an observer, too passive for any substantial or even observable participation. The sculptural object of *Farm Fountain* may be, however, a more accurate understanding of an autopoietic system than previous works, because the default state of sustained life is one of self-sustenance. The caretaking that is required by external participation involves the maintenance of lighting and temperature—interactions that take on the human involvement of intentionality and care. The autonomy and resilience of art

becomes part of its aesthetic identity, while the attention to—awareness of—the gesture of care becomes the passageway for participation; fueled in part by a kinetic intelligence that can come from a relational communication with another living thing, interaction becomes tightly bound to the actions of free will. It is a kind of bounded self-awareness that Guillemette Bolens, a researcher in gesture studies, suggests is a type of creative knowledge bound to the kinetic memory of the body. She explains, “Paying more attention to the dynamic reality of cognition helps shape the analysis of kinesis in literary narrative and art in general.”⁸⁰ So in this way, ideas about kinetic activity trigger sensorimotor activity in the body. Meaning for things that we have considered abstract, such as reading and appreciating art, is actually grounded in the embodied experience of active comprehension. In this way, the viewer is always a participant—always in motion and always responding to the part of the experience that is just beyond reach.

Control



Simon Penny, *Petit Mal*, designed 1989, built 1993, shown 1994.
A robotic momentary loss of consciousness.
Photo credit: Simon Penny.

Simon Penny's *Petit Mal* is, in some sense, an anti-robot because it is truly autonomous. Most conventional robots are elaborations of John von Neumann's notion of the *universal machine*, in which the physical machine is simply a void to be filled with software content. This attitude within robotics is an unfortunate application of the Cartesian idea of the mind-body split, where it is imagined that the mind thinks, and that then the body fulfills the mind's intentions.

Petit Mal is a very busy machine. With only two wheels and a counterbalance, it is in a constant state of trying to keep its own body upright.

This balancing is a way of existence for the machine: it constantly checks and adjusts just to stay upright, which uses most of its power. *Petit Mal* also has a secondary function, which is to find any physical obstacles in the room that may make this work of staying upright more difficult. Things that do not move, like walls or stationary objects, are observed with a camera and calculated as structures to avoid. But moving things like people are less manageable. The robot must spend time calculating the moving object, because coming close to—or perhaps touching—another object may potentially throw it off balance. This is processing time taken away from the functionality to stay upright. Within this paradox is the irony of the robot’s existence. It must search to survive but this very search makes it ever more difficult to sustain its own balance. This is an autopoietic conundrum: for existence, every system must look away from its own self while it must also manage its own behaviors. *Petit Mal* faces this duality of experience as it must do both. In other words, when *Petit Mal* is roaming about, it is impossible to distinguish where the interactant leaves off an action and where the robot picks up a response. As Penny explains:

You could say that *Petit Mal* is an autonomous agent and a realization of an artificial life entity. Not simply in the sense that it manifests some behavior that is life-like, but that it has a bottom-up logic—it doesn’t conform to a traditional artificial intelligence way of viewing the world, sometimes referred to as the sense-map-plan-act paradigm. It is reactive in the way that an insect or an animal is reactive. It is consistent with reactive robotics, which was a response to the over-reasoned over-complex computational solutions of the previous generation of artificial intelligence.⁸¹

As Penny points out, the behavior of *Petit Mal* is built upon a reactive paradigm. This paradigm is not something that can be described by software or hardware alone. *Petit Mal's* behavior arises from the dynamics of body within the world—a notion that introduces the phenomenological aspect as a seminal component of the system's functioning. In other words, it takes a dynamic world of situations to make sense of action. Hardware and software work in a seamless continuity consistent with autopoietic systems but it is the evocation of body sensations and operations that fulfills the desire of action.

A cognitive reading of *Petit Mal* would present the artwork as temporalizing involuntary participation in the world. The artwork is not projected from the gaze, as we see in Rinaldo's sculpture, but rather actively disrupts the gaze, intentionally generating disequilibrium. The artwork's action involves both the sculpture and the participant in the search for stasis. In neurological terminology, a petit mal seizure inhibits neural connections and creates a momentary loss of consciousness. It is important, for this reason, that the *Petit Mal* sculpture present itself as just a little out of control. *Petit Mal's always becoming* is a reaction to oppressive theories of control. In fact, Penny describes this robot as an engineering nightmare.⁸² Although *Petit Mal's* mechanical structure is inherently stable, it has a chaotic motion generator at its heart, with a double pendulum offsetting its center of gravity, thereby creating a range of unpredictable motion. By design, Penny has developed the robot to rely on its own movement through time and space to find balance. An artist engineering a

robot to sway between balance and imbalance is the aesthetic experience for participants with *Petit Mal*.

The interactant must relate with *Petit Mal* in a manner different from the interactions solicited by other, traditionally predictable, robotic systems. In the case of *Petit Mal*, the viewer spends much of her time interacting with the space between her own body and the body of the robot. The viewer very soon realizes that her very presence makes vulnerable the survival of the robot. This in itself turns the viewer into the interactant, because *Petit Mal* now relies on the viewer's motion. Too fast a motion from the viewer/interactant, and the robot may tip and fall down. Too much time spent by the interactant moving about the space, and the robot eventually will be unable to retain equilibrium and will fall down. The interactant must project herself into the semi-conscious state of mind of a petit mal seizure in order to formulate a knowable pattern against her own movements. She processes movement in thinking about movement.

In current neuroscience, this process is known as *mind reading*, and is about the reading of someone else's mental state. In his groundbreaking book *Simulating Minds*, Alvin I. Goldman suggests that "the notion of mentalizing anchors the fabric of social life."⁸³ An "anchor" is an appropriate model for *Petit Mal* because it is a system that does not provide a simple model of presence. Goldman would say that anchoring happens in the body of the viewer when she theorizes, rationalizes, or simulates the experience of other minds through the patterning within her own brain. Reading minds is an extended form of involuntary empathy. The *simulation theory* referenced by Goldman within the

cognitive experience is not to be confused with other simulation theories in the realms of philosophy and technology, such as Plato's art as imitation or Antonin Artaud's virtual reality—both mimetic instructions on to how to be in the world. In cognitive science, simulation theory entails sensory enactment or an imagined state of mind through physical actions in the brain. In mind theory, the important distinction is that a thing is never mimetic but always a thing in itself. In the case of embodied actions, consciousness, as a thing itself, arises from the processing of external events. Indeed, one's development as a thinking being emerges from interaction with what one perceives in other people's minds and then simulates in one's own. In a game of peek-a-boo, the infant feels the mother's delight in encountering her own body, and responds with joyful laughter to the mother's pleasure; the mother's pleasure is simulated in the infant's own mental process. Simulation can be thought of in terms of the developmental strategies for one's own consciousness in an autopoietic exchange with the ideas of the world. As the individual grows older this simulation grows into a more sophisticated act of mind reading where a pre-thetic state of consciousness projects outward to find connections, yet remains self-serving and autonomous. This entire process brings the immediate experience of the other into one's own experience of wellbeing. In this way, *Petit Mal* points us to an essential core of the self, in which we are in constant search for equilibrium and social interaction.

The mirror neuron is another example of the collapse of the brain/world split. In the case of interactivity, a mirror neuron is a neuron that fires both when the human interactant acts and when another system observes the same action

performed by another person.⁸⁴ In neuroscience, this explains how involuntary and immediate mental interactions simulate the actions of another system. Goldman explains that, “as a network, it encompass(es) environmental stimuli, internal states, and behavior.”⁸⁵ Interaction accommodates the mental functioning and the behavior of the person as a single event of action. Here we can see both an autonomous and an interpersonal functioning for the mirror neurons. The casual relations binding mental states, sensory stimuli, and motor responses give rise to intentional stances within an ontology that does not separate thoughts and objects, nor afford privileges to one over the other. This is another way of saying that what things might be, what constitutes their singularity, is likely to be found in their relations and interactions rather than in themselves alone. Simulation recuperates the self through the other and so the singular is always in an autopoietic relationship.

In the light of simulation theory, the notion of cooperation can also be understood as a hybrid in which egocentric bias becomes displaced, or even disrupted, through the inevitable entwinement with the simulated affective experience of others. In a mechanistic way, dual processing of one’s own altered mental states allows for the simultaneity of autonomous activity, with reciprocal hedonic benefits. Cognition, then, becomes characterized by the controlled flow between the perspectives of taking and receiving. Goldman terms this *enactment imagination*, in which one’s own neural structure “enacts” what it “imagines” of another’s mental activity. Enactment imagination provides the essential attributes of the other as taken into the self. Mimicry involves mechanisms beyond

decoding a visual surface, such as the visual read of a face. The other's real or imagined action, within the perceiving mind, is a neural enactment that Goldman describes as *grounding self-other symmetry*.⁸⁶

Cooperation helps release the egocentric bias in individuals. Indeed, the pull of mimicry in one's actions is such that the other's actions seem invitations for the self to participate. Often applied to contemporary aesthetics, this participatory model allows cooperation, rather than mastery over the object, to become the reflexive and preferred act of aesthetic exchange.

(Auto)Reaction

Penny's *Petit Mal* creates a simulation through action. Because the (auto)action of *Petit Mal* is consistently unexpected, the viewer positions herself in a manner that poses the physicality as a location for aesthetics. Anne-Marie Duguet delineates this dynamic in the introduction to the catalog of the 2006 Transmediale exhibition. In Duguet's view, the action of constant adjustment to the viewing state brings out the humanness of the viewer, triggering emotions and a desire for connection. Moreover, the viewer is placed in the position of playing "catch-up" to the interaction and becomes subservient to the nature of the robot's behavior, another unexpected reversal:

. . . a trace of autonomy is perceptible, all this non-resemblance falls into oblivion and a "human effect" is activated, inciting the viewer to project endlessly. Thus, the object of humor may become the viewer himself interpreting a slight step back as fear, and a step forward as curiosity. Sensitive to the environment, capable to

diversify and to involve its reactions, the robot tries to have a relationship to the human being, and this relationship is constituted from the beginning as a human relationship, one of domination or of sympathy. The robot is no longer the slave, it enslaves the other. This kind of reversal is a satire of human psychology and of the expression of the platitude of the threat that represents the development of such autonomous “creatures” for the human being.⁸⁷

According to Duguet, the viewer must rely on the action of *Petit Mal* for the aesthetic experience. It is the “stepback/stepforward” positioning of the viewer, however, which creates an uneven projection, oscillating between fear and curiosity. Confusion arises from this unexpected negotiation and a dance to find a homeostatic balance ensues. Duguet defines an interaction that is far from one of cooperation—she continues to use a dual system of experience by setting the robot up against the interactant and vice versa. She argues that the human psyche is not well equipped to take on the subtle attributes of robotic aesthetics. This is an excellent example of an autopoietic aesthetic as a valuable lens for critiquing contemporary art. In neuroscience, the physical *action* of reaching and pulling within one’s own body is also a brain-generated *simulation*, a feeding back of experience into the temporal regions. The temporal regions are believed to be the caretaker of our senses and our emotions. In these regions, what we feel is neurologically mapped with what we experience. *Petit Mal* reminds us that behavior evolves. Perhaps, in the play between the two sentient forms of robot and interactant, we realize that each is reliant upon the other for mutual evolution. We also come to understand that interactive art leaves the viewer to experience certain things that lead to reflection, which in turn leads to other experiences.

Through the intelligence of embodiment, such installations highlight how the enactment of the physical shapes the psychological, and constitutes another way in which we express ourselves.

Using this neuroscientific ontology, interactive art develops through the systems of self-reflexive connections that exist between the forms of the autopoietic object and the observer. The use of an autopoietic mechanism, along with the observational learning that occurs with structural functions such as mirror neurons, provides a method for identifying material for thought and new knowledge. In this way, interactive aesthetics move cyclically from the outer manifestations of human action to inner meaning and back out again to the aesthetic interface, in endless circulation without loss of autonomy. It is evident that experience and expression cannot be neatly separated. The singularity of perception dissolves, as meanings emerge into the world of experience through bio-physical co-evolution. The many varieties of exchange describing the autopoietic aesthetic are entangled within this force.

Autopoiesis offers us a kind of co-evolution in concert with interspecies and living/non-living systems, where art and viewer are part of the same system of experience. In this way, autopoiesis poses a question about the end of simulation, because we can understand experience as an interacting system, rather than one subject being a reflection of another. As hybrid systems that *must* interface with the larger environmental arena, systems of autopoiesis can no longer be considered simply another kind of “other.” Some aspects of their functioning may reference only their internal qualities, but total success relies on

the materiality of a larger existence, beyond insular feedback mechanisms. The interactions of Rinaldo's individual robotic arms, for example, are defined within a set of rules for their behavior, individually and collectively, which can be considered their structural identity. The structural identity in this physical sense is what defines the structural identity of actions—or as Varela states it, “The structural identity in this physical sense is what defines the structural identity of actions.”⁸⁸ This identity generates two tenets of autopoiesis. First, nothing is a model for anything else: everything has its own essence. Second, locomotion of the singular always comingles with the locomotion of the other. And seeking coherence, the world “comes up” to being through the sheer confusion of experience. Out of the clash of the internal and the external comes the sensation of a very stable reality. The brain looks for these points of placidity in every moment to create a stable arena of perception. The brain is not at all interested in actually arriving at placidity; rather it is drawn to the differences in situations. When *Petit Mal* seeks equilibrium it exposes the “points of placidity” the brain is looking for.

According to Varela, evolution has less to do with getting better through adaptation than with what we choose through experience. The tempero-spatial mechanisms of material form, such as brain cells or kinetic sculptures, give each individual moment its character and behavior. As a cell grows and lives, it develops all of its necessary life functions and continues to do so until it dies and the autopoietic cycle ceases. One similarity between a living cell and a mechanical autopoietic system is the cell's inability to make qualitative judgments

about survival without an external connection. For instance, the cell takes in chemicals for growth, but to the cell's components there is no real difference between food and a toxin. They are both perturbations that affect the efficacy of self-propagation, favorably or not. In both cases, the autopoietic system must also be reflexive within the larger arena of interaction. Aesthetic autopoiesis is a contemporary observation that simultaneously presents all facets of this prismatic truth. The autonomy and resiliency of art as part of its own identity is also, to a certain degree, its own non-identity.

Varela's autopoietic understanding of the subject holds value for the critique of interactive art because it is a method by which we can decenter our singular attention of the art form to include the activity of the entire system in which it participates. Goldman's theory of simulation provides a way in which the autopoietic methodology can distribute concepts between the interactants within such a system. For Duguet, the action of constant adjustment to the viewing state may be the major catalyst for aesthetics within experience. Because Duguet's process relies on a gesture from the human interactant, the embodied patterns of action are implicit. This state of flux is where Goldman's theory of mindreading is set in motion. But according to an autopoietic exchange, the object can also become an interactant, bringing into question the source of the aesthetic experience and the flow of activity.

Chapter 5: Interactivity

Preamble on Action

The body is so natural to us that, as long as it functions normally, we tend to neglect its existence. We experience the things we encounter directly, as if we were touching them with our very thoughts. Yet, perception happens within—not through—the body. The body operates on a sub-personal level, independent of conscious awareness, actively modulating perception to determine which information will be picked up, when, and how. This process has two outstanding features. One is that perception is formulated through intermingling with the larger world. The other is that the body must be an active participant in this world in order for perception to arise. These two features are so obvious that they are taken for granted as we move about every day.

The frame of interactive art, by deploying sensorial feedback, can help us focus our attention towards our bodies and how they are in constant play with everything the world has to offer. Our senses are only part of a larger and more complex situation that involves time, space, action, and intent. The complexity of these interactive events—how they take place and what meaning they provide in aesthetics—becomes of particular import to interactive art because of its aesthetic focus on the sensorial. Interaction is also fundamental to the contemplation of the interiority and exteriority of the self and is how we develop expression. Interactive art becomes the aesthetic rendering of the time and space that the body

undertakes. It is experience through the act of introspection.

Experience as a Flow

Functionalists in the philosophy of mind, such as Hilary Putnam, argue that psychological states are multiply realizable: there can be no one-to-one mappings of psychological states onto neural states.⁸⁹ If we agree with this premise, this multiplicity is also arguably true in mapping larger states of body action—specifically, physical gestures—to neural states. Neuroscience is unable to neatly use what we may know about correlate processing in the brain to accurately explain our actions in the world. Concurrently, our actions cannot supply an absolute correlate to how the body and external phenomena relate. What has great potential within embodied discourse, however, is the use of an enactive approach to cognitive science. Enactivism is a direct approach to the mind/body split because it depowers the centrality of the subject: the aesthetics of interactivity draw attention to our contingency in a world where we act. This is the intercorporeal self of Merleau-Ponty's phenomenological approach to subjectivity. The artist's gaze is not directed at the external world; instead, “the *incentive to create* arises from the objects themselves.”⁹⁰ Consequently, the artist is not the sole author of his or her actions. Although these actions originate in the objects, meaning arises from the artist's interaction with the form.

As Merleau-Ponty's work suggests, a type of subjective awareness is the root of true primal experience. Merleau-Ponty argues that rational operations

grow out of embodied biological activities in local environments, and that an account of abstract thinking must begin with the sensory-motor system. The dynamic interaction between agent and environment shapes the cognitive processes in real time as those processes unfold. A contemporary interpretation of “the being/becoming distinction” is observed in the complexity-based understanding of the world as being in a state of constant flux. Complexity-based systems are diverse and adaptive: they are composed of multiple interconnected elements and have the capacity to change and learn from experience. In the case of interactive art, they bind together two worlds—the intelligible and the sensible—by topologically mixing individual parts in dynamic ways. In an interactive event, there is active pushing and pulling between the body’s abstraction of becoming and the body’s immediate sensibilities. The intelligible and the sensible remain autonomous, but create a new situation of engagement that produces a pluralistic approach to the binding of the two worlds in dynamic formation. By locating the body as always-becoming-together through the act of doing, we ride across the slippage of time on experience. Here, mind and body (inasmuch as “body” is by material properties of the skin-container visible and considered indivisible) can remain a multiplicity of mind-matter and subject-object relations while always working together as a singular event.

Henri Bergson defines mind and body together as *places of passages*, not as their individual material or conceptual substrates. He expresses the body as always moving and “real movement (of the body) is rather the transference of a state than of a thing.”⁹¹ Movement is the thing itself. Bergson aptly states:

If our belief in a more or less homogeneous substratum of sensible qualities has any ground, this can only be found in an *act* which makes us seize or divine, in *quality itself*, something which goes beyond sensation, as if this sensation itself were pregnant with details suspected yet unperceived. Its objectivity—that is to say, what it contains over and above what it yields up—must then consist, as we have foreshadowed, precisely in the immense multiplicity of the movements which it executes, so to speak, within itself as a chrysalis. Motionless on the surface, in its very depth it lives and vibrates.⁹²

Bergson argues, furthermore, that such complexity of movement is a pure state of being, akin to consciousness itself. He states that “the fundamental law of physical life is the orientation of consciousness towards action.”⁹³ What is fascinating about his understanding of this movement is that the *state* of our consciousness produces a reality independent of our selves. Action, Bergson argues, creates a situation *already outside*; it is within perception that we move to bind this consciousness back to the body. The interactive loop that is created by this transference is an essential state of being and a fundamental process in which consciousness rises. Bergson’s philosophy of the body is strictly connected to his ontology of images in which the body acts as a mirror. He claims that “our body is nothing but part of our representation which is ever being born again, the part always present, or rather that which, at each moment, is just past.”⁹⁴

Each action in Bergson’s ontology shows us that time delay is the feedback system that exposes uncertainties. These uncertainties are echoed in the mechanics of the body as a discontinuous and non-totalized series of processes, flows, corporeal substances, incorporeal events, intensities, and durations.

Bergson's biological understanding of the body has it not only always in motion, but also always situational. The movement of the body-as-whole only ceases when the decay of death is so much that it cannot sustain the functioning of passing energy from one part to the other. The body changes through a series of steps, such as the onset of *rigor mortis*. If left alone, the body takes on many forms as it passes back to its most basic material components. Even in death, the body continues to act out many senescent transformations. As this process takes hold and the traditional concepts of cognitive functioning cannot be distinguished from the body-as-whole, the self finally reverts back to the material from which its form originated. Eternal oblivion is reached when the energetic form of the body breaks down into its material substrates, which carry on through their own energetic forms. Thought may also translate to another energetic form in the action of body death. In his essay "Is There Life After Death?" Henry James affirms the power of artistic consciousness to survive outside itself. He sees the aesthetic process as an "enormous multiplication of our possible relations . . . carrying the field of consciousness further and further, making it lose itself in the ineffable."⁹⁵ James shows us that the idea of perception is tied to yearnings—to be out of one's own self, even at the last moments when we pass away from our body.

This is not a transcendental death, but rather what Bergson calls "an act of duration that can be grasped through a simple intuition of the imagination."⁹⁶ A Bergsonian death can only be understood through its incomplete feedback cycle or what he calls duration. Duration is always part of life as well as death. Because

duration is ineffable, it creates freedom: we can finally exist outside of the time and space of the life mirror.⁹⁷ Bergson explains that death of the body is the final inability to interact and is the final process in the series of unfinished entanglements. So even in the finality of death, the momentum of entanglements that life has created continues in the life cycle.

Interactive art can be understood as the envelope of total life cycle—from the start of the interaction through the end, we can experience the sustenance and decay of a total life experience. And the interactant takes away an aesthetic experience that continues to activate through the memory of experience.

This understanding of body as a discontinuous and non-totalized series of processes works directly against the central theme of the twentieth-century obsession with self as the nucleus of cognition. Merleau-Ponty's phenomenology touches upon this by creating a kind of decentering of the self in which lived experience exposes the recursive nature of the larger body of lived beings. Merleau-Ponty writes that the lived body is "a horizon latent in all our experience and itself ever-present and anterior to every determining thought."⁹⁸ This viewpoint from the anteriority of the singular body exposes the precarious condition of the self. Evan Thompson understands the dynamic and even volatile condition of the self in this approach:

The enactive approach does not start from the question of whether cognitive processes extend beyond one or another boundary, such as the skin, skull, or central nervous system, that is supposed to mark some inside/outside distinction. Rather, the enactive approach starts from the question of how a system must be organized in order to be an autonomous system—one that

generates and sustains its own activity and thereby enacts or brings forth its own cognitive domain.⁹⁹

In this model of enactive theory, the self is no longer the focus nor the center from which all thought rises. This shift alters everything about how we understand the relationship between art and ourselves. Walking into an art installation becomes not only an act of visitation but a freedom to release our selves into the senses of the other.

Embodied Aesthetics

The body occupies a central position in art, sometimes as an object of contemplation, often as a means to express something about the subject whose body is the focus of the work. As long as art is produced by and for human beings, it will deal with aspects of human life—either directly (by making human conditions the topic of individual works and forms of art), or indirectly (in the sense that any representation of the world will be filtered through and articulated by human cognitive faculties). Art in all its forms is vital, because it is one of the few methods available for interrogating and exploring human life at large. As N. Katherine Hayles has stated, “[w]e do not exist in order to relate; rather, we relate in order that we may exist as fully realized human beings.”¹⁰⁰

In embodied aesthetics, this interaction is always considered an active process—or what Thompson calls *sense-making*.¹⁰¹ Interactive art focuses our

attention on the importance of making choices to render our own unique qualities in the aesthetic experience. It focuses us, through the pleasure of introspection, towards the continuously changing and actively engaged transformational process of life. This is a critical transhistorical moment for aesthetics because it distinguishes between a passive aesthetic appreciation of art and our ability to participate in making aesthetics a dynamic form of action. Action is intertwined with consciousness in ways that may be impossible to separate completely.

There are many pre-existing assumptions about how embodiment is part of the rise of conscious acts. Physical activities, such as walking or using tools, are believed to operate in the brain in radically differently ways from non-physical activities such as thought.¹⁰² This assumption has created two separate domains of research: one, the strict relationship of neural processing to abstract thought and, the other, the functionality of kinesthetic movements of the body and physical movements relationship in the world. This also has led to a somewhat *de facto* acceptance in the field of neurocognition that *doing* an activity leads to a more direct understanding of being-in-the-world than *thinking about doing* that activity. Scientists have inadvertently focused on the distinctions that exist within a body system rather than the qualities that unite a body system as a whole when the body is engaged in activity. Thought in neurocognitive language has, therefore, become a processing function upon which the *real* (being-in-the-world as the observed and abstracted) acts. Neuroscientists build scenarios in which *thought* leads to projections of the *real*; the body then follows with *doing* in the direct form (being-in-the-world as the execution of what is really going on). According

to this logic, as soon as any action involves the brain it immediately becomes abstracted and unable to retain the “true” qualities of an event. The outcome of this strange scenario, if followed, would be a body that could disconnect and carry on without the interference of thought. In order to avoid this problematic model—in which the brain resides inside an outer shell that experiences the world—the distinction between thought and action must dissolve.

Another—and perhaps more philosophically holistic—way to understand action is as a system of multiple entities dependent upon one another to function. For example, a glass of water consists of two separate elements, water and glass, yet together they create something new through their use: drinking, putting out a kitchen fire, or watering a house plant. Action can produce many meanings. Water in a glass can affect thirst, fire, and growth depending on deployment. These potential multiple effects involve many streams of activity that produce experience without much prejudice to thought *or* action. It is consciousness without intentionality, but it is still full of inventiveness and playfulness because the processes of engagement are not reduced to the functionality of a singular body but rather encompass the whole embodied gesture.

Experience, or *qualia*, is also a vital component of consciousness. Bio-electric pulses of thought share the same physicality as moving a limb. In the same way, the movement of the chemistry of consciousness is also a kinetic act within the body system. The distinction between the biology that forms the doing—thought—and the doing itself—action—is far less important than the actions they perform together. It is unfortunate that so many researchers continue

to separate the two, constructing systems of complex mimetic structures for thought while relying on oversimplified action/reaction relationships for the movement of larger body parts. This division leads to a passive model of being that Bernhard Hommel's research into an ideomotor relationship of action bemoans:

Indeed, almost all textbooks of cognitive psychology and cognitive neuroscience try to make us believe that humans are basically passive couch potatoes who are waiting for external events that make us get up and move.¹⁰³

As an alternative, Hommel posits that a combination of internal and external stimuli work together from the very start of action, carried through intentionality. To return to the example of the water-filled glass, events are less about how to fill the glass with water and how to drink it and more about the intention of bringing the water and the glass into an act of use. Dividing this process into smaller parts, as a bioengineer or cognitive scientist would be inclined to do, does not provide a more accurate description of the action, but rather fractures one event into many disconnected parts. "Action," in this sense, should be understood as an immersive phenomenon rather than a sum of mechanical parts. The philosophy of intentionality, as defined by the *Stanford Dictionary of Philosophy*, is "the power of minds to be about, to represent, or to stand for, things, properties and states of affairs."¹⁰⁴ A full use of action would be to engage consciousness in as many ways as possible, providing a depth of experience from the whole body system.

In contrast to a divided system, events may be understood as a system that operates through the activation of mechanical frameworks. Parts of the system find their meaning as they are used. In interactive aesthetics, action is used for the raising of an aesthetic experience. *What* activation occurs and *why* it is done cannot be neatly separated into unique areas of study. Interactive objects activate in ways similar to our understanding of the functionality of our own bodies, because both are in states of negotiation with each other. Each object autopoietically must negotiate with others outside itself. The neuroplasticity of the brain shows us how inventive we can be when interacting beyond our singular consciousness. Our neural pathways are used for multiple purposes and quick responses, for instance the re-routing of signals and remapping of the cortex in response to injury.¹⁰⁵ It is this flexibility and adaptation of consciousness that makes aesthetic experiences so desirable. Characteristics such as event causality and intentionality are part of what we look for in full experience. These kinds of aesthetic behaviors are designed into interactive art as part of a behavioral vocabulary aesthetics, providing a fresh perspective on the nature of the human conditions of flexibility and adaptation.

Disrupting/Reinventing Introspection



Daniel Rozin, *Wooden Mirror*, 1999.
830 square pieces of wood, 830 servomotors, control electronics, video camera, computer,
wood frame. 80 x 67 x 10 in.

Interactive artist Daniel Rozin builds mechanical mirrors that leverage action as a form for introspection. Any person standing in front of one of these sculptures is reflected onto its surface through mechanical distortion. In his work *Wooden Mirror*, the interactant becomes the content of each piece; but the reflection that is produced is a gross sampling of what a traditional mirrored surface, or a video system, might provide. Rozin embeds a video camera within the mirror to capture a representation of the interactant. The representation is then

translated into an image as chunky cubes of wood move in the framed surface of the object. Each piece rotates and catches the light to best translate the amount of light on the surface of the interactant's face. In a world of contemporary art that is often reduced to spectacle, these works offer the viewer a different interactive task: to stand quietly with an artwork and to feel the nuanced shifts of her own body. This aesthetic experience offers the interactant the ability to experience subtle changes in light and movement—revelations that the object constantly provides as a series of motors control the pitch of the wood surface in relationship to a light source. A small shift of the interactant's feet or a tilt of her head will change, ever so slightly, what the camera collects. This, in turn, is exaggerated by the large pixel-like pieces of wood. With a slight lag in processing, the object slows the gaze and provides a self-reflective focus through the distortion of material translation. The result is a generalization of form. In this case, the body's self-awareness is actually heightened by the loss of visual data. This makes Rozin's work a kind of system of simplification, slowing time and space, and thus evoking interplay through a dissonance between its slowed echo and the body that exists in its own time and space.



Daniel Rozin, *Weave Mirror*, 2007.
768 C-shaped prints, 768 motors, video camera, control electronics. 57 x 78 x 8 in.

Weave Mirror assembles 768 motorized surfaces and prints along the surface of a picture plane. “A seemingly organic smoky portrait comes in focus to the sound made by the sculpture’s moving parts. Informed by traditions of both textile design and new media, the Weave Mirror paints a picture of viewers using a gradual rotation in greyscale value on each C-ring.”¹⁰⁶

The experience of Rozin’s mirrors attacks any scientific claim that thought can be reduced and represented as a set of functions. The interplay between the mirror and the interactant makes for a system full of highly personalized and subtle changes that involves movement as it relates to concepts of the self. It is the spectacle of interactive art, however, that can distract from certain

introspective themes. The interactant must focus on the moment at hand: the sense of standing, seeing, or even breathing can become elevated, labored, and dramatized. The swing between body system and idea system must, at some point in time, overlap. This overlap also occurs while reading literature, but with less full-body processing. When reading, the body becomes more passive, with eyes focused on the page and the brain directed on the text. The question becomes how the reader can bring a world of words to a world of emotions. How can we as readers, for example, follow a fictional story as both words on a page and as a narrative that sweeps us away into thought? We appear to be able to navigate well between the two, being transported between text and meaning. Norman N. Holland explains this as a *loosing of the self and a loosing of the world*.¹⁰⁷ He writes that, “our brains behave oddly when we are transported by a literary experience. We cease being aware of our bodies and even our environment.”¹⁰⁸ This is why looking to literature is helpful in understanding what is at work in a body system. Interaction between body and environment may be more stimulus-driven than brain-literature interaction, but also calls upon our ability to focus on a particular task, if but for a moment. Cognitive physiologists call this redirection “spotlight attention,”¹⁰⁹ which is a useful term to describe a state of consciousness with temporary direction.

When discussing the concept of interplay for the act of reading, Paul B. Armstrong refers to this interplay as “to-and-fro”¹¹⁰—a kind of conflict often found in aesthetic experience that is a powerful activator in all forms of art. Armstrong supports Wolfgang Iser’s description of reading as including both the

physical act and the abstraction of reading as “the act of transgression.”¹¹¹ This transgression works due to its fictionalizing nature: it turns each (physical and abstract) into the other. For Iser and Armstrong, reading becomes the interplay between creation and interpretation and produces an overlapping space where the autonomy of each pushes and pulls against each other.

These terms, Armstrong’s “to-and-fro” and Iser’s “act of transgression,” reflect the permissible yet continued autonomous nature of the interactant and the object. In the case of reading, the object is language. For Rozin and his mechanical mirrors, the object is the shifting shape of the object surface against the movement of the interactant. Language and gesture both evoke a parallel discord. It is also important to note that the two parts that together create a whole experience do not blend into an amorphous identity, but rather render their potential from their differences. This, Armstrong argues, is what brings the aesthetic experience into play:

This conflict over whether the aesthetic experience is characterized by “harmony,” unity, and synthesis or “distortion,” disruption, and dissonance can also be found again and again in the history of aesthetics. It is evident most notably, perhaps, in the dispute between classical conceptions of art as balanced, rule-governed, and symmetrical versus Romantic valorizations of rule-breaking, original genius, and idiosyncratic particularity. This opposition recurs repeatedly and calls into question the notion that there is a uniquely aesthetic emotion that triggers a singular, identifiable aesthetic experience.¹¹²

Armstrong exposes the myth that aesthetics can be identified as one particular or singular emotion or situation. As with all phenomenological activity,

we instead must look to aesthetics as a rush of possibilities rather than an absolute equation that comes to rest on a single beautiful object. Armstrong's work with language and the act of reading reminds us that dissonance from interacting bodies is not a function of a single medium, but rather a state of activity that can be found in all forms of aesthetic experience.

Aesthetics derive meaning by rendering experience through the constant fusion and juxtaposition of streaming events. The brain's elasticity, along with the inertia of the body's mechanics, expresses a kind of push and pull that creates unique experiences. Armstrong identifies the historical trend in Western aesthetics of using both harmony and dissonance as aesthetic techniques. If we examine Rozin's mirrors through this neuroscientific lens, changes to the body are matched in the brain as minute differences but are registered in the artwork as enlarged and gross gestures within the world. This conflict, between what the brain processes and what the body experiences, cannot be resolved by the brain or body alone. The push-out towards the object—and the pull—back towards the body—is a constant negotiation in the aesthetic experience. It is highly questionable whether there is ever resolution between all the parts; more likely is a willingness to exist together in unresolvable points of difference.

The principle of self-organization is evident in Armstrong's *to and fro* of play. From an ontogenial viewpoint, the origin and the development of an organism involves an ongoing back and forth for the development of an active betweenness. It is an act of growth. This is also arguably a vital component of all creative acts. Armstrong explicitly borrows this negotiation in reading from Iser,

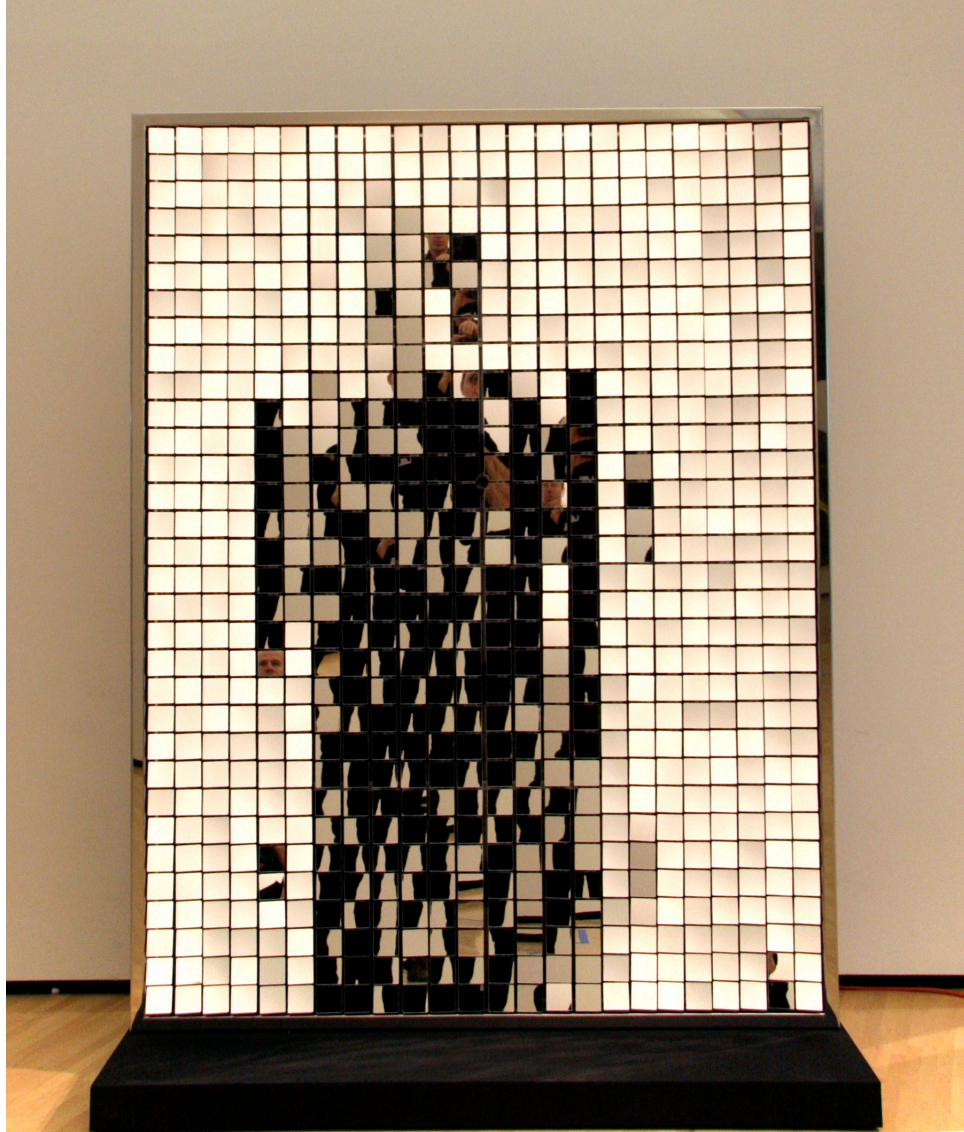
who in turn borrows from his teacher, Hans-Georg Gadamer, who worked at great length to argue that “truth” and “method” were at odds with one another.

Gadamer intended his work, *Truth and Method*, to be a description of what we always do when we interpret things. The movement *to and fro*, with its inherent dissonance, is central to the definition of Armstrong’s play and evidenced in the development of many acts of attention. Armstrong states that play is “an instrument for staging various kinds of open-ended exploratory interactions.”¹¹³ The focus remains, from Gadamer to Iser and Armstrong, on the action of attention.

According to Rozin, his mirrors explore “the line between digital and physical, using a warm and natural material such as wood to portray the abstract notion of digital pixels.”¹¹⁴ In a 2008 interview with Rozin, art critic Marco Mancuso observes that Rozin’s mirrors not only reflect, but also immerse the viewer in a dimension of unstable coexistence between the real world and a virtual world, and believes that mirrors are uniquely able to introduce this duality in a gentle and gradual way.¹¹⁵

The discussion of the real and virtual world is another permutation of need for a betweenness in interactivity. Although it is desirable to appreciate the way Rozin has built his complex objects, the interactant is not primarily focused on materialism or the mimetic structure of the digital mirror when experiencing the work. The experience evokes the very actions that are being deployed and returns them as an aesthetic intervention. The *feeling* is a kind of exposure of an internal process of one’s own gestures and, in this way, it is extremely satisfying as an

experience. Armstrong's *to and fro* is useful here to explain the dynamics among all of the parts because each part—the virtual and the physical—must retain its own presence in order for the movement of *to and fro* to occur. This engagement brings presence to interaction, which is how we are able to distinguish among things. The aesthetic characteristics of Rozin's mirrors are designed to dovetail with our own behaviors through a conscious act of exchange; they are not devised for conceptual resolution. As such, it is an understanding that the flow of interactions heightens the potential for variation and multiplicity. Interactive aesthetics frames them with concepts brought through the performative and action-oriented procedures as states of betweenness. This understanding, that ideas are never complete, brings to both aesthetics and action science the nature of human activity as a functionality of expression and inventiveness.



Daniel Rozin, *Mirrors Mirror*, 2008.

768 mirror tiles, 768 motors, video camera, control electronics. 90 x 70 x 6 in.

Another work by Rozin, *Mirrors Mirror*, creates the viewer's image by directing 768 mirror tiles in a way that reflects different portions of his image. Brighter pixels reflect the upper body of the viewer and the wall behind him and dark ones are aimed lower. So the environment is important as it affects the reflection. Because of the shape and position of the tiles, the viewing experience is private to the reflected person. This piece also includes an animation feature

when the interactant leaves the piece. This is an aesthetic function that allows the past to replay upon the surface of the mirrors, folding the past onto the present.¹¹⁶

The mirrored surfaces also offer a different understanding between the participant and the object by including the entire optical environment as part of the form. Distinctions between the participant and the object are further eroded by the folding of the external onto the surface of the mirror in both space and time. The splintered self is reconstructed but never made whole. The multiplicity of new forms manifests in a stream of parts that collide in many fleeting moments upon the mirrored surface.



Daniel Rozin, *Mirrors Mirror* (detail), 2008.
768 mirror tiles, 768 motors, video camera, control electronics. 90 x 70 x 6 in.

Also using the mirror to critique the embodied experience is the robotic work of Louis-Philippe Demers. His work *The Blind Robot* takes on the task of parsing the multiple face of each physical/virtual subject as read by a set of robotic fingers.



Louis-Philippe Demers, *The Blind Robot* (detail), 2011–12.
Development commission for the Robots & Avatars project.
Robotic hands, 3D scanners, proprietary software, participant, mirror.

The Blind Robot addresses the kinds of engagements generated when a social robot intimately touches a person. The robot delicately explores the body—mostly the face—of the participant. On a nearby screen or projection, the machine then produces a visual rendering of what its fingertips have “seen.”



Louis-Philippe Demers, *The Blind Robot*, 2011–12.
Development commission for the Robots & Avatars project.
Robotic hands, 3D scanners, proprietary software, participant, mirror.

As subjects are touched and scanned by the robot's fingertips, they watch themselves mirrored on the computer screen. A strange, disoriented feeling comes over the subject. The subject is surprised about how gently the robot does this routine. There may be a feeling of awkwardness that the robot has become so intimate with the skin of the subject. There is also a sense of empathy towards the robot as it works to make sense of the subject's features. Finally, an introspective moment is gathered and offered back to the subject through the mirror. The whole experience can be traced from a series of visual and tactile perspectives, creating a completely different perspective on robots.

"It is a psychological experiment," writes Demers. "[J]ust by the fact that I state that this is a blind robot, you will accept that this machine can touch you in very intimate places. If there would be a robot and I wouldn't say anything or tell you that this device is here to measure your heart-rate by touching you, you would

have a very different reaction.”¹¹⁷ So the robot has a vulnerability that provides a unique access to the subject. This in turn provides an aesthetic of trust between subject and robot that brings to light a codependency between the two that is immersed in the experience itself. The social experience is a cybernetic connectivity between subject and robot.

Causality in Aesthetic Action

Current action science research starts with the premise of first looking towards a particular goal and terminates with the achievement of that goal.¹¹⁸ In the example of Rozin’s mirror projects, we project ourselves into the difference between what we see and what we believe to be ourselves. This is part of the aesthetic of the mirror—discovering the difference between the seen and the believed stimulates us to find out why and how that difference takes place.

As a point of philosophical reference, the aesthetic use of the mirror and the transhistorical interest in mirroring systems has long been part of the human condition and is found in many art contexts. Examining how the work of Jacques Lacan and his *mirror stage* of development may fit into a neuroaesthetic reading of Rozin’s artworks is useful here. The fragmentation of the self is a critical aspect of Lacan’s understanding of how the mind develops and can be a useful metaphor for how to negotiate self-discovery. The seeking of self-reflection and the *mirror stage* is an important component in Lacan’s critical reinterpretation of the work of Sigmund Freud. Lacan shares Freud’s view that the development of

the self is never explainable as a whole—isolated—experience, but forms part of the permanent structure of subjectivity. In what Lacan terms “the imaginary order,” the viewer’s own image permanently catches and captivates the subject:

[T]he mirror stage is a phenomenon to which I assign a twofold value. In the first place, it has historical value as it marks a decisive turning-point in the mental development of the child. In the second place, it typifies an essential libidinal relationship with the body-image.¹¹⁹

In the *mirror stage*, Lacan most certainly identifies a coexistent relationship between the mind and the body. Deploying use of psychoanalysis to understand our bodies may nevertheless be problematic for an embodied reading of interactive art. Vittorio Gallese argues that putting psychoanalysis and neuroscience together, at the more general level, is immensely problematic.¹²⁰ Although both disciplines are working on the same brain problems, their methods are so different that there is great resistance against their integration, even within the emerging field of neuropsychanalysis. Professionals who work within neuropsychanalysis, Gallese notes, cherry-pick items from each field to support their own conclusions, rather than finding ways to successfully integrate both approaches.

An important point to consider is that Freud’s work set the stage for a different form of introspection: a process that relies exclusively on the observation of one’s own mental state and is in direct contrast with external observation. Freud’s introspection generally provides a privileged access to our own mental states over an embodied approach.¹²¹ Freud’s process was refined

from a more embodied approach to understanding cognition; but the process of traditional Freudian psychoanalysis—the passivity of lying down upon the couch and relinquishing power to the psychoanalyst for access—is a disembodied experience for the patient. This interpsychic dimension in psychoanalysis is even more important in today’s practice as, ironically, the social element of cognitive functioning is becoming an increasingly relevant aspect of neuroscience. Gallese notes that in order to observe the dynamic functioning of the brain one must observe the whole embodied dynamic rather than the outdated focus on mentality.

Another issue critical to both neuroscience and psychoanalysis is memory retrieval. Neuroscientist Christina Alberini warns that retrieved memories become fragile. In the state of psychoanalysis, memories are easily changed or altered and cannot be relied on until enough time has elapsed to settle the event. This neurological process that neuroscientists call reconsolidation, occurs when the memory becomes more stable over a period of time. “During this time window when the memory becomes stronger again, new associations can form in these retrieved memories.”¹²² Although identifying memories is a key activity within a therapeutic setting, the fragility of a new memory is not one that should be manipulated. According to Alberini, the memory needs to reach a state of stability before it is anywhere near representational of the actual experience. Any manipulation during this time contributes to the creation of false memories. Moving memories from the unconscious to the conscious is a far more vulnerable process than even Freud imagined.

Lacan does move past this strict methodological interpretation of the Freudian view by suggesting a reciprocal relationship between the physical body and cognition. Lacan realizes that the dissonance between body and perception is essential to identity. He writes that “[t]he vision of the body as integrated and contained, in opposition to the child’s actual experience of motor incapacity and the sense of his or her body as fragmented, induces a movement from ‘insufficiency to anticipation.’”¹²³ This inability to unify these two—how the mind sees the body with how the body functions—expresses well the quandary of the mind/body problem. This is also perhaps the major point at issue in a Freudian critique of interactive aesthetics: that the dissonance in perception is one that needs to be *rectified* in the first place. Freud’s original intention for psychoanalysis was to create a clinical method of discourse between a patient and a doctor designed to help settle the troubled individual through therapeutic efficacy; it was not to create a playful or aesthetic dialogue. This intention matters. The psychoanalytic use of the subconscious as a phenomenon of repression is an interpretation that has been severely criticized. Jean-Francois Lyotard’s challenge to the function of the Freudian dream reverses many assumptions. Lyotard writes that the “unconscious is a force whose intensity is manifest via disfiguration rather than condensation.”¹²⁴ The loss of an ontological remedy for the subconscious at the end of a century of the self is part of the collapse of the grand narrative’s hold on human purposefulness.

The irony of human development, as Lacan understands it, is that it is forever broken, unable to fulfill our desire for rational order. What is formed in

the mirror is a fantasy, an unreal image that only seems real. In the 1981 philosophical treatise of Jean Baudrillard, the question of authenticity of any representation of reality is always already ideological, always already constructed by simulacra.¹²⁵ Simulacra are copies that depict things that either have no reality to begin with, or that no longer have an original. Postmodern art has also blurred distinctions between the authentic and the simulated, leaving the simulacrum as the only truth.

The compelling concepts of Rozin's mirrors do not lie in the disparity between real and virtual, but rather in the *situation* in which the installation invites a causal discourse. Causes and effects are typically related to changes or events and are usually focused on the subject and their situation in action. If the second event is understood as a consequence of the first, then the first event (in this case, the human participant) is understood as privileged in the causal relationship. Looking at a modernist painting, for instance, exposes the power of observation—the observer takes from the painting what is imparted by the artist onto the canvas and then positioned passively for the observer to glean. Accordingly, our understanding of Armstrong's *to and fro* is always prioritized by a causal relationship that reflects the self-conscious aim of, as example, the modernist painter.

It was Immanuel Kant who first claimed that people have innate assumptions about causes. To Kant, it appeared that science was evolving to incorporate all reality, including human behavior, into a mechanical model. This would suggest that all events, as part of a unified mechanism, could be explained

by cause and effect. This new functional understanding of events became the critical appraisal of the capacity of human reason and laid the foundation of modern sciences. Although Kant's understanding of prior knowledge professed not to arise from experience, Kant believed that knowledge about causality is *a priori*, or within the faculty of rational judgment.¹²⁶ The *to and fro* that is the play between the intellectual launching of an event and the embodied experience of that event is another lens through which to examine the subject-object problem, and one that has found its way into the interactive art discourse.

In interactive art, causality and effect are aesthetic subjects that release previous assumptions of stilled objecthood.

VIDEOPLACE, by artist Myron Krueger, was one of the first artworks to focus on causality and effect as interactive aesthetic subject matter. The installation uses computer projection that interacts with the viewer's physical shadow. The work is a useful example of the fundamentals of embodied interactivity, because it is a prototype for what would eventually be called Virtual Reality, but with a focus more on the human gesture than the computer simulation.



Myron Krueger, *VIDEOPLACE*, 1969.
Computer projection, proprietary software, interactants.

As a responsive environment, *VIDEOPLACE* reacts to the movement and gesture of the viewer through an elaborate system of sensing floors, graphic tables, and video cameras. Audience members can directly interact with the video projections of others through the shared graphic environment.

Designed so that the computer controls the relationship between the participant's image and the objects in the graphic scene, the responsive environment coordinates the movement of a graphic object with the actions of the participant. While gravity affects the physical body, it may not control or confine the image, which can float around the screen. A series of simulations can be programmed based on any human action that is identifiable through the participant's shadow-like silhouette. For example, when a participant's silhouette

pushes a graphic object, the computer can choose to move the object or the human silhouette. In this way, the computer becomes the conceptual space between the participant and the projection.

At the heart of Krueger's contribution to interactivity is the notion of the artist as a composer of intelligent, real-time, computer-mediated spaces, or responsive environments, as he has called them. Krueger claims that "technology [is] an inevitable consequence of the laws of physics and therefore as natural as the birds and the bees."¹²⁷ In activating the space, the computer responds to the gestures of the audience by interpreting and even anticipating the participants' actions. *VIDEOPLACE* is an example of interactive art in which both the participant and the object can engage in causality and effect as autonomous agents. The friction between resolution and the impossibility of resolution creates a different kind of causality that involves choices and decisions from both the interactant and the object, each working towards a whole. In other words, the purpose of functionality is an aesthetic of exchange; a coming-to-being is the achievement of this purpose. The aesthetic move of one event towards another shifts the attention away from objecthood into the act of negotiating the sequencing in time and space. Interactive art brings this intentionality to the forefront of contemporary practice by claiming that aesthetic potential is full of the autopoietic drive. It is specifically interactive art, however, that focuses our attention on the importance of making choices to render our own qualities in the aesthetic experience. This is a critical distinction in aesthetics because it

distinguishes between a passive aesthetic appreciation of art and our ability to participate in making aesthetics a dynamic form of action.

A neurological understanding of the brain can be applied as an aesthetic model for critiquing art involving bodily participation. The neurophenomenology of action and response, along with an examination of the material aspects of how neurobiology expresses itself in time and through action, provides a reasonable methodology for understanding causality in aesthetics. It is less straightforward, however, to describe the intentions, desires, or choices inherent in an action. How do you assess the odds and project future outcomes? Often, intending to do something prevents us from doing that very thing. Aristotle reminds us that trying to be happy is unlikely to produce happiness. It is intention that positions emotion as a lived experience. For Aristotle, happiness is an act; his prescription of “living well and doing well” is a way to push through past choices, intentions, and wants into *doing*.¹²⁸ Not only does happiness involve Aristotelian reason, but it also needs to be activated by a living being.

Another important aspect of Aristotle’s overall understanding of emotions is that they are dependent upon the emotions of others. What, of course, is meant by “other” is open to interpretation: how we describe the other always speaks to how we describe the limits of our selves. Merleau-Ponty’s argument of the intersubjective is a sustained argument for interactivity. In fact, a phenomenological analysis of intersubjectivity does not merely concern concrete face-to-face encounters between individuals. It is also at play in simple perception, action, emotion, drive, and different types of self-awareness.

It is this complex understanding of the intersubjective that William James argues for in his lectures entitled *A Pluralistic Universe*: “Livingly, things *are* their own others.”¹²⁹ For James, pushing one’s intentions into actions out in the world with others who are doing the same thing brings out the very emotions we consider to be our innermost valued parts of the self. As a proponent of embodied philosophy, Francisco Varela would also argue that action can be found within the self as a natural point of intersubjectivity. In Varela’s autobiographical essay “Intimate Distances,” written shortly before his death, he challenges the notion of an interiority and exteriority to his own body. After receiving a liver transplant, he questions the feeling of existence as an embodied sentience with the liver organ that has been taken in as part of the other. His experience is a decentered alterity that must exist in both places:

These parallel themes serve as the hidden scaffolding for the analysis here. First the lived body as focus: The intrusion, the alien as flesh, and the always already mobile subject of enunciation and hence the mobility of the lived body’s identity. Second, the networks of dissemination playing in unison: The social network of the gift, and the imaginary circles of the images that give this inside a metaphorical concreteness.¹³⁰

The transplant, with its focus on the placement of the organ, is also a reflection upon the interiority of the self as a mixture of intimacy and profound splaying of that self onto the impersonal functions of body parts within an impersonal hospital. The play of these two realities crystallizes the paradox of the organ that is functional yet impossible to reconcile.

Rozin's installation works upon the assumption of aesthetic activity as a search for self, an action that is never resolved and always dissonant. It requires practice on the part of the interactant to find a way to be present within the dissonance. The rise of this aesthetic is best cultivated over time, over multiple encounters with the installation—a quality common to many interactive artworks. Due to the kinesthetic nature of the interactive experience, the action calls upon the construction of the body for participation. The installation activates its own agency and, in turn, creates a shared action of intentionality. This is the causal power of choice: it does not necessarily lead to any resolution but rather to the freedom to explore the world from a series of choices and a space to allow the aesthetic experience to rise.

In *Essays of Actions and Events*, Donald Davidson argues that the freedom to act can be a “causal power.”¹³¹ By causal power, Davidson means a relationship to freedom of choice. He defines a causal power as “a property of an object such that a change of a certain sort in the object causes an event of another sort.”¹³² According to causality theory, willing is not an act distinct from doing and, therefore, cannot be a cause of the doing. Davidson clears up this confusion by claiming that “free action is one where a change in the agent causes something to happen outside him[self].”¹³³ This is a powerful notion. The claim that the freedom of an individual act is in relationship to something that is not part of that individual's own free self goes to the very core of the description of autonomy. A causal power is therefore a system that is free but still autopoietically closed: each

agent relies on resources from another, yet those shared resources do not become part of the other's permanent operation.

To follow the autopoietic development of intentionality, the information encoded in the human desire to survive requires a biological intentionality. In his essay on the subject, Varela builds the foundational issues of the relationship between autopoiesis and perception, wherein the relation between an organism and its medium is continuously regenerated through the intentionality of negotiation with others.¹³⁴ Varela set this up as a paradox:

It is ex-hypothesis evident that an autopoietic system depends on its physico-chemical milieu for its conservation as a separate entity, otherwise it would dissolve back into it. Whence the intriguing paradoxicality proper to an autonomous identity: the living system must distinguish itself from its environment, *while at the same time* maintaining its coupling; this linkage cannot be detached since it is against this very environment from which the organism arises and comes forth.¹³⁵

For Varela, it is autopoietic unity that creates a perspective from which the exterior (understood as the environment or other autopoietic entity), may be used by the subject to further its own sustainability. It is significant that this negotiation is seen from the point of view of the living system. Varela argues that “what the autopoietic system does—due to its very mode of identity—is to constantly confront the encounters (perturbations, shocks, coupling) with its environment and treat them from a perspective which is not intrinsic to the encounters themselves.”¹³⁶ In other words, the intentionality of the subject to interact does not “dissolve” the quality of the subject, but rather works to sustain and even

fortify its own experience. Varela further argues that an organism's circular experience is inherent in all life and is a part of its assertion of presence.

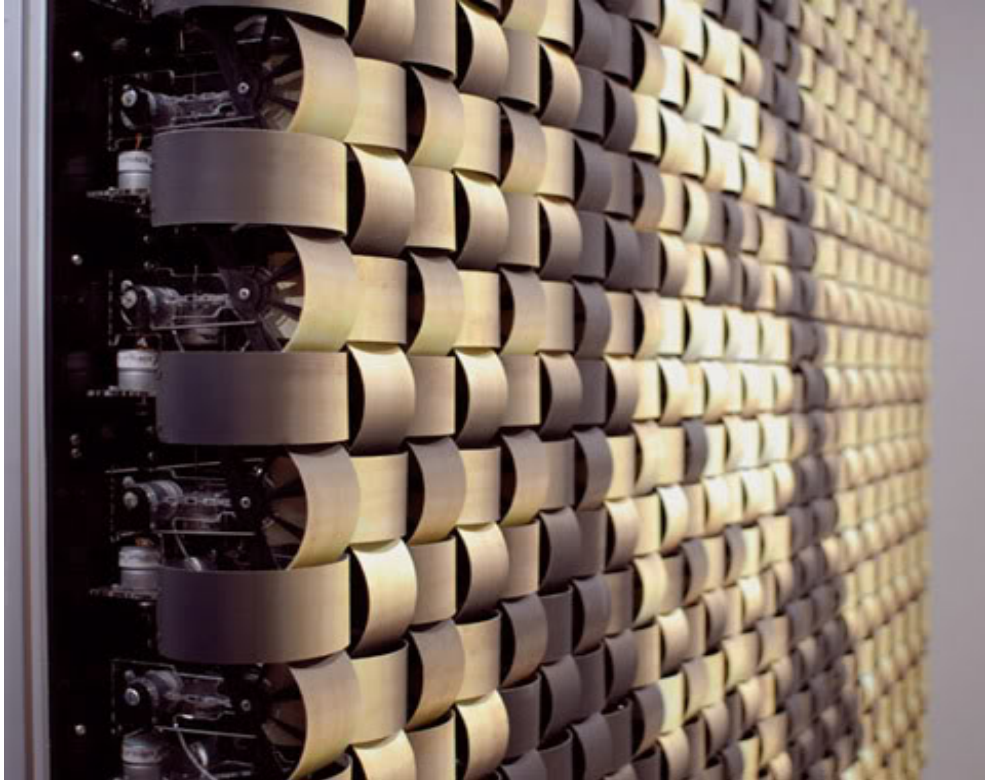
An entity's autopoietic link with its environment, necessary for its own continuity, is also essential to aesthetic expression. This "environment" includes space, objects, and other people. The question arises: to whom does the aesthetic belong in such a negotiation? This argument is easily resolved if each entity retains its own intentionality, because then each may build its own meaning. Each system creates meaning only because each entity is intentional. Inter-subjectivity comes from the wealth of experience that Varela refers to as a "surplus of significance" within the entire ecology or system of interaction.¹³⁷ This surplus can be located and utilized in each pathway back to each agent. "The nature of the identity of the cognitive self . . . is, like that of the basic cellular self, one of emergence through a distributed process."¹³⁸ Varela stresses that autopoietic systems work well when an agent—an integrated whole with an individual purpose—does not need central supervision. Interactive systems are able to participate in this autopoietic interplay within an overall system of constituted selves.

Biologists commonly claim that an organism's interactions with its environment are fundamental to the survival of both that organism and the ecosystem as a whole.¹³⁹ Charles Elton, one of the founders of ecology, put forth many ideas about our need to search for and sustain aspects of interactivity that have proven accurate and even remarkably prescient. His work, along with that of the many others who developed the structure of biology, is science's earliest

attempt to find order in the diversity of life that has its basis in the critical aspect of interaction between species. It is from this work that interaction can be understood as the ontology of biology because relationships are used as a basic category of being.

The implication for how we view, make, and critique art is important here because what we see as evidence of the artist's process is also modeled simultaneously in the synapses of the brain. Scientists no longer regard the brain as the engine of the body, the decision maker, or even the sole source of consciousness. One does not trigger the other; consciousness is an emergent pattern that can be found at many levels of experience. When art is experienced, these patterns restate both the biochemical and the mechanical locomotion of consciousness. The pattern is reciprocal; consciousness creates the aesthetic moment, and the process of experiencing art becomes a reflection of our consciousness. Interactivity becomes an instrument for this understanding in action. We do, we see, we, we comprehend, and we react as part of a whole action of becoming conscious. Contemporary art that explicitly stretches these boundaries fosters an inter-subjective contribution to the transformation of the historical mind/body duality. Developing an interactive aesthetic is part of an awareness of this exchange, and manifests the literal nature of this duality by working beyond a singularity of the sense, towards the relational nature of a new corporeal understanding and aesthetic experience.

Mechanical Aesthetic Behavior



Daniel Rozin, *Weave Mirror* (detail), 2007.
768 C-shaped prints, 768 motors, video camera, control electronics. 57 x 78 x 8 in.

Mechanical interactions take place in both the sculptural object and the body of the interactant. How do these systems function independently? Where there is potential for intersections, how do they provide an aesthetic space of interaction? Motor motions are far more precise than the movements of biological bodies, since biological bodies are open systems that allow for unpredictable change. The differences between these kinematic systems provide variations to the space of potential change.

The scientific understanding of mechanical interactions is divided into five specific categories that, in a variety of configurations, make up all physical events. Consider the following as conditions not only for mechanical motion but also body events. Machine actions create physical displacements by working for, against, and in interaction with each other:

1. An applied or direct interaction, which occurs when two non-elastic entities push or pull each other.
2. A physical contact of interaction.
3. A friction interaction, which occurs when two surfaces rub against one another.
4. A drag interaction, as when one's own body is used to pull an entity.
5. An elastic interaction, which occurs when two entities push or pull on each other and at least one of them resists or is stretched.

The aesthetics of motors and mechanical joints are critical factors contributing to the specific type of motion in kinetic objects. Rozin uses servomotors, which are particularly useful because they are able to keep track of where they began their motion. In this case, movement is not relative to the last place traveled but rather to a default point relative to all other locations. When servos are commanded to move by the circuit, they move to the prescribed position and hold that position. If an external force pushes against the servo while the servo is holding a position, the servo will resist moving out of that position as best as the torque will allow. This position pulse must be repeated to instruct the

servo to stay in position. In this way, the robotic system always knows where it is in space relative to a resting position. The individual evolution of a servomotor is possible with memory provided by attached circuits. The motor can identify itself through the relative positions to which it has moved prior to each reading, creating feedback data that provide possible future positions. The capabilities and limitations of the servomotor define the parameters of the aesthetics of computer-mediated interaction; neither the work itself nor the subjective experience holds aesthetic value alone. Aesthetic value is additionally derived from a feedback relationship between the mechanics of the machine device and the mechanics of the human and the critical events that exist within the gap perceived between the two. Also, each autonomous part has its own way of pushing and pulling in and out of space, each with interactive properties shaped by potentials and limitations in the process of cause and effect.

The Body in Aesthetic Feedback

Feedback is a part of a homeostatic imbalance that is also part of a body in motion. Just as muscles work with memory and expectations of possible futures, mechano-electric feedback works in the body as a highly personalized system. Feedback is a key aspect of interactive aesthetics—it is how the system plays out through time, choice, and action. As part of a chain of cause-and-effect that forms a circuit or loop, the event feeds back into itself.



Daniel Rozin, *Mirror*, 2007.
650 wood dowels, 650 motors, video camera, control electronics.
42 x 42 x 6 in.

In order to properly position the aesthetic concept of feedback, a look into action theory is useful in considering theories about the processes of human bodily movement. This area of thought has elicited strong philosophical interest since Aristotle's *Nicomachean Ethics* and provides a platform for the many theories of action discussed in neuroscience today. Aristotle's discussion of the ethics of one's actions can be used as a way to discuss the physical actions of the body. He posits that one kind of moral action may be transferred to a physical relationship to the world; or, that being virtuous is bound by the actions of the body. Aristotle claims that virtue and vice are voluntary actions resulting from decisions, deliberations, and wishes. They are actions within our own power, not universal attributes.¹⁴⁰ We learn intellectual virtues by instruction and we learn

moral virtues by habit and constant practice. We are all born with the potential to be morally virtuous, but it is only by behaving in the right way that we train ourselves to be virtuous. In Book III of *Nicomachean Ethics*, Aristotle describes how our evaluation of a person's actions depends on our perception of whether those actions are voluntary, involuntary, or non-voluntary. In all cases, it is the action of self-reflection that makes for good morals and it is this kind of deliberation that precedes choice. Temperance is the mean state with regard to physical pleasure. Although Aristotle tends to see physicality, such as touch, as the most liable source of licentiousness, he believes that the temperate person will feel appropriate amounts of pleasure:

What do we mean by saying that we must become just by doing just acts, and temperate by doing temperate acts; for if men do just and temperate acts, they are already just and temperate, exactly as, if they do what is in accordance with the laws of grammar and of music, they are grammarians and musicians.¹⁴¹

Again we can see that the arts have their goodness in themselves.

This is the genius of Aristotle's *Ethics*: individual choice is controlled by how one formulates and acts upon a concept, *not* by how one follows a pre-described ethical stance. Aristotle determines that the degree of exactness required and made for human actions is not universally the same, therefore not universally applicable. The problem of free will is much debated in modern moral philosophy. Presumably, we can be held morally responsible only for those actions that we perform of our own free will, so determining the source and scope of our freedom would seem a necessary prerequisite to determining the source and

scope of moral responsibility. Aristotle gives us a workaround, however, telling us that we are not responsible for actions carried out under ignorance or compulsion. The focus, he argues, is on our choices rather than their outcome, because of the noble ends at which they aim. Intention is an aim in itself and making choices is part of a system of self-observation or feedback. This underscores Aristotle's belief in art for art sake: "products of the arts have their goodness in themselves."¹⁴²

Embodied Intentionality

Intentionality, also called *aboutness*, is considered in embodied theory to be a voluntary choice wherein the capacity of a rational agent can choose a course of action from among various alternatives. George Lakoff and Mark Johnson discuss this as our spatial awareness, our bodily movement, and the way we manipulate objects—all of which provide the pattern for how we reason about the world. Acts of reason are acts of cognitive effort.¹⁴³ Most important is that intentionality is a *choice* that can be sourced back to a disposition in the brain of an emotional state or desire. As an enactive approach, however, there are two critical concepts that should be followed. The first is that the cognitive process is not an extension out from the full body, but rather a question of how the body is organized as an autonomous system. The second critical concept is that the body's system has its own regulatory behaviors that work to sustain itself and to regulate its interactions with the larger world. This is what Evan Thompson refers to as

sense-making—the relational side of autonomy. In a less granular form (but with the same claims of inter-relationships), it is what Merleau-Ponty explains as each organism’s ability to “modif[y] its milieu according to the internal norms of its activity.”¹⁴⁴

A project that draws attention to modifications of internal norms is called, *The Machine to Be Another: Embodiment performance to promote empathy among individuals*, by the artist group BeAnotherLab. Using virtual reality (VR) technology, multiple subjects can visualize what it looks like to be the other. Subjects looking at their own bodies see a three-dimensional video of the other subject in the place of their own. When the performance is synchronized between two subjects, each one has the sensation of “feeling” the other’s body.



BeAnotherLab, *The Machine to Be Another*, 2013–present.
Embodiment performance to promote empathy among individuals.
Virtual Reality performances.

The Machine to Be Another combines neuroscience protocols with art performances. It uses VR not to facilitate seeing oneself in the body of a VR subject (as in neuroscience experiments), but to put one's image into another subject's body through first-person stereo camera technologies, and to swap the other subject's body with one's own seamlessly, through carefully orchestrated performatic acts. An interesting aspect of this performance is that because the VR technology only works strapped to the subject's head, the only audience of the body swap is another performer. In this way, the performance is a closed loop of activity only experienced between performers. The perception of body

modification thus becomes an act of introspection. Spatial awareness remains grounded by tightly scripted body gestures, while the cognitive effort of swapping bodies allows for a claim of inter-relationships. The mental state is therefore tightly locked to the physical state, even through swapped bodies, and the aesthetic experience becomes the feeling of the other.

As an ontic condition of a person who is in full consciousness, this behavior is, with some level of transparency, one that satisfies the intender in the act of exchange. Franz Brentano, who brought the idea of intentionality to contemporary philosophy, called it *mark of the mental*.¹⁴⁵ Brentano's empirical perspective claims that the mental state of intentionality stands separate from the physical intentionality, and that making conscious choices is a judgment that is not even part of the physical realm.

Every mental phenomenon includes something as object within itself, although they do not all do so in the same way. In presentation something is presented, in judgment something is affirmed or denied, in love loved, in hate hated, in desire desired and so on. This intentional in-existence is characteristic exclusively of mental phenomena. No physical phenomenon exhibits anything like it. We could, therefore, define mental phenomena by saying that they are those phenomena, which contain an object intentionally within themselves.¹⁴⁶

From Brentano's observation, we can surmise that mental intentionality decenters the status of the self through the emancipation of the idea, which is incorporated in the sense-making of the individual.

In his *Phenomenology of Perception*, Merleau-Ponty shifts the locus of intentionality from a Husserlian consciousness to the body-subject, which disrupts the notion that intentionality could ever be separate from the whole of human experience. His later transition from “the body” to “flesh of the world” in *The Visible and the Invisible* marks a further move in this direction, reinforcing the idea that intentionality should be generalized to all living organisms and, consequently, to the whole of nature. This notion clearly resonates with Merleau-Ponty’s description of an organism’s attunement to its environment and his characterization of the relationship between organism and environment as one of reciprocity.¹⁴⁷ The emphasis given to the unique role of the body in Merleau-Ponty’s philosophy of perception is not to be regarded as a way of privileging the human subject, and thereby a commitment to a dualism of humans versus nature. On the contrary, *le corps propre* as embodied subject serves to establish a methodological standpoint which ultimately yields a continuity between humans and non-human organisms that emphasizes the similarities between humans, other animals, and living things, rather than the differences.

If we reconsider the artwork of Stelarc, we are reminded of his robotic prosthetic control systems in which the motions of his arm are controlled by the electrical signals of his own muscles; these are typically automatic motions not controlled by intention. The result is that one part of Stelarc’s body is in control of another part; the original body is an extendable entity that can enrich its own functionality through added technology.



Stelarc, *Ping Body*, 1996. Institute of Contemporary Art. Sydney, Australia.

In *Ping Body*, Stelarc extends and controls his body by means of special interfaces that are situated in three different locations: Paris, Helsinki, and Amsterdam. As depicted in the above photograph, Stelarc's biological body and his prosthetic extension are performing in Sydney. According to Stelarc:

The body works not only controlled by own metabolism and internal rhythm but also in the net of connected bodies, devices. This performance was not focused on highlighting the ability of sending complicated information but it was concentrated on the active exchange of physiological and physical energy.¹⁴⁸

For Stelarc, this distribution of control is a natural extension of what he refers to as an *obsolete body and brain*. Stelarc's body always includes technological extensions as an evolutionary tract. This is subsequently deployed

or linked into a distributed system much larger than his own original biological form. The first layer of interaction is the relationship between his biological leg muscles and his prosthetic legs—each tries to control the other while walking. The next layer of interactions are the remote controllers from Paris, Helsinki, and Amsterdam—each one also working in concert to control his gait. In addition, his body is divided into different biological sections, each also in communication with a separate remote controller. Together through this distributed method, the controllers attempt to move Stelarc's body. For Stelarc, body is always part of cognition. Here, Stelarc explains his intentions in a conversation with Paolo Atzori:

We shouldn't start making distinctions between the brain and the body. This particular biological entity with its proprioceptive networks and spinal cord and muscles, it's the total kinesthetic orientation in the world, it's the body's mobility which contributes towards curiosity.¹⁴⁹

Stelarc understands the brain as a central control system that is part of many other systems. It is the act of intellectual inquiry that sets us out beyond our own skin.

Evan Thompson and Mog Stapleton discuss this distributed relationship to cognition as part of their examination of current mind-body theories:

We propose the following “transparency constraint”: For anything external to the body's boundary to count as a part of the cognitive system it must function transparently in the body's sense-making interactions with the environment. We also hypothesize that tools and aids that conform to transparency are incorporated into the neurophysiological body schema.¹⁵⁰

Even when authorship is put into play through the body, every act also includes countless actions that are already automatic. Some anti-intentionalists, such as Ned Block, argue that phenomenal conscious experience, or qualia, is a vital component of consciousness that is not intentional. When intentionality is applied, intentionality becomes the free will of neurophilosophy. According to Patrick Haggard from the Institute of Cognitive Neuroscience, “intentional action involves both a series of neural events in the motor areas of the brain, and also a distinctive conscious experience that ‘I’ am the author of the action.”¹⁵¹ This both affirms and questions the notion of the self; as Antonio Damasio notes, “consciousness is knowledge of one’s own existence and of the existence of surroundings. This knowledge means that we must experience and we must be aware that we are experiencing. With lack of consciousness, we do not know of our existence; and we do not know that anything else exists.”¹⁵² Damasio very much privileges the self in the process of consciousness and acknowledges that the acts of a living organism incorporate a social dimension.

For Merleau-Ponty, meaning is also biologically based. In this way, Merleau-Ponty does not tie us to a world where mind or cognition can be separated from the whole. “Ping” is the word used to describe the sound generated by sonar equipment in submarines. The distance to another object is measured by the time it takes this sound to echo back. Stelarc explains that the ping values represent the distance and time on the Net and constitutes a live performance. The values are also converted into a graphical interface on a screen and into sound

depending on proximity, position and angle of arms and legs. So the performance that is controlled by activities on the Net, can again be seen there, live. Where normally people cause events on the Net, here the Net determines what happens to a person, becoming Stelarc's external nervous system and turning him into a machine.



Stelarc, *Ping Body* (detail), 1996. Institute of Contemporary Art. Sydney, Australia.

Stelarc exposes a process of the posthuman condition. What is less obvious is that the work also explores activities that are already in play within our bodies. Examples of reciprocal actions in biological bodies include regular events of involuntary reaction of muscles to the strain of a flexed joint or a chemical reaction in the skin of a threatened individual that creates heat and sweat. As neural and phenomenal events relate to any action, free will is always tangled in a

set of circumstances in which the “I” responsible for the event is embedded in both intentional gestures and Aristotle’s ignorant or compulsive action. In other words, creating useful categories to distinguish between Aristotle’s involuntary action and those performed under free will may be impossible to make through an embodied action lens. The act of the intentional moment is an endless weave of bodily and environmental factors that are always at work, softening distinctions between individual parts and their codependent functionality within the whole. An action, therefore, is both an agent of free will and contingent upon numerous other activities of embodiment. Each bodily activity can be dissected into the many parts that make up the whole involvement. Each part may be distinct and identifiable, but they are never far from the intentions, or the lack thereof, of an action goal.

Another important realization emerges from Stelarc’s *Ping Body*.

Individual muscles that Stelarc has connected to the robotic system are controlled from different locations and none of these individual locations is aware of how the others are controlling Stelarc’s body. To watch this performance is to watch the tearing apart of his body. Stelarc uses his body to manage the commands that, for instance, take him forward on the left leg and backward on the right leg at the same time. But the ongoing distribution of actions that are set upon his body become, in many cases, impossible and dangerous. Ultimately, Stelarc must manage the incoming commands by mechanically shutting down some input altogether, lest he be ripped apart at the joints. He must be the ultimate taskmaster for the goal, and no one else can manage this for him. Ultimately, his embodied

actions must be his own. The viewer stands watching the dreadfulness of it, imagining the feelings in their own limbs, and unable to alter the outcome. The horror of observation becomes a horror of one's own embodiment. With a lack of any authorship, the audience finds their own loathing of inaction.

Intentionality

According to Evan Thompson, the enactive approach in cognition is grounded in the “sense-making activity of autonomous agents—beings that actively generate and sustain themselves, and thereby enact or bring forth their own domains of meaning and value.”¹⁵³ The whole notion of autonomy, however, is much more complicated than once thought. It is now difficult to differentiate between what is part of the singular agent and what is an influence upon it. According to the extended mind thesis, “the environment constitutes part of the mind when it is coupled to the brain in the right way.”¹⁵⁴ Within this understanding, the brain can never be completely autonomous. The way in which a distinction is made between extension and incorporation of an agent, Thompson argues, is incorporated in these processes.¹⁵⁵

According to Evan Thompson and Mog Stapleton, the phenomenology of action requires an appropriate predictive, or link, between intentions; this link sets internal clocks in action.¹⁵⁶ This understanding of action focuses on the mechanisms that mediate synchronization of circadian rhythms between SCN neurons (neurons that receive inputs from specialized photosensitive ganglion

cells in the retina). Understanding how these neurons communicate, Thompson argues, is a network of circadian oscillators.¹⁵⁷

Semir Zeki and Jonathan Strutters demonstrated that subjects' preference for kinetic stimuli correlates not just with the activity of the orbitofrontal cortex, but also with activity in a specific part of the visual cortex, namely area V5. Taken together with Thompson and Stapleton's work, these studies are important in highlighting the role of early sensory cortices in subjective preference.¹⁵⁸ Zeki and Strutters argue that the dynamics of information flow in response to aesthetic stimuli arguably provides insights into how desirability arises. Such efforts significantly contribute to characterizing the feedback and feed-forward mechanisms involved in intentional flow. Zeki and Strutters propose that this is the neurological state for aesthetic judgments.¹⁵⁹ If this is accurate, then Kant's understanding of aesthetic judgment as separate from the body is problematic at the core. Kant believes that we have prior knowledge about causality and that we hold *a priori* knowledge not from sense experience but directly from the faculty of rational judgment. All analytic judgments are *a priori* for Kant since our knowledge of such matters does not require experience. Synthetic judgments are, for the most part, *a posteriori*, in that they occur after an experience of observation. An *a posteriori* judgment is a proposition for which the predicate concept is not contained in its subject. The separation of these judgments may no longer be a useful concept in a world where the causal power of embodied experience is not as distinct as once imagined. Interaction is best understood, not only by the interplay of its parts, but also as a phenomenon of change.

Time, space, action, and intent cannot be separated from experience. Kant's system of what happens in experience expresses as a miniature internal model—what is happening as a separate reality outside our bodies. This is precisely why Kant's system breaks down in the face of embodied theory. Rozin shows us the wholeness of experience while exposing differences between autonomous agents. Stelarc warns what can occur when experience is not integrated. It is a precautionary tale of how the functional parts must work together through feedback for humans to endure. These projects all hold the core concept that interactivity is not a state of aesthetic finality but rather a constructivist contemplation, the potential of a wholeness in a fragmented reality. Interactivity, therefore, in all these projects, is what Heidegger calls the *flow in the life worlds*, the situation in which we are embodied.

Epilogue: Performative Being

All art is performative. The very act of experiencing art activates the body in multiple ways. Emotions, such as enjoyment or distaste, can be directly associated with brain patterns that are activated during an aesthetic event. These brain patterns—from biochemical triggers of the body to kinesthetic responses—are an important aspect of interactive art, even though they are so nuanced they are difficult for us to perceive, let alone recognize as motivating our behaviors and affecting our aesthetic tastes. Engaging with interactive art inspires us in many ways, not least by engendering the relationship between our mental interest and our spatial inquisitiveness. Being inquisitive in turn moves us towards realities beyond ourselves. Damasio's mind reading is a neuroscientific explanation of this human attribute: the brain seeks out the uncanny, the unusual, and the non-quantifiable. The brain simply does not like routine behaviors. It *prefers* the decenterings or slippages that occur in the shift from one idea to another, and gets particularly excited when a slippage is delivered as a kind of puzzle that requires high-level brain function. A neurophilosophical appreciation of the aesthetic experience, one that is attuned to these shifts that occur in experience, is essential to the contemporary moment. In both art and science, engaging in the world is a manifestation of our desire to explore and bind together the fragments that come our way.

Framed philosophically, this curiosity responds not to what we are, but to what we desire. Desire is in close proximity to absence, and maintaining a difference between what is perceived and what can be evoked from experience reaches into the heart of aesthetics. It is important to note, however, that a neurobiological reading of desire is very different than one that comes from the psychoanalytical roots of Freud. Freud disregards negation as being the work of denial, while the neurological view identifies negation as a dissonance between potential and an activation of creativity. Art should disturb, not console. The aesthetic object as well as the viewer should not rest but explore this unbinding rupture. This is a desire that is in constant motion to make sense of a world that will never be whole.

Interactive art, as performance, unearths the deeper nature of contemporary aesthetics as well as the exploratory desires of the human subject. It is the subject that conceptualizes and deploys action by rendering the behaviors of aesthetics. The living subject is always engaged in an inquisitive search to some extent. Art frames this engagement with particular aesthetic behaviors that lay claim to one of the most fundamental of human experiences: self-awareness through introspection—an act rendered as a private performance to the self. The internalization of every interaction creates waves of interrelated activity among muscles and bones, cells and fluids, and neurons and chemistry, all of which through their actions bind together the existence of the self back to its own motion. And yet the body occupies an ambiguous, even paradoxical, role. Its parts must work together to make a singular moment, and this singular moment cannot

exist without engaging the world beyond the self and all things that the self is not. The self is never an isolated condition but always an interactive subject. That is, the subject cannot be whole until the body is put to work in the world. It is only in this moment of engagement that we find a sense of wholeness; as we move inwards we are simultaneously moving outwards, all as one action. As neuroaesthetics reduces art experiences to neural events, it also opens us to the life world that Heidegger argues is fundamental for all epistemological inquiries. Cognition is very much part of this practicality and of life events.

Husserl originally framed the life world as a pre-epistemological steppingstone for the phenomenological analysis of the grand theater of world objects, but also as the place where the subject infuses its dynamic influence. He writes, “we—subjectively...[are] constantly functioning.”¹⁶⁰ Experience, Husserl argues, is the phenomenological environment in which a subject may come to know an essence or identity. Embodied cognition, as defined by Varela, Maturana, Thompson and a growing number of scientists, is the content of mental conditions that are influenced by the states of our bodies. These states incorporate the phenomenological environment and include the transformation of thought into action. Husserl and Merleau-Ponty laid the ontological underpinnings of the embodied theories of consciousness and action that are now bringing a phenomenological understanding of the world back into current discourse, with new scientific realizations that a brain and a body may be far more elusive than ever imagined.

Aesthetic experiences, from the embodied perspective, can be framed as the creation and appreciation of the inductive process of action theory. In this sense, the move towards the object requires both introspection and active involvement. This set of ideas is the phenomenological platform on which interactive art exposes the self to the world; it is through the act of aesthetic engagement that we simultaneously require both embodied experience and introspection. The outcome is a human transformation of *feeling*. Aesthetic behavior becomes an entanglement with the life world as an evolutionary tract. Aesthetics, as a way of understanding this transformative process, can change the world. And it is interactive art, specifically, that serves as a phenomenological roadmap to the enactment of perceptual presence.

Embodied Being

The phenomenological implications of embodied aesthetics and the inherent qualities of interactive art necessitate the development of a new interdisciplinary framework for understanding them in relation to the transformation of embodied selves. Embodied philosophy recognizes that the human form largely determines the phenomenon of human consciousness. Cybernetics holds that the nature of the body is in the process of the posthuman condition. The subject in cybernetics is the cyborg. Neuroscience identifies the functionality of biology, which is constructive as humans begin to offload that functionality from carbon-based life forms to a variety of other systems based on

code and silicon. The convergence of these multiple perspectives on the body has provided a better understanding of the augmented and transitional human. This transitional position wreaks havoc on the ontological stand that being is an absolute situation and, by default, owned exclusively by the carbon-based subject. The relationship between the structure of the form and the functional outcomes of human action are in play, and the shifts that are underway expose fundamental questions about how the subject organizes itself as a living/extended-living form within a dynamic environmental system. Phenomenology is an organizational approach and the scientific study of the mind tends to look towards structure to understand cause and effect. Although there are ontological disagreements within the disciplines of phenomenology and philosophy of mind, it is clear that their overlap provides a new critical discourse for critiquing the life-based activity of interactive art.

Maturana and Varela attempt to define the difference between organization and structure. They argue that the organization of a system consists of the necessary relations that define the system. The structure of a system consists in the actual relations among its components, which serve to integrate the system. Individual structures in the organization can vary provided they satisfy the organizational constraints of the system.¹⁶¹ This is an interesting model to use when thinking about a living/extended-living form because it suggests that there is an organizational system—and a variety of relations—that can differ from the object in which the form exists. In Maturana and Varela's prime example, the autopoietic system allows for both autonomy and interrelationships between

objects. This makes even more sense when we apply it to the activity of subject-artwork interaction, because it is the autonomous subject who sustains an essential quality of self as she engages with the other. Again, it is interaction that is part of the singular body's ability to rise to a new experience while maintaining a sense of self. The phenomenological self exists in the immediate given within a dynamic structure. It is a self that provides the agency of reflexive perception, while it is experience that binds the self to the world. This understanding needs both the phenomenological and neuroscientific approaches to allow subjects to grow in their understanding of experience as both a personal and a shared phenomenon.

Some Problems of Being

The ontological problem of being remains unresolved. Philosophers who divide thought and action continue to propagate the cogito myth, locating the human essence of being within a platonic paradigm of pure thought while assigning the body to the oversimplified acts of processing sensations. Art history is also riddled with notions of the beautiful that stem from a modest understanding of the sensorial. Intellectual concepts are often viewed as disconnected from the sensory world. In this ontological misstep, the embodied form is impure and adulterates thought, while thought tends towards the rational, goal-oriented, and privileged. In contrast and according to embodied philosophy the human essence of thought should be part of the entire human condition and

the body should be part of the container. The act of thought is no longer considered an abstraction or underlying configuration to human activity but, rather, part of awareness.

Another problem with the concept of being is that the totality of the human condition is imperfect. In embodied theory, existence changes with every action. So in a world of constant activity, nothing remains the same. This may appear to be self-evident, but we rarely accept this phenomenon in our everyday lives, and forget to make use of it in aesthetic critique. In the aesthetics of action, change is built into the art experience and reminds us of the temporality of all things. The aesthetics of action also includes the realization that all things involve a multiplicity of potential outcomes; the awareness of one's own actions can never render a single ontological standpoint. To further complicate the situation, the state of being has a remarkable fluidity that takes on many forms and outcomes in the aesthetic experience. Subjective temporal structures guide aspects of behavior and cognition, distinguishing memory, perception, and anticipation, which are all embedded in concepts of time. The contemporary object interlocks with the subject in a closely knit kinship making it difficult to claim a strict autonomy for either. It is easy, by contrast, to see the object blending with the subject, both locked together in an autopoietic state of flux. It appears that the more we work on the problem of being—being in pursuit of a state of singular human existence, being as a uniquely human quality—the more nebulous our notion of being becomes.

This inability to pinpoint a precise state of humanness is important in the context of neuroaesthetics, because it is impossible to accurately align being with the reductionist system that neuroaesthetics currently deploys. As long as we are unable to reduce being to a single state, art as a dynamic act of being cannot be accurately described by neuroaesthetics alone. This argues that neuroaesthetics must mature, from its current ideological construction of reductionist methodologies, to including the situational conditions of the subject as a social being. The subject must be seen as *part of* events, just as mirror neurons are *part of* empathetic behavior (but are not its cause or *raison d'être*). There are many factors that bring a human to action and not all of them are part of a neatly interlocking system of human intentionality. Some are choices made by chance or impulse—gestures of unwitting whim. Some move towards the subject from the surrounding world. Some are even mistakes that turn out to change destiny. Perhaps the most important aspect of the contemporary moment is that being can be flawed, or missing ontological markers altogether, and still manage to render a sense of reality. Interactive art capitalizes on this because it is less about realizing an aesthetic form than about the unusual situations that emerge from process.

Process therefore becomes the critiqueable subject that does not stand still. An open system of this nature may never be accurately understood through a reductionist analysis, because nothing critical comes of distilling the essential elements of a material form, especially one that brings attention to its own emergent properties. Rather, it is the accumulation of events that brings all of the parts together in an additive and *functionally negotiated* process. This is why the

kismet that controls what happens in the future cannot be accurately predicted. Actions are therefore the consequences of the potential of possibilities; and the language of interactive art helps place us as participating beings in the world.

Being as a question of grounding the self in the world has long been an issue of philosophy. This question goes to the heart of Heidegger's existential analysis of a phenomenological description of *Dasein*. From this ontological position, what do we make of the transitional posthuman being? Heidegger perceives cybernetics as an end, and whatever comes after is a new subject of philosophical inquiry. Heidegger further argues that cybernetics replaces philosophy—that there are no ethical questions left when cybernetics becomes integrated with being.¹⁶² If the ethics evaporate through cybernetics, Heidegger argues, we are left only with a technical rendering of the world. Heidegger anticipated a tremendous change to humanity with the advent of modern science. In his 1969 essay “The End of Philosophy,” he writes that, “No prophecy is necessary to recognize that the sciences now establishing themselves will soon be determined and steered by the new fundamental science which is called cybernetics.”¹⁶³ Heidegger agrees that technology and humanness can come together. It is the outcome that he concerns himself with. He continues by claiming that “in the Cybernetically represented world, the difference between automatic machines and living things disappears. . . . [T]he cybernetic world project, the victory of method over science, makes possible a completely uniform and in this sense universal calculability, in other words the controllability of the lifeless and the living world. In this uniformity of the cybernetic world, man too

gets installed.”^{164, 165} In his view, technology stalls the ability for the human to move freely in the world with the same force of will. Although Heidegger’s critique of cybernetics produces a termination, it is also clear that some kind of being prevails. It is at this juncture where human and posthuman collide—an ending that terminates and a beginning that opens new possibilities. In this way cybernetics, and the fundamental challenges it brings into being, start the world anew. The question then becomes, can the new being who rises from this termination ever find a new method to create a new poetry?

Heidegger describes the state of being grounded as *presencing*—a blend of the words “presence” and “sensing.” Heidegger’s presencing is never in a stable state, but rather always in a transformative state. This is important, because Heidegger sees technology as a unique (perhaps historically intermediary) ungrounding of the human. This is a very different kind of state than presencing: Heidegger goes so far as to suggest that technoscience retools philosophy into superficial theory as it attempts to work in a technological world. Bret Davis argues that the problem of will has long been central to Heidegger’s later thought, and that in the context of will, cybernetics is an imitation of being.¹⁶⁶ Heidegger does not see presencing in technology—presence and sensing are attributes of his historical understanding of humanness. Cybernetic function is thus denied any ontological meaning.

With what Heidegger claims to be a loss of self-reflection, the Cybernetic represents the loss of the modern epoch, or what he calls the “will to will.” Heidegger argues that due to technology, the will to will requires that human and

non-human nature be reduced to the function of “standing-reserve,” or a taking *from* humanness. “The enhancement of power,” he further explains, “is at the same time in itself the preservation of power.”¹⁶⁷ Using his fundamental treatise on being and his deep concerns about technology, Heidegger suggests that Cybernetics becomes more powerful than the human can sustain. For Heidegger’s biological subject, a special kind of rupture between human and technology remains in reserve, making it unavailable to human access.

Heidegger may be correct about technology’s interaction with the human subject, but only to a degree. Technology is an extension of the human ideal and, therefore, too easily disconnected from the unconditional uniformity of biological humankind. Another way to consider the human cyborg, however, is to proceed with the understanding that there is no axiological value to any human-made form, without the intervention of the human. Power, as deployed by Heidegger, is the struggle to retain rather than negotiate.

Heidegger could not have imagined a situation in which the technological form extended the human condition in the way a contemporary cyborg does, a form so distant from our carbon-based being. But the Heideggerian “history of being” is a history of being’s oblivion as the subject’s state of unknowing. This is precisely what our investigation into technology deploys. Heidegger’s end therefore can be re-interpreted as an inability to move humankind forward. McLuhan would argue that as media, human-made forms are extensions of our selves. And, in the case of the cyborg, the subject reclaims presencing of being through robotic extensions. In this way, the human remains in all technology

because technology would have no meaning without it. No matter how complex the technological system, the human subject *delivers back to itself* in the act of introspection for the subject. Working with technology is not a move away from, but rather an oscillating return to, humanness. This return is also within the work of interactive art: it is the ability of the subject to identify with the object. The delivering back of these aesthetic qualities to the subject is essentially what we look for in our aesthetic experiences. The offloading of the historical being to the cyborg is, therefore, not the end of philosophy but a provisional reinvestment in the human. A fresh understanding of embodied aesthetics, therefore, is valuable in binding the posthuman to all of the life activities associated with the historical human.

According to Heidegger, the experience of what is present signifies the true, unmediated experience of “the things themselves.” If there is a single truth presented at the moment of the presence, however, it cannot last. In Heidegger’s view, we can see truth for a moment and then it slips away. So the things themselves must also always be changing. Heidegger’s approach towards ideals of human perfection creates an ontological stalemate because truth does not transform at the same pace that beings move in time. The reminder that experience is both temporal and full of slippages is another important feature of interactive art. The subject interacts with the object in embodied time but the object always stands separate in some way. The possibilities of a new critique lie in the to-and-fro of the autopoietic exchange between the two. This also signifies

a move from modernism to a new form of aesthetics that provides room for the collision of new methodologies of inquiry regarding the subject.

As an alternative to Heidegger, Haraway's cyborg is almost always ungrounded, not of this world or tethered to human history. Yet her cyborg speaks of the human condition. Haraway uses the transformation of the carbon-based life form as a kind of freedom from the patriarchal hold on the subject.

Each of these cyborgs extends the humanist project by providing the new subject a body that becomes more than the biological subject. So decentering is not a loss of subject, but rather a repositioning of the center that creates an oscillating relationship between things. For the neuroscientist, decentering may be the mechanisms by which the brain maintains its internal balance—processes that control whether a neuron relays information to other neurons or suppresses the transmission of information. For the interactive artist, the oscillation between participant and object goes to the heart of the aesthetic experience. In interactive art, it is this negotiation with technology, in which each looks to the other, that always returns us to ourselves. This dance between an organic subject and technology plays a fundamental role in how introspection works for the aesthetic subject, because it is contingent upon the subject's relationship to the interactive experience.

Being must transform as humanity evolves. What is being if being is disconnected from its own evolutionary and transmutable course? Here Heidegger's argument has become stuck; it works from an ontological form that frames a singular fundamental nature of reality. Heidegger's modernity sits

squarely on the ancient shoulders of Plato, who saw the world built upon a system of truths and untruths—art being part of the latter. And, because Plato's world of appearances stems from sensory falsehoods, the subject remains oddly out of step with the rest of the world. In this model, art is perceived as a travesty of falsehood. It is time for this misunderstanding of the subject and the experience of art to be re-evaluated. Experience is the subject's motivator and cannot be separated from the involvement of being. The world embraces the subject because the subject is the world. Being involves the emergent possibilities of subjects working together and is not a singular condition of a single entity. If presencing is an act of imperfection that forms the human condition, we certainly should embrace it as a critiqueable act of aesthetics.

Another critical problem that constrains being stems from the cogito. Western metaphysics continues to privilege the thinking part of cognition over the physical attributes of the subject. In most metaphysical thinking, cognition remains an act of thought rather than an act of embodiment. But acts of being involve both. And the embodied being, as an active agent of *change*, is an essential attribute of contemporary aesthetics. Contemporary art is no longer interested in the modernity of the single subject's experience. The century of self has been replaced by a situation that continually unfolds to embrace many subjects with divergent experiences. Furthermore, the subject is not passive. As an active participant, the subject uses her agency to elevate the aesthetic nature of the object. Aesthetics is created through seamless, endless moments of interaction. Aesthetic beings exist in a co-negotiated, ontological space. In addition, being is

always changing and emerging. There are both distinguishable choices and subtle or even untraceable attributes in play, so being as a participant in the aesthetic process must remain fluid and open to both accident and the unknowns of evolutionary surprise. Interactive art can describe an aesthetic domain around these accidents wherein participants can free themselves from the predictability and dread of Heidegger's technological mastery. Active presencing as the face of cybernetic introspection has become the new critique.

Naturalizing Aesthetic Beings

According to philosopher Alfonsina Scarinzi, "the project of naturalizing human consciousness/experience has made great technical strides, but has been hampered in many cases by its uncritical reliance on a dualistic 'Cartesian' paradigm."¹⁶⁸ Her assessment is accurate if we continue to look only to the reductionist methodologies of most neuroscience. As an alternative to this historical approach, a growing group of theorists such as Scarinzi are looking to the new domain of embodied aesthetics. This domain draws from a rich history of American pragmatists such as Dewey, James, and Peirce, and encompasses the work of philosophers such as Merleau-Ponty, Valera, Johnson and to some extent Damasio. Embodied aesthetics also pulls from enactive cognitive sciences, motion theory, literary studies, and art history and theory to produce a fresh look at aesthetics.¹⁶⁹ Embodied aesthetics is interdisciplinary at its root, not unlike the collision of cybernetics and art that occurred mid-century.

It is generally accepted that aesthetic experience requires work from the faculty of imagination. By naturalizing aesthetics and looking at the parts of the brain that are activated through acts of imagination, it is possible to excavate a single aspect of the experience. The totality of experience, however, is not a question of how perception might activate imagination, but rather of how aesthetics and imagination may be seen as essential functions of the total embodied experience. Cognitive scientist Ruth M. J. Byrne has proposed that “everyday imaginative thoughts about counterfactual alternatives to reality may be based on the same cognitive processes that rational thoughts are based on.”¹⁷⁰ So rather than allocating imagination a position away from perception and the shared world, naturalizing the experience suggests that imagination is indeed part of the world. Following the line of Byrne’s observation, it is very possible that science will find that the distinctions between the facts of science and the fantasies of imagination may not be as contradictory as once argued. Imagination and rational thought have both been identified as showing activity in the occipital, frontoparietal, posterior parietal, medial parietal (precuneus), and dorsolateral prefrontal regions of the brain¹⁷¹—two very different outcomes sharing the same brain space. Imagination and rational thinking are two outcomes that we may now begin to realize have overlapping potential. But perhaps more importantly, when we consider how experiences arise, we must also *always* consider the issues of context both in the body and in the world. Bringing imagination and rational thought closer together is another way in which the end of simulation takes hold, replacing the cogito.

Another characteristic of naturalizing aesthetics is the consideration of the social subject. The social subject calibrates an object from both an internal view and an external environmental experience. Interactive artworks offer participants these kinds of internal/external projections and signals within the context of the artist's frame, the process of embodied meaning-making. The artwork first, and perhaps foremost, helps identify the bodily physical structure as part of the aesthetic experience and appreciation. The subject is also essential to the work's expression of meaning. The aesthetic gesture is the coalescence of an experience rather than the mimetic potential of the object.

Aesthetic objects with which the subject interacts are considered, in Western aesthetics, to be mimetic. But the subject's experiences are not. If physical and mental activity are necessarily bundled together to process experience, then the subject's experience is the thing-in-itself. Because of the fundamentally active nature of experience, the subject undertakes experience in the here and now. Action and introspection work together to produce experience as quickly as the physical limitations of the body can process it. This is important to understanding aesthetics: if experience is not mimetic, then neither are the experiential components of aesthetics.

The Materiality of Perception

The relationship of cybernetics to systems theory and simulation models suggests that development of the field is heavily weighted towards mimetic and

symbolic structures. In 1948, however, Norbert Wiener defined cybernetics as “the scientific study of control and communication in the animal and the machine.”¹⁷² His original examination of human-machine interaction was grounded in the physical attributes of the tasks. Wiener was interested in the interactive aspects of the interrelationships of learning tasks, using pointers such as stimuli, oscillation, and feedback between living and mechanical systems. The organizational properties of both biological and mechanical systems are physically tethered to their material properties—this is an often-overlooked aspect of contemporary cybernetics. A seminal point that has emerged from Wiener’s work on cybernetics—and has been picked up by embodied theory—is the understanding that cognitive functioning must shift from predominantly disembodied and computational views of the subject to more embodied and situated views. Specifically, Wiener’s mathematical postulates have led to the realization that mental functions cannot be fully understood without reference to the physical body and the environment. Wiener would agree that while mentality can be abstracted, it is also a system made up of physical materials. This is the purposefulness in interactive art: aesthetics are inextricably tied to the embodied self in a way that other contemporary technological practices, such as virtual reality, are not.

Behavioral aesthetics exposes the materiality of ideas and helps describe what might arise in the exchange of the physical processes of the body. It is important to note that interactive art includes both biological materialism and posthuman developments as part of an evolutionary trend in aesthetics. As

cybernetic art began to take on the physical traits of human action, the need to describe the particular situations for aesthetics became apparent. The more recent post-biological claim that organic matter no longer has a singular hold on life is a profound moment for aesthetics, because the aesthetic object has claimed its own autonomy. Sight, touch, vision, smell, and taste are all sensations afforded to the cyborg. Baumgarten highlighted the importance of our senses in experience and Kant realized that the intellect must play a role in aesthetic judgment. Although neuroaesthetics is the neural basis for the contemplation and creation of a work of art, we can look back to Merleau-Ponty's ontological body-subject, where there is a mutual engagement in the ever-present world frame. It is the perception, identification, and interpretation of sensory information that enables an understanding of the environment. Without perception, action would be unguided. Without action, perception would serve no purpose.

The constructivist understanding, that matter and action work together, constitutes a conditionally open position for the subject. If all goes well in experience, perception and enaction combine to provide a rich environment where consciousness emerges and activity is the agent for invention. It is important, therefore, to move past the idea that the brain passively transmits impressions. We live in our environment—not only as observers, but also in how we act and use our understanding to create our world and our place in it.

Interactive art offers responsive environments that react to many things—most importantly to the subject. Autopoietic environments act unto themselves and represent a new kind of cybernetic subject. The object can also be the subject

and participate with its own sensory experiences. In Merleau-Ponty's account of visual perception, empiricism is bound within sensory experience. When autopoietic systems overlap or blend with one another, they create new typologies according to their behavioral characteristics. The idea of the subject, therefore, becomes far more ambiguous than in the past. The activity of aesthetic experiences becomes a discovery of how we lose ourselves and then find ourselves again.

Disruptive and Decentered Beings

Being is anything but a passive process. A sounding of Heidegger's cybernetic alarm is perhaps a pointer to a watershed in contemporary philosophical development—the un-grounding of the subject from all metaphysical underpinnings. The decentering of the subject is an outcome of this technological experiment, and interactive art performs an essential role for future agencies.

The next era of human evolution with cyborgs does not imply the end of humanity. Not only will biological, unmodified humans exist in the far future, they will always reserve the right to stay that way. Transhumans and posthumans are likely to exist (whether they are genetically modified, cybernetic, or digital) as part of a new diversity of subject. Through prosthetics, cyborgs are functioning and capable of substituting motor, sensory, or cognitive modalities. Near-future functional applications include neural enhancements, advanced cognitive features,

and extended physiological senses. The next-generation brain-to-computer interfaces will be used for assisting, augmenting, or repairing human cognitive or sensory-motor functions and will communicate thoughts and intentions to a cyborg for augmented functionality. Brain-to-brain interfaces that translate thoughts, sensations, or impulses into digital signals already exist in experimental states.

Alongside the work of the scientist and the researcher, the artist works to critique the human experience by constantly re-evaluating her position relative to herself and to others. The interactive artist challenges historical ideas of the body's particular regions and discrete boundaries, exposing these as far more malleable than previously thought. Interactive art can help express the complexity of the body through the performative, introspective, and energetic qualities of being with, and being of, the art.

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