Neurorhetorics: Cybernetics, Psychotropics, and the Materiality of Persuasion

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Abstract

This article maps notable moments in, and intersections between, mid-twentieth-century scientific investigations into cybernetics and psychotropics. In particular, it focuses on the two fields' recurring interests in identifying the role of rhetoric, or persuasion, in the various networks (biological, technological, cultural) that surrounded both their scientific investigations and the presentation of such research within their formal disciplines and to the public. The article begins and ends by considering might what be learned from this history in thinking through our possible analyses of, and responses to, the contemporary moment, one in which two phenomena that very much grew from these earlier scientific inquiries—psychopharmacology and human–machine networks—are becoming increasingly ubiquitous.

> "The cultural-technological standards do not represent Man and his Norm. They articulate and decompose bodies that are already dismembered."
>
> Friedrich Kittler[1]

> "Will the turning point not be elsewhere, in the place where the brain is 'subject,' where it becomes subject? It is the brain that thinks and not man—the latter being only a cerebral crystallization."
>
> Gilles Deleuze and Félix Guattari[2]

1. Friedrich A. Kittler, *Discourse Networks, 1800/1900*, trans. Michael Metteer, with Chris Cullens (Stanford, CA: Stanford University Press, 1990), p. 215.

2. Gilles Deleuze and Félix Guattari, *What Is Philosophy?*, trans. Hugh Tomlinson and Graham Burchell (New York: Columbia University Press, 1994), p. 210.

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In March 2002, twenty-one-year-old Wisconsin resident Shawn Woolley committed suicide.[3] What made Woolley's death the topic of both a potential civil suit and popular media attention was the combination of his psychiatric diagnosis—clinical depression—and his primary pastime—twelve-hours stints engaged in the popular online role-playing game EverQuest. Spending the majority of his waking life inhabiting a virtual body in a simulated realm, Woolley's mother argues, aggravated his depressive episodes and increased his withdrawal from "real" social interaction. While the distribution of agency and culpability of Woolley's mother's lawsuit is unsurprising —*your* videogame killed *my* son—subsequent considerations of his demise provoked more complex questions: Insofar as such prolonged immersion in the virtual realms of online gaming would alter Woolley's dopamine levels, was his "obsession" a form of self-medication that eventually failed?[4] Or, conversely, did Woolley's intense engagement with a simulated reality hasten the physiological acceleration of his condition?

It is the combination of these conflicting narratives of Woolley and his demise that form an exemplary tale for life in the age of cybernetics and psychopharmacology. Perhaps never really reducible to a single or static body or mind, contemporary human subjectivity has become inextricably marked by a mutating distribution of agency and cognition, a circulation of shifting networks gathering interior and exterior capacities. On the one hand, our location in a world gone informatic, our performance of and interaction with simulated selves, telepresence, and telecommunications inspire a certain technologically driven ecstasy, a feeling that Brian Rotman refers to as a "becoming beside oneself" through the creation of plural selves and various digital proxies.[5] To emend McLuhan's paradigmatic slogan, interactions with new media technologies have produced not so much an "extension of man," but a distribution of human subjectivity throughout the infosphere. On the other hand, however, the products of contemporary technoscience have introduced a corresponding "intension" of the self in relation to the

3. Woolley's death (and its subsequent controversy) was widely covered by the mass media; see, for instance, Stanley A. Miller, "Death of a Game Addict," *Milwaukee Journal Sentinel*, March 31, 2002, and Martha Irvine, "A Troubled Gaming Addict Takes His Life," Associated Press, May 25, 2002.

4. See M. J. Koepp et al., "Evidence for Striatal Dopamine Release During a Video Game," *Nature* 393 (1998): 266–268.

5. Brian Rotman, "Becoming Beside Oneself." 1999. http://www.wideopenwest.com/~brian_rotman/becoming.html.

body. At the same moment that the body appears to have become knowable or alterable through the operations of contemporary molecular biology, neuroscience, and bioinformatics, it has taken on a new "solidity" in both the sciences and humanities, as seen in the renewed interest in the impact of affective states and physiological process on our cognition and behavior.

Both conditions—the exteriorizing of subjectivity and the intension of the material body—mutually create not so much feelings of alienation or interpolation, but a certain sense of "internal alterity" produced by being at the center of various tangles of internal and external motivations, physiological and ideational forces. One establishes relations with its own variations as subjectivity seems to emerge as not so much inherently multiple, but distributed differently in accordance with specific times and spaces. In what follows, I map the scientific and social emergence of this network in the early days of research into cybernetics and psychotropics—the two disciplines that led the mid-century "rediscovery" of the human nervous system and its impact on identity and behavior. In particular, I am interested in the difficulties that participants in these two movements encountered in separate motivational forces among these various categories—physiological, social, technological—and how these difficulties might be useful in thinking through how these forces shape our subjectivity today: the intersections between the alteration of our physiological capacities and the more traditional forces of subjective persuasion associated with the domains of rhetoric.

The Great Anti-Depression

As an avatar of the rhetorical and ethical dilemmas of such alterations in human subjectivity, the Woolley case circulates between a traditional cause/consequence schema (one embodied, for instance, by previous court cases alleging the destructive forces of popular media on "vulnerable" youth) and this more complex and contemporary tangle of concerns over the relationship between experiential and neurochemical vectors that drives much recent work in both technoscience and critical theory. Undoubtedly, one of the most urgent sites for such considerations has been the bloodstreams of the large amount of individuals currently taking prescribed psychopharmaceuticals (around 20 million in America alone), a focus additionally aided in popular media by such best-selling books as the "depression memoirs" *Girl, Interrupted* (1993) and *Prozac Nation* (1994), and, perhaps most famously, by Peter Kramer's largely autobiographical account of treating patients in the age of psychopharmaceuticals, *Listening to Prozac* (1993).

The latter work contains perhaps our most nuanced account of the difficulties of practicing therapy in the time of psychopharmacology. Although *Listening to Prozac* became a lightning rod for allegations of neurological determinism at the time of its publication, Kramer is attentive to the complicated emergence of disorders through both experiential and neurological factors. Most notably, he endorses the "kindling theory" of affective disorder and neurological conditioning that is primarily associated with the work of Robert Post, one in which neural structures influencing affective experience are taken to develop different thresholds and limits based on subjective experience.[6] For instance, the repetition of traumatic experience "kindles" neural networks, leaving them more susceptible to recurrent bouts of depression. As Kramer notes, the kindling model compels us to recognize that the "scars" of personal trauma persist not only "in cognitive memory," but materialize quite physically in "changed anatomy and chemistry within the brain."[7] As feminist psychologist Elizabeth Wilson highlights, clinically tested theories such as the kindling model can help us understand how "rather than simply leading to depression, neurological matter itself may become weakened, neurasthenic, depressive"; in place of a clear cause/consequence conception of biology and experience, the structure of neural networks becomes both recursive and co-implicated.[8]

Although invested in the progressive possibilities of neurobiology for understanding such a complicated relationship between the experiential and the physiological, Kramer also has ears for the potentially harmful cultural impact of Prozac on both the popular conception

6. Paralleling the genealogy of many processes that will be discussed in this essay, as a model of neuroplasticity, kindling was first modeled by "direct" stimulation of the brain via electrodes implanted in mice (and applied to the study of epilepsy), then later became a crucial vector in both dopamine and serotonin research via experimentation with the ingestion of narcotics and then affective experiential phenomena. See G. V. Goddard et al., "A Permanent Change in Brain Functioning Resulting from Daily Electrical Simulation," *Experimental Neuroscience* 25 (1969): 295–330; Robert M. Post and Susan R. B. Weiss, "Psychomotor Stimulant vs. Local Anesthetic Effects of Cocaine: Role of Behavioral Sensitization and Kindling," in *Mechanisms of Cocaine Abuse and Toxicity*, ed. Doris Clouet et al. (Rockville, MD: National Institute on Drug Abuse, 1988), pp. 217–238; and Robert M. Post and Susan R. B. Weiss, "Sensitization and Kindling Phenomenon in Mood, Anxiety, and Obsessive-Compulsive Disorders: The Role of Serotonergic Mechanisms in Illness Progression," *Biological Psychiatry* 44 (1998): 193–206.

7. Peter D. Kramer, *Listening to Prozac* (New York: Penguin, 1993), p. 123. Subsequent parenthetical references are to this edition.

8. Elizabeth Wilson, *Psychosomatic: Feminism and the Neurological Body* (Durham, NC: Duke University Press, 2004), p. 29.

and clinical treatment of current affective disorders. In the case studies that he details, Kramer is continually forced to make hard interpretations of his patients' conditions based on verbal and affective dialogues. Symptoms that might have previously been easily traced to anxiety emanating from subjective circumstances—recent events in a patient's life, his/her general socialization, and so on—might now, in the wake of anti-depressants and their concomitant psychological and pharmacological theories, alternately be defined as consequences of brain chemistry or side effects of prescribed medications. The introduction of pharmaceuticals for the elimination or management of human depression produces a corresponding compression, if not conflation, of the socius and the cerebellum that itself tangles and untangles not only in the space of Kramer's office, but is distributed across contemporary culture: a Great Anti-Depression. As Kramer writes, Prozac's celebrity status is itself the effect of a "new biological materialism" (p. xiv), one augured not only through advances in pharmacology, but also through the development of bioinformatics and assorted cybernetic technologies: "During the American civil-rights struggle, for example, the proposition that biology is destiny became unthinkable. Today, in a society filled with the material fruits of the new biology—PET and CAT and MRI scanners, genetically engineered plants and animals, recombinant-DNA probes, and so forth—the proposition may seem incontrovertible" (p. xvi).

For many, the "incontrovertible" nature of this proposition is not only troubling, but Kramer's implied contrast between a communal political movement and the new biology is all too telling. Rhetorical theorist John Schilb pursues this dichotomy in his "Autobiography after Prozac," a mapping of how autobiographical works by users of anti-depressants have generated "new accounts of selfhood."[9] For Schilb, the biological materialism hailed by these compounds and assented to by the writers he surveys dislocates a more traditional historical materialism, a perspective that would foreground how "economic conditions and cultural circumstances," rather than neurons, "greatly and fundamentally affect human lives."[10]

Concomitantly, this sense of subjectivity privileges individual practices of medication rather than communal practices of social amelioration. Although Elizabeth Wurtzel might be right to refer to

9. John Schilb, "Autobiography after Prozac," in *Rhetorical Bodies*, ed. Jack Selzer and Sharon Crowley (Madison: University of Wisconsin Press), p. 203.

10. Ibid., p. 204.

the emergence of a "Prozac Nation," Schilb seems to suggest that we can expect no form of Prozac nationalism; a political consciousness dependent on the intersubjective experiences of the individual inside of various networks of power is displaced by an overwhelmingly subjective consciousness composed by neural networks. Such a shift, Schilb argues, not only obscures our political and ethical considerations of affective experience, but additionally threatens to overwrite the rhetorical ecologies impacting subjectivity with a neurological determinism. Primary forces of persuasion and motivation are seen to emerge from neurological chemistry, while our traditional access and possible resistance to such forces seem restricted to a meta-level of analysis, such as in Schilb's concern over how it is in the best interests of pharmaceutical manufacturers to persuade the general populace to accept such a neurologically entwined sense of self.

Although it may be tempting to read Schilb as merely nostalgic for a time when the relatively less complicated category of the ideological, rather than the biological, was taken to be the primary content provider for individual belief, I am interested in taking his concern with the challenges posed by neurobiology to our traditional conceptions of persuasion quite seriously here. However, though Schilb details a fairly clear opposition here—either subjectivity and connected affective processes are primarily an output of biological materialism *or* historical materialism, the result of physiological structure *or* social construction—I take it that the harder question, given the tangle of physiological, cultural, and technological forces that Kramer outlines above, is how to think about these ecologies appositionally, or as parallel processes. The following text focuses on the challenges and opportunities of "treating" neural capacities in two senses: as it is configured as a subject of inquiry, and how it might be altered through rhetorical practices. In other words, my attempt will be to assay the potential of what we might call a neurorhetoric, an investigation into the interaction between the force fields of persuasion and neurological matter.

Such a consideration might not be as heterodox as it initially seems; given the permanent plasticity of at least certain parts of the brain, it is perhaps fair to say that persuasive interactions may "change our minds" in more than a figurative sense. Below, I pursue this itinerary by focusing on the early genealogies of cybernetic and psychotropic inquiry, movements that were first called upon to account for the disjunctions and connections of neurological matter and subjective experience. I will argue that the rhetorical and ethical dilemmas developing in these sites not only prefigure the complexities of life when cybernetics and psychotropics have become ubiquitous, but might also be salutary in informing our possible ethical and rhetorical responses to this moment.

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Perhaps as an unavoidable act of replication, a significant amount of data has been encoded these last few decades that documents the ongoing "informatization" of human bodies, consciousnesses, and the networks that construct and connect them. By this term, I refer both to the semiotic quantification of all phenomena that has at various times been associated with the self, as well as attempts to replicate these models in nonbiological realms—two poles of a recursive process that, for instance, cash out in the human genome project's attempt to conceive of life as a program of sorts and the competing endeavors to literally "conceive life" manifested in the development of ever more complex systems of "autonomous" artificial intelligence.[11] Although taking the informatic impulse in seemingly opposite directions, the two converge in their mutual assumption that human consciousness (in the former through extension of the human body) might be quantified in an iterable program—digitized, such as in the innumerable 1s and 0s of binary code.

This suspicion that both life and self can be reduced and read as arithmetic process or code is in many ways both the hypothetical goal and baseline notion of the new biology Kramer refers to as the cultural catalyst for the mass usage of neuropharmaceuticals, and, for many, its "material fruits," of which Prozac numbers only one, do not fall far from the cybernetic tree. To give a few notable examples, cybernetics circulates in Haraway's early work as a vital precursor to the rhetorical transformation of a "natural object" into a "technical object with a knowable structure" that is present in ergonomics, bio-semiotics, and the sociobiology of communication systems; as worthy of a byline in Lily Kay's interrogatory *Who Wrote the Book of Life?*; and as the primary midwife for the virtual bodies of Katherine Hayles's *How We Became Posthuman*—artificial bodies that seduce the post-human gaze into privileging "informational pattern over material instantiation."[12]

11. For a detailed reading of this genealogy, see Richard Doyle, *On Beyond Living: Rhetorical Transformations of the Life Sciences* (Stanford, CA: Stanford University Press, 1997).

12. Donna J. Haraway, "The High Cost of Information in Post–World War II Evolutionary Biology: Ergonomics, Semiotics, and the Sociobiology of Communications Systems," *Philosophical Forum* 13:2/3 (1981–82): 245; Lily E. Kay, *Who Wrote the Book of Life?: A History of the Genetic Code* (Stanford, CA: Stanford University Press, 2000); N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999), p. 2.

While acknowledging the integral role cybernetic theorizing plays both in the creation of technologies and theories for conceiving of the body as information and in the subsequent transcription of this process in science studies, my interest here is in slowing down this genealogy to locate particular sites or cuts between these conceptual poles of human as sovereign subject and human as codescript. In other words, my focus will be in taking the *program* of cybernetics—both the overriding metaphor and *telos* of the movement's research and its subsequent material effects—and find the points where it turns from a noun into a verb.

Even cybernetics "founder" Norbert Wiener, who once famously hypothesized that a human might be converted into code and transmitted via telegraph at some point in the future, was preoccupied in his present with much smaller divisions of the body for more immediately pressing problems. For instance, while collaborating with Julian Bigelow on Project D.I.C. 5980—the wartime attempt to perfect anti-aircraft firing—Wiener assays the levels of sensory disassociation a pilot must deliberately cultivate to execute evasive maneuvers:

> [w]e realized that the "randomness" or irregularity of an airplane's path is introduced by the pilot; that in attempting to force his dynamic craft to execute a useful maneuver, such as a straight-line flight, or a 180 degree turn, the pilot behaves like a *servomechanism*, attempting to overcome the intrinsic lag due to the dynamics of his plane as a physical system, in response to a stimulus which increases in intensity with the degree to which he has failed to accomplish his task. A further factor of importance was that the pilot's kinaesthetic reaction to the motion of the plane is quite different from that which his other senses would normally lead him to expect, so that for precision flying, he must disassociate his kinaesthetic from his visual sense.[13]

Wiener here foregrounds the complex interactions taking part in a network comprised of explicitly material variables as well as the pilot's response to both changing physical factors and his own relative success or failure to achieve an established goal; what emerges from this system was an interdisciplinary endeavor into cataloging and manipulating the disassociations produced both consciously (as in the pilot's learned separation of his kinaesthetic and visual senses) and unconsciously (such as in later investigations into the process of vision itself) by organisms.

Of course, the originary dissociation required for the bundle of practices and theories that formulate cybernetic inquiry was perhaps

13. Reprinted in P. R. Masani, *Norbert Wiener* (Basel: Burhaüser, 1990), p. 189.

the hardest to manage: the problem of separating the discrete physical and mental processes being assayed from the subjective "I" of both the pilot being observed and the observer attempting to navigate the pilot's interactions in this network, a problem that required the creation of new conceptions of the biological and the mechanical as well as the individual and the environment. Such a process was conceptually violent, disjoining components of human physiology while disrupting common conceptions of the human organism and human subjectivity. Writing in a different context, Wiener would alibi such violence through reference to the development of anatomical science: "My excuse is that it is only through the knife of the anatomist that we have the science of anatomy, and that the knife of the anatomist is also an instrument which explores only by doing violence."[14] However, the "new anatomy" that emerged in the early days of cybernetics would distinguish human bodies, and through them, human subjectivities, not so much in accordance with their material components as through the differing capacities they could evince.

Concomitantly, such an anatomy of capacitation would not so much divide the whole of an organism as diagram the various ways it could be coupled or connected with itself and various organic and machinic agencies. Although the perspectival dilemma caused by assaying an ecology where human conception itself played a vital role would become a cornerstone of second-wave cybernetics, it initially required canny rhetorical moves in the early cybernetical works of Wiener, Bigelow, and Arturo Rosenblueth—persuasive strategies organized around the goal of convincing a resistant scientific community "that as objects of scientific inquiry, humans do not differ from machines."[15] Wiener would retrospectively describe this intersection of disciplinary perspectives, the beginnings of a decade-long investigation of associations between the machinic and the affective in viral terms, claiming that in its wake, the vocabulary of engineers "soon became contaminated with the terms of the neuro-

14. Norbert Wiener, *God & Golem, Inc.: A Comment on Certain Points Where Cybernetics Impinges on Religion* (Cambridge, MA: MIT Press, 1965), p. 9.

15. Arturo Rosenblueth and Norbert Wiener, "Purposeful and Non-Purposeful Behavior," *Philosophy of Science* 17:4 (1950): 326. On second-order cybernetics, see Heinz von Foerster, "Cybernetics of Cybernetics," in *Communication and Control in Society*, ed. Klaus Krippendorff (New York: Gordon & Breach, 1979), pp. 5–8; and "Ethics and Second-Order Cybernetics," in *Understanding Understanding: Essays on Cybernetics and Cognition* (New York: Springer, 2003), pp. 287–304. For Wiener's early interest in the problems of perspective in scientific epistemology, see his "The Role of the Observer," *Philosophy of Science* 10:1 (1943): 18–24.

physiologist and the psychologist."[16] Such a contagion, of course, would eventually flow in the opposite direction. As concepts unhinged from the life and human sciences were hybridized with the traditional vectors of engineering, the interdisciplinary control science of cybernetics would equally hail the application of these vectors to organic bodies and minds. In such a shift, processes of human cognition and subjectivity were not so much reductively transcribed into mechanical systems, but were multiplied and distributed across different regimes of representation and materiality.

Perhaps most notably, the same year that Wiener, Bigelow, and Rosenblueth began making their public case for their ideas about the affinities between the mechanical and the biological through the conceptual tool of the network, Warren McCulloch and Walter Pitts were making far deeper cuts in structures of mind and body and crafting a system that would explain how ideas themselves might be distributed in network fashion.[17] McCulloch/Pitts's "A Logical Calculus of the Ideas Immanent in Nervous Activity," which would be later recognized as a watershed event in the genealogies of neurophysiology and the emerging science of artificial intelligence, translated the "all or none" law of nervous activity—their status as either firing or not firing—into a two-valued propositional logic. In their schema, consciousness and intelligence emerged from the accumulated activities of neurons stimulating and responding to one another as part of a vastly interconnected network. Although the sequence of actions required inside the activity of a human brain to produce a recognizable activity of consciousness—what McCulloch/Pitts code "ideas" in their title—could not be feasibly mapped onto a physical model, the individual steps in this process could be schematically diagrammed in relation to a neuron's response or failure to respond to a connected neuron.

It is at this point, or this node in the network, that we find one of the first technoscientific stagings of the complex relationship between neurological matter and experiential phenomena so unavoidable in the age of antidepressants: the creation of a conceptual technology for this process that is at once thoroughly systematic and imminently recursive. Mapping neuronal activity required a double act of translation: first, a proposition that held some recognizable "meaning" was converted into symbolic logic, then this two-valued

16. Norbert Wiener, *Cybernetics; or Control and Communication in the Animal and the Machine*, 2nd ed. (Cambridge, MA: MIT Press, 2000), p. 15.

17. Arturo Rosenblueth et al., "Behavior, Purpose and Teleology," *Philosophy of Science* 10:1 (1943): 18–24.

structure was itself mapped onto a diagrammatic model of neuronal relationship and activity. In this sense, the diagram could be read sequentially, with the interaction of each neuron holding a representational value similar to a cinematic frame. Crucial to this process was a precise understanding of the temporal and spatial dimensions of neuronal activity:

> Between the arrival of impulses upon a neuron and its own propagated impulse there is a synaptic delay of more than half a millisecond. During the first part of the nervous impulse the neuron is absolutely refractory to any stimulation. Thereafter its excitability returns rapidly, in some cases reaching a value above normal from which it sinks again to a subnormal value, whence it returns slowly to normal. Frequent activity augments this subnormality. Such specificity as is possessed by nervous impulses depends solely upon their time and place and not on any other specificity of nervous energies.[18]

This temporal dimensions and variability of neuronal activity emphasized by McCulloch/Pitts generated an incomplete calculus, one that could map neuron activity from a starting point of neuron interaction to a stipulated end, but could be only indefinitely reverse-engineered to speculate on what activity preceded this point. Despite these shortcomings, the value of the McCulloch/Pitts theorem as an iterative technology, a shorthand for transcribing an already determined or hypothetical sequence of neuron activity, was shortly canonized as a groundbreaking achievement for endeavors to understand nervous systems. Among its early admirers was polymath and automata researcher John von Neumann, who argued that McCulloch/Pitts's work contradicted claims that the activities of the human nervous system are so complicated that they could not be performed by "ordinary mechanisms," and proved "that anything that can be exhaustively and unambiguously described, anything that can be completely and unambiguously put into words, is ipso facto realizable by a suitable finite neural network."[19]

Von Neumann's focus on both the ingenuity of the calculus's formula and its process of translation and transposition highlights the rhetorical nature of this early manifestation of neural networks, one that I will try to parse into two levels below. First, there is the argu-

18. Warren S. McCulloch and Walter H. Pitts, "A Logical Calculus of the Ideas Immanent in Nervous Activity," in *Embodiments of Mind*, ed. Warren S. McCulloch (Cambridge, MA: MIT Press, 1965), p. 21.

19. John von Neumann, "The General and Logical Theory of Automata," in *Cerebral Mechanisms in Behavior: The Hixon Symposium*, ed. Lloyd A. Jeffress (New York: Wiley, 1951), p. 23.

mentative structure used in its introduction to scientific audiences. The caveat emphasized by von Neumann—the necessity of first putting neuronal activities "into words" before running it through the calculus—was integral to the theorem's elegance and provided the starting point for a feedback loop that would compose the rhetorical structure used by McCulloch/Pitts in forwarding their theorem. Mathematician and theoretical biologist Jack Cowan retrospects on the late neurophysiologist Donald McKay's characterization of the rhetorical ecology of these debates as not only a trying of the theorem, but a larger challenging of the limits of description:

> [I]f you are arguing with someone about what a machine can or cannot do, and you can specify exactly what it is the machine cannot do, then their theorem guarantees that there exists at least one machine that can do exactly what you say it cannot do. If you can specify in enough detail what it is that you say a machine can't do, you've produced a solution. So the real question is, "Is everything out there describable?"[20]

To use a term coined by von Neumann himself, the theorem invited a zero-sum game: either you can describe a process to another individual (in which case it is translatable into a neural net), or you cannot describe it, in which case it can exist only immanently, unrealizable by both your neurons and McCulloch/Pitts's figural simulations.

In this sense, the malleability of this iteration of the theorem as a technoscientific theory mirrored its argument for the adaptability of neuronal structures. As detailed above, the two key issues comprising the reach of McCulloch/Pitts's calculus, the stipulations that make it a fundamentally iterative technology, were respective of space and time factors. Spatially, the facilitation and extinction of a neuron's responsiveness were dependent on the activity of neurons surrounding it and their effects on the neuron under consideration; temporally, in a prototypical anticipation of the kindling phenomenon of neuron activity that forms an integral part of contemporary understandings of affective disorders, McCulloch and Pitts recognize the malleability of neural nets' capacity for response based on their previous exposure to stimuli: "activities concurrent at some previous time have altered the net permanently, so that a stimulus which would previously have been inadequate is now adequate."[21] Far from a trivial matter, this neuroplasticity was the key to the brain's very capacity for difference, its ability to "learn"—a term used by McCulloch/Pitts to denote changes in neuronal activity that sur-

20. James A. Anderson and Edward Rosenfeld, eds., *Talking Nets: An Oral History of Neural Networks* (Cambridge, MA: MIT Press, 1990), p. 125.

vived sleep, coma, convulsion, and so on, and later expanded by D. O. Hebb in reference to the somatics and psychosomatics of emotional disturbances—a process of alteration that subsequently provided the richest resource for researchers attempting to themselves learn how this process functioned and could be affected.[22]

At the same time, however, the calculus was productive of another rhetorical doubling, one involving a feedback loop between individuals and their relationships to their own neural structure. Undoubtedly, the most notable upshot of the textual simulation of the calculus was its ability to be reproduced in mechanisms more "material" than mathematics, the promise of using such structures as a core component in creating complexes of artificial intelligence and artificial life that would reproduce elements of the self in future technologies. At the same time, however, this very anticipation, as well as the conception of neural structures as malleable systems, solicited new manifestations of what Foucault termed "technologies of the self"—ethical and rhetorical operations in which one attempts to establish a relationship with his/her own subjectivity. As a technology of the self, the challenge of conceiving of one's own subjectivity as a distributed process created by the neural net of early cybernetic theory in many ways presages our contemporary interaction with cybernetic systems, one in which agency and subjectivity emerge as not only internally distributed in the brain, but externally dispersed through various cultural and technoscientific networks. As Foucault writes, technologies of the self, largely discursive and reflective, are both descriptive—one attempts to narrate or capture his/her self at a particular moment—and transformative, the practitioner attempting to "perform operations on their own bodies and souls, thoughts, conduct, and way of being, so as to transform themselves."[23]

Although this vector of description and capture would be outsourced to both textual translations and machinic realms, I attempt to index the other vector of transformation below. More specifically, though neural nets are enjoying a "new life" in contemporary neo-connectionist research into artificial cognition, I explore a different trajectory of its import, one in which neurons are multiplied once

21. Ibid., pp. 21–22.

22. D. O. Hebb, *The Organization of Behavior: A Neuropsychological Theory* (New York: Wiley, 1949), pp. 235–274.

23. Michel Foucault, "Technologies of the Self," in *Ethics, Subjectivity, and Truth: The Essential Works of Michel Foucault, 1954–1984*, vol. 1., ed. Paul Rabinow, trans. Robert Hurley (New York: New Press, 1997), p. 225.

again in the discovery of the "second nervous system" of neurochemicals. More than a simple addition, further attempts to follow consciousness now distributed not only through the connections of neurons, but also through the fluid movements of chemicals, would prove salutary for the production of other hybrids; established vectors of cybernetic theory joined with the new technoscientific practices required by experiments with psychotropics culminated, in at least the minds of many researchers, in the investigation of ecologies that combined both.

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And yet perhaps on several conceptual planes, as well as in their shared trafficking of the human nervous system, the mid-century interdisciplinary endeavor of cybernetics was already enmeshed with the centuries-old genealogy of psychedelic inquiry. The worldview of the former and the experience of the latter both tended toward the conclusion of a radical connectivity between organisms and environment, and the synaesthesia that remains a hallmark of psychedelic experience would be intensified to transhuman levels in cybernetic theories and technologies. Psychedelic experience would also serve as a crucial assaying device both directly, as in Heinrich Klüver's and Jack Cowan's attempts to study the biology of brain systems through the contents of psychetropically triggered visual hallucinations, and indirectly, such as in the sequence articulated in the following anecdote Warren McCulloch was apparently fond of spreading, retold here by his former student Michael Arbib:[24]

> The big thing that Warren McCulloch was worried about at that time was reliability: how is it that neural networks can still function although we know there are lots of perturbations? His favorite story on this line was a midnight call from John von Neumann from Princeton saying, "Warren, I've drunk a whole bottle of absinthe, and I know the thresholds of all my neurons are shot to hell. How is it I can still think?" That was the motivating problem.[25]

Despite the locker-room-at-MIT undercurrent of McCulloch's tale, it foregrounds both the intrinsic difficulty haunting all attempts at making a "conscious" study of consciousness, and the related prob-

24. Heinrich Klüver, "Mechanisms of Hallucinations," *Psychedelic Review* 7 (1965): 41–69; G. B. Ermentrout and J. D. Cowan, "A Mathematical Theory of Visual Hallucination Patterns," *Biological Cybernetics* 34 (1979): 137–150. Cowan has recently returned to this research; see Paul C. Bressloff et al., "Geometric Visual Hallucinations, Euclidean Symmetry, and the Functional Architecture of Striate Cortex," *Philosophical Transactions of the Royal Society* 356 (2001): 299–330.

25. Anderson and Rosenfeld, *Talking Nets* (above, n. 20), p. 216.

lem of an accounting-self measuring its own altered mental activity against a previous state: "How is it *I* can *still* think?"

Of course, this problematic is deeply inscribed in the segment of neuroscientific investigations that pursued chemical in addition to mechanical adjuncts, finding perhaps its most present and most popular manifestation in the every-increasing bandwidth hosting online trip reports, but its most historically important occurrence being in Albert Hofmann's accidental ingestion of LSD and subsequent attempts to assay its effects through self-experimentation. In the first line of his autobiographical account of these events, *LSD: My Problem Child*, Hofmann warns readers that attributions of the discovery of LSD to this accident are "only partly true": "LSD came into being within a systematic research program, and the 'accident' did not occur until much later: when LSD was already five years old, I happened to experience its unforeseeable effects in my own body—or rather, in my own mind."[26] At this fixed point, the beginning of his narrative, Hofmann immediately thematizes several of what would become canonical *topoi* of psychotropic research: an inability to predict the effects of the psychotropic compound ahead of time; the necessity of experiencing these results firsthand; and a difficulty in distinguishing between "body" and "mind"—two categories with an already contentious definitional history that would once again be troubled and reframed by successive technoscientific investigations into psychotropics and neurochemistry.

All of these factors help explain Hofmann's rather remarkable course of action after experiencing "unusual sensations" while purifying LSD in the laboratory: "If LSD-25 had indeed been the cause of this bizarre experience, then it must be a substance of extraordinary potency. There seemed to be only one way of getting to the bottom of this. I decided on self-experiment."[27] As Richard Doyle highlights, such an action is hard to imagine, let alone endure; if in a traditional experiment, one body manages and records the effects on another, how can someone "decide" to carry out a scientific experiment with a psychotropic substance? Perhaps more pragmatically, how can they hope to adequately record and measure cogent results? As a "self-experiment" immediately troubles our traditional common notions of the terms on both sides of the dash, it would seem to require a new system of evaluation to gauge its results. In

26. Albert Hofmann, *LSD: My Problem Child—Reflections on Sacred Drugs, Mysticism, and Science* (New York: Putnam's, 1983) (available online at http://www.druglibrary.org/schaffer/lsd/child1.htm).

27. Ibid.

the frame of this rather unique orientation, Doyle parses the self-experiment as "both failure and success":

> As an experiment *with* the self, the outcome is close to null. No meaningful report can be generated, and therefore the knowledge of the hallucinogenic experience can in no way be gathered or repeated. As an assay, the self is found wanting. . . . As an experiment *on* the self, the ingestion of LSD-25 was indeed a resounding success: the experimental object was unmistakably transformed, alteration extending even to the agency of Hofmann himself.[28]

Indeed, Hofmann would later record that the disassociation required to attain an "outside" perspective on his self-experiment could occur only as a hallucination that was itself generated by the compound: "At times I believed myself to be outside my body, and then perceived clearly, as an outside observer, the complete tragedy of my situation."[29]

More than simply a symptom of psychotropic experience, the visual hallucination would also prove to be a mobilizing point for technoscientific investigations into the neurological mind. Configured by many as a proto-typical EEG device, a way of imagining the brain's activities through a visual representation, psychotropic hallucination persists, as in the research of Jack Cowan mentioned above, as a unique avenue for tracing neural-net behavior even after the development of such imaging technologies. As in many ways a synecdoche for the problematics of self-experimentation itself, hallucinatory experience would also again introduce the importance of indexing space and time in subjectivity: the nonspace of the immaterial hallucination in consensus reality, its operation through the physically distributed activity of neurons and neurochemicals, and the momentary and mutable nature of the vision itself.

For psychiatrist Roland Fischer, the spatiotemporal complexities of hallucinations were responsible for its moribund clinical designation as "perceptions without an object," one being challenged by recent technoscientific technologies of quantum physics (physical measurements dependent on cloud and bubble chambers or nuclear emulsions were similarly captured by this definition). Fischer's proposed operational definition for hallucinations—the inability of a hallucinating subject to verify in three-dimensional space the phenomena experienced in the conceptual or sensory dimension—

28. Richard Doyle, "LSDNA: Rhetoric, Consciousness Expansion, and the Emergence of Biotechnology," *Philosophy and Rhetoric* 35:2 (2002): 163.

29. Hofmann, *LSD* (above, n. 26).

would also require a new logic of simulation to calculate hallucinating subjects themselves into the equation:

> Dreams and hallucinations are intentionally structured experiences which follow their symbolic, multivalued logic and not the two-valued Aristotlean true-false logic of physical or survival space-time. The two-valued, object-subject logic prevents us from differentiating between the image of an object and the object itself. For example, when a subject looks into a mirror, he sees himself as another object. However, lifting up a second mirror enables him to see himself as a subject looking into another mirror in which he sees himself as an object. Multivalued logic is like holding up a series of mirrors to our own subjective self-reflecting nature.[30]

For Fischer, the binary logic that served as an epistemic vector for Aristotle, and, as detailed above, a neurological vector for McCulloch and Pitts, could not adequately capture the persuasive import of these activities on the brain of the subject. A crucial qualification of value was missing, one that also entailed an equally necessary multiplication of the subject's cooperation: "Within the logic of such mirrors, hallucination and dream experiences may not only be 'true' or 'false' but also 'as-if true' and 'as-if false,' while the subject is playing an actor's role and is, at the same time, a captive audience of his own drama."[31]

Whereas McCulloch in particular struggled with the problem of using "true" and "false" values within a system to which they did not adequately cohere—notably mentioning that one must act *as if* the "myth" of causality existed in a situation where it did not legitimately seem to apply—and laid an equal stress on the problems of categorizing experiences that diverged from consensus reality, these aporias would return in many ways as important assays for psychotropic investigations into the nature of neuronal activity and the mind. For Fischer, hallucinations serve as learning experiences for more than just technoscientific inquiry; for one, hallucinations also posed a challenge to their subject's interpretive abilities: "One could interpret these levels of 'reality' as attempts at problem solving, that is, establishing a (mental) steady state with the highest sensory to motor ratio denoting the complete inability of the individual to map his ideational (mental) structures into physical structures."[32] Such expe-

30. Roland Fischer, "The Perception-Hallucination Continuum (a Re-Examination)," *Diseases of the Nervous System* 30:3 (1969): 166.

31. Ibid.

32. Ibid., p. 169.

riences were neither insignificant nor fleeting; rather, they marked, as in early cybernetic research into neural properties and subjective experience, how neural capacities were not only a complex structure, but are themselves open to *being structured* through experimentation, and, in particular, the ability of the brain to respond to simulations. Turning to the language of programming, Fischer's assays the possibility that their effects might become elements of the individual's very proprioceptive practices and neural systems: "It could be hypothesized that during both hallucination and dreaming—in the cerebral (mental) dimension—the subject's interaction with the change he is experiencing may become part of his program."[33]

This concern over the capacity of hallucinations and neurological alteration to structure the "program" of an individual would be salutary in foregrounding the ethical dimensions of neurology and psychotropics—both the normative aspects of interacting with substances that might change neurology, and the role of neurological thresholds and responses as in our pre-modern understanding of "ethics" as involving an individual's "ethos," or fashioning of subjectivity. Retrospecting on his research about a half-century after his first engagement with LSD, Hofmann would clarify that as a vector for the production of scientific knowledge, self-experimentation was an essentially ethical endeavor: "it was simply unethical to think that someone else should be first."[34] The lessons learned from such an engagement would subsequently manifest themselves as an "ethics" in at least two registers in addition to Hofmann's admirable concern for protecting others from the potential danger of an "untested" compound, both of which in many ways themselves feed forward from Hofmann's initial emphasis on care and concern. For Timothy Leary, the ethical intensities of early investigations into LSD under the auspices of both university and government agencies have been obscured by the resulting media frenzy over both the compound's pharmacological and legal status:

> Rarely in the short history of psychology was such elegant, complex, socially influential research conducted! At the same time that the CIA was furtively dosing unwitting Harvard students for purposes of control and destruction, we were operating with the books wide open. No secrets, careful record-keeping, pre-post testing. Triple-blind designs, total collaboration, the intensive training of "guides."[35]

33. Ibid., p. 166.

34. Lawrence K. Altman, *Who Goes First?: The Story of Self-Experimentation in Medicine* (Berkeley: University of California Press, 1998), p. 209.

35. Timothy Leary, *Change Your Brian* (Berkeley, CA: Ronin, 2000), p. 5.

On the one hand, such a differential highlighted what Leary writes of as one of the first questions facing his team or researchers: "Who gets to go?" The availability of a new compound that altered brain chemistry brought with it ethical questions over who would have access to it and under what terms, questions that for Leary and many others became a political project centered around an individual's right to alter his/her brain. The Harvard researchers' concern with structuring psychotropic experiments to ensure both safety and validity would also produce another "ethics": a set of practices designed at first to structure experiments in the laboratory, expanded into guides stipulating productive "set and settings" for the uses of independent psychonauts, and later transformed by experimental psychiatrist and animal researcher John Lilly into a neurologically based program involving rhetorical practices of self-persuasion that were informed by, but not dependent on, the use of psychotropic compounds.[36] This latter endeavor—itself staging yet another encounter among cybernetic theorizing, the emphasis on programming exhibited by Fischer, and neurochemistry—would in many ways both prefigure and attempt to structure the problematic subjects of the contemporary psychopharmacological age.

+1. Under the Influence

> "If a committee of my scientific peers at the National Institutes of Health awards me a large grant, I experience a rush of self-esteem—the reviewers might just as well have administered an infusion of cocaine."
>
> Soloman H. Snyder[37]

As I tried to highlight briefly above, the itineraries of cybernetic and psychedelic research continually intersected one another, chiefly in their mutual interest in practices of "intersection" themselves as they occur in networks of the subjective and the material, or the cultural and the biological: the physical networking of humans and machines and the effects produced in neural networks through combinations of ideational and affective processes. Leary's career, in addition to its half-century span and its manifestation in various different registers of scientific, cultural, and popular areas of knowledge production, is particularly instructive on this point insofar as it foregrounds how these itineraries functioned in a symbiotic relationship. In recounting his own initial attraction to psychedelic research,

36. See, for instance, Leary's *Psychedelic Prayers and Other Meditations* (Berkeley, CA: Ronin, 2000).

37. Soloman H. Snyder, *Brainstorming: The Science and Politics of Opiate Research* (Cambridge, MA: Harvard University Press, 1989), p. 18.

Leary emphasizes both the importance of a cybernetic understanding of the human organism in motivating psychotropic research, and the need for a "new, empirical, tangible cybernetic" to study and manage the impact of studies into psychotropics.[38] In his later writings on contemporary information and media technologies, Leary would write of their joint contribution to understanding human neural activity while marking the different trajectories exhibited by their manifestations: "The convergence of these waves of information, the inner psychedelic and the ScreenLand cybernetic, made it possible for the first time for human beings to understand how the brain operates."[39] As detailed above, functioning in a relationship more appositional than oppositional, the "inner" direction of the psychedelic—traced by experiential narratives and early attempts to image brain activity—and the "outer" direction of the cybernetic—emerging through such transparently material models as McCulloch/Pitts's theorems, prototypical automata, and early digital computers—maintained a dynamic relationship in technoscientific inquiry between simulations of brain activity and vectors for healing, transforming, or otherwise neurologically influencing human awareness, cognition, and behavior.

The attempt to bring these two logics together as pragmatic vectors of alteration rather than merely ontological models was perhaps most relentlessly explored by John Lilly, one of the few scientists to attend influential Macy Foundation conferences on both LSD and cybernetics. In *Programming and Metaprogramming in the Human Biocomputer*, originally written as a report for the National Institutes of Mental Health that had funded his previous five years of research, Lilly draws heavily on the cybernetic theories of McCulloch, Heinz von Foerster, Gregory Bateson, von Neumann, and Ross Ashby in conjunction with his own investigations in psychotropic research to render the human brain and the nervous system as a "bio-computer," as both structured and alterable like a computer program.[40]

38. Timothy Leary, with Robert Anton Wilson and George A. Koopman, *Neuropolitique* (Las Vegas: Falcon, 1988), p. 7.

39. Timothy Leary, *Chaos & Cyberculture*, ed. Michael Horowitz (Berkeley, CA: Ronin, 1994), p. 7.

40. Leary also would adapt the term bio-computer, exploring the idea of human self-transformation through the lessons of contemporary technoscience most explicitly in his *Info-Psychology: A Manual on the Use of the Nervous System According to the Instructions of the Manufacturers* (Las Vegas: Falcon, 1990). Lilly does stipulate, as did von Neumann, that the human brain and nervous system would be analogous to a parallel-processing computer, not yet invented at the time either was writing; see John C. Lilly, *Programming and Metaprogramming in the Human Biocomputer: Theory and Experiments*, 2nd ed.

In analyzing American psychologist and cyberneticist Silvan Tompkins's analogous interest in this simile—a conception they deem the "cybernetic fold"—Eve Kosofsky Sedgwick and Adam Frank highlight this hypothesis's dependency on a conception of the human brain as a "differenti*able* but not originally differentiated system," and its tendency to invoke a set of diagnostic categories that are extra-binary though finite (what they transcribe as *infinity>n>2*).[41] Lilly would draw on the latter formation by stipulating a schema of "additional" and "subtractional" states of consciousness, cataloged in relation to baseline consciousness as, for instance, a state of +1 or +2. The former vector—the capacity for differentiation—was configured by Lilly from an evolutionary perspective, finding its traces in the nervous activity of "lower" life forms and useful as a crucial assaying device for determining contemporary human neuroplasticity and for identifying which neural "programs" are open to alteration: "In the simpler basic forms, the programs were mostly built-in: from genetic codes to fully-formed organisms adultly reproducing, the patterns of function of action-reaction were determined by necessities of survival, of adaptation to slow environmental changes, of passing on the code to descendants."[42]

In an oft-repeated literary device in evolutionary narratives, Lilly's genealogy marks as a crucial point the moment when human brains developed the ability to undergo adaptations not immediately necessary for survival:

> Eventually, the cerebral cortex appeared as an expanding new high-level computer controlling the structurally lower levels of the nervous system, the lower built-in programs. For the first time learning and its faster adaptation to a rapidly changing environment began to appear. Further, as this new cortex expanded over several millions of years, a critical size of cortex was reached. At this new level of structure, a new capability emerged: learning to learn.[43]

Using the language of cybernetics, Lilly indexes these capabilities along axes of programs and programmabilities; systemic processes, environmentally influenced adaptations, and learned behaviors

(New York: Julian Press, 1968), pp. 126–127 (available online at http://www.city-net.com/~mbt/pamithb.html), and John von Neumann, *The Computer and the Brain*, 2nd ed. (New Haven, CT: Yale University Press, 2000), pp. 50–52.

41. Eve Kosofsky Sedgwick, with Adam Frank, "Shame in the Cybernetic Fold: Reading Silvan Tompkins," in Eve Kosofsky Sedgwick, *Touching Feeling: Affect, Pedagogy, Performativity* (Durham, NC: Duke University Press, 2003), p. 105.

42. Lilly, *Programming and Metaprogramming* (above, n. 40), p. viii.

43. Ibid., p. ix.

embodied in the nervous system are configured as smaller "programs" within the larger program of human selves, and "learning to learn"—this watershed moment in human evolution and the holy grail of automata research—is designated as a "metaprogram." As a sea change in human organisms and technoscientific understandings of the same, the emergence of metaprogramming was salutary for Lilly in invoking a moment of hesitation to consider the limits of neural transformation and the means through which it might be accomplished.

We ourselves might hesitate for yet another moment over the dynamics of this process and the relatively unique problematics it poses for technoscience, challenges that unfold both through complexes of self-referentiality and the similitude between organisms, as well as between organisms and machines. Lilly's diverse and divergent scientific career may have made him particularly hospitable to such comparisons, he having variously explored and contributed to, in addition to cybernetic and psychotropic research, the domains of developmental psychology, affective disorders, animal psychology, medical diagnostic technologies, zoosemiotics, and interspecies relations. As a whole, this itinerary is marked at several significant moments by a profound "feeling for the alien," an attempt to find communicative and transformative vectors for bridging gaps between difference without reducing them to the same. The logics of neurons, unfolding throughout organisms and being introduced into mechanical familiars, would in this sense emerge as both a robust system for interspecies analysis and a crucial conceptual device for producing new lines of scientific experimentation—a novel way of thinking about thinking, or itself an instance of "learning to learn."

We can locate the importance of both of these effects, to use an example particularly resonant to the genealogy under consideration here, in autobiographical accounts of Soloman Snyder and Candace Pert's work in neuroscience. Snyder and Pert are the American "co-discoverers" of the brain's opiate receptors, perhaps the most pivotal contemporary step toward the synthesis and mass distribution of anti-depressants.[44] For Pert, as for Lilly, one of the most potent and surprising results of acknowledging neurotransmission, particularly as experimented with across species and subcultures, was its func-

44. The "discovery" of these transmitters is complicated (and controversial) to the degree that it is hard to attribute it to the work of one country, let alone one laboratory; see Susan E. Cozzens, *Social Control and Multiple Discovery in Science: The Opiate Receptor Case* (New York: SUNY Press, 1989), pp. 65–83.

tion as a neurological equalizer: "it didn't matter if you were a lab rat, a First Lady, or a dope addict—everyone had the exact same mechanism in the brain for creating bliss and expanded consciousness."[45] Of course, this similitude was in important ways limited to the mechanism; the thresholds, proclivity, and experiences of individuals using compounds affecting opiate receptors would be structured by ecologies, hence the important function of "set and setting" played in both psychedelic manuals and studies of narcotic addiction.[46] As both Snyder and Pert note, ecological concerns would also play large in preparing individuals for the new knowledge that might be produced by this research. Snyder began his research at a time when, by his own account, a scientific interest in the biology of emotions was likely to be itself diagnosed as a symptom of neurosis:

> A psychiatric trainee who expressed a strong interest in basic biological research was regarded as somewhat peculiar, perhaps suffering from emotional conflicts that made him or her avoid confronting "real feelings." An interest in science was regarded almost as sick, some sort of stratagem to avoid psychoanalytic issues that *mattered* by fleeing to science.[47]

Snyder's situation is notable for two interconnected reasons: for one, it put him in the ostensibly impossible and oddly performative position of having to overcome allegations of personal psychological pathology in order to reinterpret the nature of psychological pathology itself; and second, the outcome of this new conception of the mind would require a reorienting not just of pathology, but of experiential and pharmacologically induced effects on the mind into a neurological spectrum of difference based on degree and not kind. Such a differential tends to find its way into language in a way that is more than metaphorical, such as Snyder's comparison—quoted in the epigraph above—between the experience of cocaine infusion and receiving a large grant for scientific research. Such a statement is both strikingly peculiar—particularly because a large amount of Snyder's research was funded by governmental initiatives to staunch the growing use of cocaine by Americans—and particularly appropriate given Snyder's contribution to neurological understandings of human experience and behavior.

45. Candace Pert, *Molecules of Emotion: Why You Feel the Way You Feel* (New York: Scribner's, 1997), p. 63.

46. Concerning the latter, see, for instance, Norman Zinberg, *Drug, Set, and Setting: The Basis for Controlled Intoxicant Use* (New Haven, CT: Yale University Press, 1984) (available online at http://www.druglibrary.org/schaffer/lsd/zinbergp.htm).

47. Snyder, *Brainstorming* (above, n. 37), p. 10.

For her part, Pert's accounting of the road toward her and Snyder's celebrated discovery emphasizes both an intimate understanding of neuroplasticity and the transformations one must perform upon him-/herself to detail this process in a technoscientific register. Commenting on her initial affective apprehension to the use of white mice in the transmitter experiments, Pert writes: "I knew I had to desensitize myself if I was to succeed, and so I began the gradual process of rewiring my nervous system a good week in advance of my first day on the opiate-receptor project. Each day I forced myself to stand a little closer to the door of the room where they did the killing."[48]

This uncanny replication, the tangled web of limits and capacities that would be both positioned as the essential processes of mind and asked to perform in attempts to understand and alter the mind, continues to remain the remainder of these inquiries, though it has perhaps reached a previously unforeseen level of intensity and urgency in the age where unprecedented amounts of individuals regularly used psychotropic substances, and the difference between the neurological effects of these substances and the substances of everyday life and culture became increasingly harder to determine. For Lilly, this problematic demanded a radical reconception of the knowledge production evinced by both a partially plastic neurological structure and human behavior around logics of belief and simulation. Such a procedure would itself require a peculiar doubling, taking the classical scientific vector of the thought experiment as both its subject and mechanism.

Starting from the hypothesis that there are ostensibly no boundaries to what an individual might believe, Lilly begins to parse the limits of this capacity and how these limits might themselves be altered when involving relationships with other individuals; for instance, he considers the symbiotic functioning of a group collaborating on problem-solving agenda, what Lilly codes a "network of bodies," where ideas and effects are distributed among and between whole minds much like the neural nets inside of physical brains. For both, physical limits effect and experiential factors affect the validation of beliefs, but only this latter process will enable a special category of knowledge production: "the bodies of the network housing the minds, the ground on which they rest, the planet's surface, impose definite limits. These limits are to be found experientially and experimentally, agreed upon by special minds, and communicated to the network. The results are called consensus science."[49] However,

48. Pert, *Molecules of Emotion* (above, n. 45), p. 52.

49. Lilly, *Programming and Metaprogramming* (above, n. 40), p. xiii.

assaying the mind is in many ways a unique category or problem for such a procedure; as Lilly states, "the province of the mind is the only area of science in which what one believes to be true either is true or becomes true within limits to be determined experimentally."[50] In other words, thinking is positioned not as a reflection to action or response to material circumstances, but as an action itself, one that can create its own material trace in neurological networks and, when in a cycle of repetition, alter the neurological thresholds and constructs of the brain to create different capacities to respond to phenomena in the future. For Lilly, this technoscientific singularity, the tendency for what is believed in the mind to become true to the mind, required a research agenda oriented around several salient questions:

> Given a single body and a single mind physically isolated and confined in a completely physically-controlled environment of true solitude, by our present sciences can we satisfactorily account for all inputs and all outputs to and from this mind—biocomputer (i.e., can we truly isolate and confine it?)? Given the properties of the software-mind of this biocomputer outlined above, is it probably that we can find, discover, or invent inputs-outputs not yet in our consensus science? Does this center of consciousness receive-transmit information by at present unknown modes of communication? Does this center of consciousness stay in the isolated confined biocomputer?[51]

Pace the "experimental epistemology" of second-order cybernetics, the experiments detailed in *Programming and Metaprogramming in the Human Biocomputer* explore these limits and potentials through the use of such vectors as LSD, hypnosis, and isolation tanks. In the confines or under the influence of these technologies, Lilly assays these capacities, empirically cataloging an individual's ability to think and behave in accordance with a stipulated belief, and what effects this endeavor produces on his/her current and subsequent behavior and sense of self. Crucial to this operation was a careful management of not only space (what we might use to code the physical environment of the laboratory and the isolation tank, as well as the material functioning of the nervous system) but of time as well: the experiments depended on the stipulation of a certain belief at the beginning of the process, one that would produce multiple and perhaps unforeseen effects in the future.

This engagement required for Lilly, as with Fischer, the use of a multivalued logic encompassing both "as if true" and "as if false" values, as well as the classical binarism. Although the use and study

50. Ibid., p. 57.

51. Ibid., p. xiii.

of psychotropics were important to Lilly's conception of and experimentation with both this multivalued logic and the manipulation of neuroplasticity through the indirect means of the thought experiment, these *topoi* were already integral to his earlier considerations of nervous functioning. From his experiments in developmental psychology, Lilly hypothesized the existence of "ways of so influencing the young vulnerable animal that one can cause the permanent lowering of the thresholds for starting and/or maintaining intense, continuing activities in either or both kinds of system," a practice of influence that could be achieved only by "indirect means."[52] Perhaps more importantly, Lilly's earliest lessons in self-persuasion and performativity apparently came from his father's own practice of the same: "My father was the head of a big banking system; he taught me something about passivity. He said, 'You must learn to be as if angry, and then you'll always be ahead of the guy who gets really angry.'"[53] Lilly's next work, *Simulations of God*—named after the articulation point for one of the largest investments of counter-intuitive belief—would similarly take up these "as-if" values and the simulative logics they described as rhetorical vectors for practices by the self on the self.

For Lilly, the simulations produced by cybernetic constructions of automata were by their nature and function productively joined to the simulations of his work on thought experiments: they both shared the same logic of differential replication, and were salutary for attempts to alter conceptions of self and subsequent behavior that would be impacted by this new thinking. Attempts to model the human mind in different media were at first the culmination or end of a pragmatic investigation into its nature:

> As we discover inside ourselves how we are built, so we can build outside ourselves how we are built, so we can build outside ourselves simulations of ourselves. (We say this is certain or determinate.) We then can produce, can create from the raw materials of the mother earth planet very peculiar forms—solid state, liquid state, gas state, gel state, and so forth, replications, models, simulations of ourselves, extensions of ourselves.[54]

52. John Lilly, "The Psychophysical Basis for Two Kinds of Instincts: Implications for Psychoanalytical Theory," *Journal of the American Psychoanalytic Association* 8 (1960): 71.

53. John Lilly, "From Here to Alternity and Beyond," in *Mavericks of the Mind: Conversations for the New Millennium*, ed. David Jay Brown and Rebecca McClen Novick (Freedom, CA: Crossing Press, 1993), p. 218 (available online at http://www.levity.com/mavericks/lilly2.htm).

54. John Lilly, *Simulations of God: The Science of Belief* (New York: Simon & Schuster, 1975), p. 24.

This ability to simulate, however, would itself possess a pedagogical power; its use as an assaying device for human belief structures, conceptions of similarity, and simulating abilities would provide for Lilly the basis of rhetorical practices that would enable both momentary and durable alterations in the human nervous system, its thresholds and capacities:

> The word "simulation" is, for the purposes of this book, similar if not identical to its use in computer programming. A simulation of an original of something, or a model of an original of something, is a set of concepts, ideas, programs interconnected in such a way as to generate for the thinker, the reader, the programmer, the programmee, a connected whole sufficiently resembling the original something so as to be confused with, equal to, identical with the original something.[55]

This human capacity for confusion that gives the simulation its power and its identity is also the capacity that makes processes of identification and practices of neural differentiation possible.[56] The thought experiments Lilly details require the active positioning of a belief "as if" it were true and the corresponding deliberation and behavior that such a value would necessitate in order to produce the "passive" affective (re)conditioning of human neurology. It is not that the belief will "come true" for either consensus science or consensus reality, nor even that it will become to be coded "true" by the subject undergoing the experiment; rather, the performing of the process hails a trying and training of neurological thresholds, an attempt at altering affective responses through the conscious repetition of these practices, rather than, or in addition to the ways—as with contemporary neurological kindling theory—plasticity and neural inhibition and excitation are influenced by singular traumatic events or the uncontrolled repetition of affective states.

55. Ibid., p. 36.

56. As Lilly makes explicit, this process was enabled by the conception of human subjectivity as a multiplicity: a distributed set of programs that compose the metaprogram of the individual. A metaprogrammer may alter the smaller programs that compose his/her subjectivity, but the metaprogram cannot act on itself as a whole. Lilly would later find an analog in contemporary considerations of the potential for self-reproducing automata, a thought experiment that finds its most popular affects in both the fear of an uncontrollable robot population or a world covered by the "grey goo" of rapidly reproducing nanobots, as well as the hope of creating a mechanical avatar that could fulfill the common precepts for being designated a life form. He writes in "From Here to Alternity and Beyond" (above, n. 53), p. 212: "A large computer can simulate a smaller computer but it cannot simulate itself, because if it did there wouldn't be anything left except the simulation. Consciousness would stop there."

Lilly's techniques in many ways work the interstice between the domains of rhetoric and neuroscience, configuring them in ways in which one cannot be presumed to explain the other. In this sense, his work on both the logic of simulation and its recursive relationship to technoscientific inquiry into the nature and function of mind recalls the conflation that has haunted the discipline of cybernetics etymologically, since Norbert Wiener decided to name this new ecology of knowledge production after the Greek work for "steersman," or "navigation." In Plato's *Gorgias*, Socrates compares this function to rhetoric, separating them both from the privileged domain of philosophy; for second-order cyberneticist Satosi Watanabe, Wiener's appropriation was prescient for the discipline's subsequent engagement with scientific epistemology:

> [I]t is highly significant that in his mind Plato somehow associated rhetorics and cybernetics. We should notice that these two arts have indeed something in common: They both represent flexible and adaptive methods aiming at utilizing, influencing, controlling, and overcoming the outside world, mental or physical, in order to achieve one's own goal. They are entirely different from primarily disinterested sciences such as geometry or astronomy or from straight technology such as bridge-building or oil pressing.[57]

Watanabe here draws our attention to the relation of rhetoric and cybernetics as examples of a particular category of forces; as with neuroplasticity, these forces emerge in the networking of the interior and exterior and are responsive to established thresholds and limits, even as they work to transform or alter them.

Although conceptualizing human bodies and subjectivity in reference to machines has often been criticized as an ethically dangerous reduction, Lilly's work highlights how such a practice can itself form a distinct ethics, a method for manipulating affective and cognitive forces to change human capacities for responding to their environments. Although focused on the multiplicity of elements—physiological, ideational, and rhetorical—impacting subjectivity, such an ethics is perhaps compelling insofar as it draws our attention to the particular admixture: the ways that neurology structures what we find persuasive and our ability to respond to persuasive forces, but is itself "persuadable," or open to alteration through habituation and experimentation. Similarly, it foregrounds how the materiality of the brain structures affective responses, even as thought itself functions as an action and can become "material" or materialized in neurological structures.

57. Satosi Watanabe, "Epistemological Implications of Cybernetics," in *Proceedings of the Fourteenth Congress of Philosophy* (Vienna: Herder, 1968), p. 152.

And it is such a materiality of thought, originally developed in mid-twentieth-century inquiries into psychotropics and cybernetics, that I would argue we need to do some hard thinking about in crafting our ethical and rhetorical responses to the present. On the one hand, neurological vectors have likely always played a large, if largely unrecognized role in politics and culture. For instance, as William Connolly has argued, in the challenging of biological conceptions of race that have, rightfully, taken in both technoscience and the humanities, we may have been too quick in dismissing the way that the cultural experiences of being a particular race, or being treated "as if" one is the member of a particular race, are corporealized in individuals' "visceral habits of perception" and affective responses to various situations.[58] In other words, although however we configure race (and here one might add categories of gender, sexuality, and so on) to function is heavily dependent on cultural rather than, or in addition to, biological factors, cultural experiences themselves have a way of leaving a material mark on our nervous system.

On the other hand, however, such an intersection of neurology and culture is perhaps reaching unprecedented degrees of intensity in the present moment as our affective capacities and neurological responses increasingly appear to be the common ground of contemporary experiences with not only psychotropic substances, but also our growing immersion in virtual realities and online realms, as well as the general productions and flows of hypercapitalism. Steven Shaviro thematizes such an intersection nicely in his more-than-rhetorical question about the conflation of psychotropics and mass entertainment: "After all, don't ecstasy and Disney Land have at least this one thing in common, that they both make you feel like everyone loves you and that you love them all back?"[59] The point is not that the two are wholly equivalent, but rather, as capitalist production shifts toward the manufacturing and marketing of ever more "intense" experiences, the affective economies mapped in early psychotropic and cybernetic research—particularly because of their concentration on networked interaction and our bodily responses to simulations—have become increasingly ubiquitous.

Similarly, as organizations such as the Center for Cognitive Liberty and Ethics have underscored, our access to, and protection from, phenomena that impact our neurological responses may

58. William E. Connolly, *Neuropolitics: Thinking, Culture, Speed* (Theory Out of Bounds, no. 23) (Minneapolis: University of Minnesota Press, 2002), p. 47.

59. Steven Shaviro, *Connected, or What It Means to Live in the Network Society* (Electronic Mediations, vol. 9) (Minneapolis: University of Minnesota Press, 2003), p. 184.

emerge as a crucial site for contemporary considerations of civil liberties, whether they be the legal status of psychotropic substances or the regulation of "neuromarketing" techniques, in which medical technologies are used to gauge the brain's responses to advertising strategies. Indeed, many of our familiar political debates are becoming at least partially, to borrow a term coined by Leary (and refrained by Connolly), "neuropolitical." For instance, in November 2004, the potential affinities between narcotics and electronically mediated experiences of a particular type were being considered in a congressional session sponsored by Kansas senator Sam Brownback.[60] Senators taking part in the session listened to a variety of academic and independent researchers such as Mary Anne Leyden, co-director of a sexual-trauma program at the University of Pennsylvania, argue that the effects of prolonged exposure to Internet pornography could replicate both the addictive properties and physiological effects of opiates such as heroin or crack cocaine. Although critiques of pornography that are along moral lines or based on the supposed connection between this material and criminal behavior have a long history, the combination of a relatively new delivery system (the Internet) and contemporary research into the physiology of the brain has repackaged 1950s-style concern over the "mental hygiene" of the populace for the contemporary network society. All of these phenomena mark the wane of what Foucault famously deemed the "disciplinary" mode of power and subjectivity formation.[61] Whereas disciplinary power functioned primarily through the enclosure of physical bodies in particular sites (the prison, the factory, the school), and the forming of these bodies to adopt a particular subjectivity or identity, the gradual disintermediation of these sites as part and parcel of broader changes in technoscientific and economic production has made way for the appearance of new flows of power focusing more specifically on affective capacities and the internal neurology of human bodies to produce discrete capacities rather than generic identities.

In contemporary attempts to attend to the relationship between the biological and the social with which this essay began, the works of Judith Butler have been exemplary in underscoring the ethical complexities inherent in such an endeavor. As she famously argues

60. See Connie Cass, "Addiction to Porn Destroying Lives, Senate Told: Experts Compare Effect on Brain to that of Heroin or Crack Cocaine," Associated Press, November 18, 2004 (available online at http://www.msnbc.msn.com/id/6525520/).

61. Michel Foucault, *Discipline and Punish: The Birth of the Prison*, 2nd ed., trans. Alan Sheridan (New York: Vintage, 1991).

in *Bodies That Matter*, strong conceptions of social construction begs a number of questions concerning both embodied materiality and agency, most notably "If everything is discourse, what about the body?" and "If the subject is constructed, who is doing the constructing?"[62] Butler's solution is to shift our conception of subjectivity *as a* "construction" to that of one that emerges through its *response to* a "materialization," its abilities to respond to a series of social and political structures. Drawing from the ecology of linguistics and the discursive, Butler foregrounds the possibilities of "rearticulation" as a mode or resistance in response to established structures of identity and culture. Drawing instead on the ecologies of code and programming, Lilly might be taken as drawing our attention to the need not only for practices of *rearticulation*, but also for those of *reticulation*: recognition and creative manipulations of our abilities to respond as they are networked not only through cultural institutions and discourses, but through the very material alteration of our neurological responses and affective capacities. Insofar as persuasion is increasingly taking on such forms, one of the primary challenges for ethical and rhetorical theory may be to configure neurological and affective forces as vectors of persuasion, and we would do well to "learn to learn" how to inhabit such an ecology.

62. Judith Butler, *Bodies That Matter: On the Discursive Limits of Sex* (New York: Routledge, 1993), p. 6.