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Neocybernetic Emergence: Retuning the Posthuman

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…We review the history that has unfolded second- from first-order cybernetics, and take exception to some recent accounts that discount **the importance of the second-order or neocybernetic line of development**. We argue that neocybernetic concepts in the line from von Foerster to Maturana, Varela, and Luhmann challenge not just the rigidities of AI and first-order mechanical and social systems engineering, but also, and more profoundly, **the epistemological foundations of philosophical humanism**…To understand today's hyperacceleration of technoscientific incursions into the human, and to arrive at more highly articulated observations of **the systemic situatedness of cognition**, we **correlate epistemological closure with the phenomena of ontological emergence**. If the human is and has always already been posthuman, this understanding demands the perspective afforded by neocybernetic recursion.

In this essay we will offer some criticisms of Hayles's more recent work, *My Mother Was a Computer: Digital Subjects and Literary Texts* (2005). But we can set the stage for those by looking at a characteristically problematic passage from *How We Became Posthuman*. Here Hayles draws some debatable conclusions from a consideration of von Foerster's famous image, first appearing in his 1960 essay "On Self-Organizing Systems and Their Environments" (Foerster, 2003d) and later reprised in 1973 in "On Constructing a Reality" (Foerster, 2003c), **the man with the bowler hat**:

> The potentially infinite regress of men in bowler hats does more than create an image of the observer who observes himself by observing another. It also visually isolates the observer as a discrete system inside the larger system of the organism. In the aftermath of the Macy conferences, one of the central problems with **reflexivity** was how to talk about it without falling into solipsism or resorting to psychoanalysis. The message from the Macy Conferences is clear: **if reflexivity was to be credible, it had to be insulated against subjectivity and presented in a context where it had at least the potential for rigorous (preferably mathematical) formulation**. … Distinguishing the observer as a system separate from the organism was one way to make reflexivity more manageable, for it reduced the problem of the observer to a problem of communication among systems. (1999, pp. 133-34)[4]

The larger problem inhabiting this passage, as well as *How We Became Posthuman* as a whole, is **the suppression of the properly cybernetic term *recursion* under the subjectivistic misnomer *reflexivity*.**

Boe: **recursion – reflexivity; selfreference**
subject/object: **it is the subject/object distinction itself that is the conceptual aberration to be deconstructed**.

The result is that Hayles can approach the **significance of the concept of self-reference** in the observation of observation only as
a derivative of *idealistic platitudes about solipsism*,
only as an *aberration of the "subjectivity" embedded in the use of the subject/object distinction* to begin with—when, as von Foerster labored to show, **it is the subject/object distinction itself that is the conceptual aberration to be deconstructed**.

In other words, **the effort to insulate reflexivity from subjectivity is paradoxical precisely because reflexivity as a concept is inextricably inscribed within the discourse of subjectivity**.

Second-order cybernetics is nothing if not **the productive unfolding of paradoxical self-reference** initiated by von Foerster's playful epistemological writings and **carried to a high degree of sophistication in Luhmann's adaptations of Spencer-Brown's concept of reentry to the description of autopoietic operation**.

And in that development, the processes of **selfreferential *recursion* in both biotic and metabiotic autopoietic systems** are extracted from the false problematics into which Hayles's treatment has deposited them.

Other issues at stake in this sometimes contentious milieu of discussion concern philosophical and ethical commitments that tend either to **Varela's school of embodied mind at the nexus of living and psychic systems**, or to **Luhmann's school of emergent communication at the nexus of *meaning* as the medium interpenetrating the operational forms of psychic and social systems**.

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However, what both of these neocybernetic schools share is, one, a rootedness in von Foerster's **recursive constructivism**, and two, a systems-theoretical approach to *posthumanism* that discards both the usual technoid trappings of that concept and the **problematics of disembodiment** through which Hayles develops the topic to **concentrate instead on the environmental embeddedness of the human within wider biotic and metabiotic systemic frames**.

In order to understand today's hyper-acceleration of technoscientific incursions into the human, and **in order to arrive at more highly articulated observations of the systemic situatedness of cognition altogether, epistemological closure must be correlated with the phenomena of ontological emergence**.

The contemporary understanding that the human is and has always already been posthuman could not have emerged, and cannot be rendered productive, without the perspective afforded by neocybernetic recursion.

Boe: recursive constructivism – systemic situatedness of cognition
epistemological closure – ontological emergence

The Neocybernetic Situation
In the introduction to his selected edition of von Foerster's papers, *Observing Systems*, titled "The Ages of Heinz von Foerster," Francisco Varela concluded with a characterization of "the last age of Heinz" (Varela, 1984, p. xvii). In the chronology of second-order systems theory, this would be considered its *first* age, the period during the early 1970s when **von Foerster laid out his ground-breaking sketches of, in Varela's words, "recursive mechanisms in cognitive systems"** (Varela, p. xvi), thereby producing the initial formulations for **a cybernetics of cybernetics**. What struck Varela in the early 1980s was the extent to which the force of von Foerster's cognitive innovations had not yet gained secure footholds in the mainstream academy, had

not permeated our intellectual preferences and current thinking. … **There is little doubt that our current models about cognition, the nervous system, and artificial intelligence are severely dominated by the notion that information is represented from an out-there into an in-here, processed, and an output produced.** There is still virtually **no challenge to the view of objectivity understood as the condition of independence of descriptions, rather than a circle of mutual elucidation**. Further, there is little acceptance yet that **the key idea to make these points of view scientific programmes is the operational closure of cognizing systems, living or otherwise**. These are precisely, the leitmotives of Heinz's last stage. (Varela, 1984, p. xvii)

Boe: information –
Varela: **current models about cognition, the nervous system, and artificial intelligence are severely dominated by the notion that information is represented from an out-there into an in-here, processed, and an output produced.**
Container and transport metapor!!

Since then, there has certainly been some significant if modest penetration of these fundamental cognitive motifs into the "intellectual preferences" (Varela, 1984) of thinkers across the spectrum of natural, mathematical, and discursive disciplines. As we see it, however, Varela's words still ring true of our present time. To the extent that they do, the discourses of second-order cybernetics and systems theory still have important work to do. For one, **it is only by the theorizing of the operational closure of cognizing systems that cultural theory can rescue agency**—albeit agency of a far more complex variety than that of traditional humanism—from being overrun by the technoscientific processes that are everywhere transforming today's material world. Indeed, given the acceleration in technoscientific development since the 1980s—(87) acceleration that has witnessed the advent of artificial life, complexity theory, and other technosciences of emergence—**the imperative to theorize the operational closure of cognizing systems** has never been more urgent. Better late than never, neocybernetics can perhaps now finally come through on its promise to provide the ecology of mind best fitted to the demands of our intellectual, institutional, and global crises.

Boe: **neocybernetic (second-order cybernetics) notions of self-reference, emergence, and autopoiesis – information theories.**

As the readers of this journal are already aware, some of the most important theoretical and critical conversations going on today in the **cognitive sciences, chaos and complexity studies, and social systems theory, stem from neocybernetic notions of self-reference, emergence, and autopoiesis**. Putting von Foerster at the head of neocybernetics throws attention on what is still, in the larger international academy, a minority account of cybernetics' intellectual accomplishment and cultural significance. Nonetheless, a growing body of scholarly work is rethinking the shape and evolution of the relations among science, technology, sociology, psychology, philosophy, history, literature, and the arts, through neocybernetic terms.

Neocybernetics' greatest interest for textual disciplines, media studies, and the social sciences, we argue, derives from particular advances upon first-order cybernetics in the biological, cognitive, and social systems theories developed in the work of von Foerster and Gregory Bateson, and extended from there by thinkers such as Henri Atlan, Humberto Maturana, Francisco Varela, Lynn Margulis, Susan Oyama, and Niklas Luhmann.

Expanding the initial transdisciplinary framework connecting the natural and human sciences with **information technologies**, Michel Serres, Gilles Deleuze, Felix Guattari, Donna Haraway, Bruno Latour, and Isabelle Stengers, to name some writers especially important in the contemporary American humanities academy, have deployed neocybernetic discourse extensively and transformatively.

Neocybernetic discourse is central to current historical, interpretive, and **theoretical investigations using concepts such as narrative, medium, assemblage, information, noise, network, and communication to remap the terrain of knowledge with reference to the *operational boundaries of systems and their environments*.**

This body of work is both inspired and admonished by the larger unfolding of cybernetics, its institutional ups and downs, its cultural impacts and resistances, its culs-de-sac and continuing intellectual and social promise.

Neocybernetic concepts in the line from von Foerster to Maturana, Varela, and Luhmann **challenge not just the technoid rigidities of AI and first-order mechanical and social systems engineering**, but also, and more profoundly**, the epistemological foundations of philosophical humanism** altogether.

For neocybernetic posthumanism, systems—whether technical, biotic, psychic, or social—are **bounded semi-autonomous entities coupled *with* their environments and *to* other systems**. One shifts attention from isolated elements and relations to **the emergent behaviors of ever larger ensembles**. Neocybernetic **systems theory stresses the recursive complexities of observation, mediation, and communication**.

Whatever comes to be (observed) owes its term of being to systems (88) within its environment. Autonomy can never be solitary: In second-order systems theory autonomy is rethought as operational self-reference.

Boe:
- **semi-autonomous entities coupled *with* their environments and *to* other systems**.
- **emergent behaviors of ever larger ensembles –**
  Deacon: w(holes) -
  http://www.uboeschenstein.ch/texte/deacon-IncompleteNature18.html
- **systems theory stresses the recursive complexities of observation, mediation, and communication (Luhmann, Fuchs)**
  shifts the emphasis of observation and description from subject to system
- **a shift of interest from the identities of subjects to the networks of connections among systems and environments**.

In brief, neocybernetics **shifts the emphasis of observation and description from subject to system**. One form of the neocybernetic turn is **a shift of interest from the identities of subjects to the networks of connections among systems and environments**.

The humanist project that unified perception and communication in one subject, shored up against all odds by the first cybernetics, is now observed as an amalgamation or **structural coupling of multiple observing systems**.

With this move **the noumenal unity of the humanist subject gives way to a posthumanist perspective, a differential observation of the interrelations of living and nonliving systems and their environments, such as human and nonhuman bodies and societies**.

From Cybernetics to Neocybernetics
The cultural history of cybernetics is still being written. There is no authoritative version, rather, a swarm of competing accounts. Given the welter of disciplines engaged in the movement, as well as **the recursive, self-reorganizing turn in cybernetic thought** itself, a definitive history would be an impossible project.

Boe: **the recursive, self-reorganizing turn in cybernetic thought**
selfreference – selforganisation
(vgl. Hoffmeyer Biosemiotics:
http://www.uboeschenstein.ch/texte/hoffmeyer-biosemiotics.html

As has often been told, however, the first cybernetics emerged in the 1940s as a technoscience of communication and control drawing from mathematical physics, neurophysiology, information technology, and symbolic logic.

Historically concurrent with the post-war spread of linguistic structuralism in Europe, cybernetics was set forward in the States and then vigorously transplanted to Soviet and European subcultures.

From a base **connecting biological and computational systems by way of information theory and communications technology, cybernetics was academically mainstreamed under the names Artificial Intelligence and, more broadly, computer science in the service of command-and-control systems**. But due to the long interdisciplinary roster of Warren McCulloch's invitees to the Macy Conferences—including Lawrence Frank, Heinrich Klüver, Gregory Bateson, Margaret Mead, and Lawrence Kubie—cybernetic discourse entered psychology, anthropology, and other social sciences, and from there, in the 1950s and '60s, the humanities and the creative arts.

Coined by original Macy participant Norbert Wiener, ***cybernetics*** in its initial formulation was the "**study of messages, and in particular of the effective messages of control**" (Wiener, 1950, p. 8). But for Wiener, in addition, cybernetics also raised new issues about the "definition of man" (Wiener, p. 2): If "human behavior" (Wiener, p. 1) can be duplicated by machines, how is one to "differentiate man"(Weiner, p. 2) from other entities? Keeping the focus on information and communication but extending it beyond machines, **Wiener argued that among living beings only man is so obsessively driven to communicate.**

While this was not in fact a satisfactory criterion of distinction between human beings and other living and nonliving things, it did show that from the start, cybernetics put the ontology of humanity into question.

Less than a decade later, H. Ross Ashby (1956) deflected Wiener's emphasis on human communication and control toward **the ontological neutrality of Claude (89) Shannon's information theory**. In a similar vein, Gregory Bateson (1972) wrote of the first cybernetics that its subject matter extended across traditional disciplinary registers in focusing on "**the propositional or informational aspect of the events and objects in the natural world**" (Bateson, p. 401).

Boe: ***virtuality*** **correlated with actuality,**
shift in emphasis from the actual to the virtual

Today we would say that cybernetic methodologies draw out the ***virtuality*** **correlated with actuality**, but clearly the **shift in emphasis from the actual to the virtual** was already under way in first-order cybernetics. According to Ashby (1956), with regard to the substance of the media conveying informatic forms, "the materiality is irrelevant" (Ashby, p. 1).

Cybernetics marks a shift away from the building-blocks of phenomena—so long the focus of chemistry and physics and, given the success of these disciplines, too often a model for biology and psychology—to the form of behaviors, what things do and how they are observed.

The first-order cybernetic **demotion of material substance relative to informatic pattern** is memorably recorded in *The Human Use of Human Beings*, when Wiener (1950) rehearsed a teleporter scenario which operated on a form/substance binary characteristic of the first cybernetics' formal bias: "**the individuality of the body is that of a flame rather than that of a stone, is that of a form rather than that of a bit of substance**" (Wiener, p. 109). Nevertheless, the teleportation of that form for the purpose of rematerialization at a distance would almost surely involve at least the momentary destruction of the organic being undergoing the process.

Wiener described the visceral horror of such a process with a remarkably bloodless and surgical élan: Any scanning of the human organism must be a probe going through all parts, and must have a greater or less tendency to destroy the tissue on its way. To hold an organism stable while part of it is being slowly destroyed, with the intention of recreating it out of other material elsewhere, involves a lowering of its degree of activity, which in most cases we should consider to prevent life in the

tissue. In other words, the fact that we cannot telegraph the pattern of a man from one place to another is probably due to technical difficulties, and in particular, to the difficulty of keeping an organism in being during such a radical reconstruction. It is not due to any impossibility of the idea. (p. 110)

One could generalize from Wiener and Ashby—as well as from much of its popular offspring in cyberpunk and other technoid fantasies—that first-order **cybernetics remains inscribed within classical scientific thought**. It holds onto humanist and idealist **dualisms** that describe the world in terms of an equivocal **dialectics of matter and form, of substance and pattern, in which the immaterial wrests agency away from the embodied**.

One way to mark the emergence of neocybernetics is to emphasize its new questioning and eventual **overcoming of such classical substance/form distinctions**.

Neocybernetic systems theory radicalizes the constructivist epistemology inscribed within the first cybernetics by **shifting to an autological rather than ontological theory of form**.

In neocybernetic theory, **the form/substance dichotomy is superseded by the distinction between form and *medium*.**

Boe: Dualism - **substance/form distinctions: the form/substance dichotomy is superseded by the distinction between form and *medium*.**
Luhmann: Medium/Form – System/Umwelt

Putting form and medium theory together, neocybernetics goes beyond classical ontology's impasse before **the oscillations of being and nonbeing**. Such imponderables—concerning that which *is*, is it form, or is it matter? no-thing, or (90) every-thing? —have always **presupposed some ultimate fundament upon which to evaluate this all-or-nothing conundrum. Neocybernetic epistemology replies by deontologizing the question. Neither form nor medium reaches bottom: There is no bottom.**

Forms are temporary fixations of elements within a medium, and when enough like forms coalesce, they become another medium for a new, emergent set of forms. Luhmann (1990) writes: "in the case of art … form first constitutes the medium in which it expresses itself. **Form is then a 'higher medium,' a second-degree medium which is able to use the difference between medium and form itself in a medial fashion as a medium of communication**" (Luhmann, p. 218).

Building upon this understanding, Michael Schiltz (2009) draws out the implications for Luhmann's theory of positing ***meaning* as the medium within which psychic and social forms interpenetrate**:

If the medium of meaning is indeed the ultimate medium of psychic and social systems, i.e. if **meaning is 'the medium of itself,**' then what is its 'form,' the distinction through which it can be expressed? I perceive only one answer: **the medium of meaning must be identical to the difference between form and medium, and the re-entry of that distinction into itself**. **Its consequent indecidability is the symbol of our dealing with the world**. (Schiltz, 2009, pp. 172-173)

First-order cybernetics importantly underscored the provisional nature or the ***constructedness* of cognitions within observing systems**, but it did so by undercutting the significance and contribution of material/energetic environments to the cognitive systems that emerge within them. The strong constructivism of neocybernetic systems theory deals with the world by **promoting a new level of attention to the media of its forms, or more concretely, to the *environments* and the *embodiments* of systems**.
We see this ecological convergence of constructivism and cybernetic environmentalism in

the key figure responsible for **the turn from first- to second-order systems theory**, Heinz von Foerster. At the beginning of his 1974 essay "On Constructing a Reality," von Foerster, then Director of the Biological Computer Laboratory at the University of Illinois, recounted how, "perhaps ten or fifteen years ago, some of my American friends came running to me with the delight and amazement of having just made a great discovery: 'I am living in an Environment! I have always lived in an Environment! I have lived in an Environment throughout my whole life!'"(Foerster, 2003c, p. 211). Yet despite the ecological revelation of their newfound Environment, according to von Foerster, his friends had yet to make another and even more crucial discovery: "**when we perceive our environment, it is we who invent it**" (Foerster,p. 211)

91 Joining this broad neocybernetic consensus, systems theorist Dirk Baecker writes that

> One of the most important aspects of systems theoretical thinking is to proceed slowly, to look at things again, and to take the time to spell them out. … We should not jump, as systems do, from one event to the next simply to show that we can do so. Rather, we should look back at each instance, again as systems do, to see how we effected the last jump. (2001, p. 70).

Following Latour, Margulis and Sagan, and Baecker's complementary invocations for a slowing down of technoscientific hybrids, of ecological depredations, of systems theorizations. We acknowledge a similar need for a slowing down, in our case of everything that has recently come together under the rubric of the posthuman, for the purpose of careful neocybernetic consideration.

By now already a cultural cliché often lacking definitional consensus, **the posthuman has been wielded to encompass everything from contemporary theorizing and cutting-edge cultural history, to work in nontraditional sciences like non-linear dynamics, robotics, artificial life, and indeed to the science of emergence that has been dubbed (by its most ambitious proponent) *A New Kind of Science*.**

Following a kind of **performative polarization deploying classic binary logic**, facile versions of the posthuman only reproduce the human as the very *other*—**the easily despised and criticized figure of a unified and fully autonomous human subject**—whose devalorization is to give them teeth.

As we see it, **the human has always been a complex of operationally autonomous systems complexly enfolded into its environments**, and it is precisely a recognition of this complexity that informs the historical moment of second-order cybernetics as well as its continuation in what we are calling neocybernetics.

Central to the priority we want to claim for neocybernetics is **the concept of autonomy as double closure** or, as von Foerster puts it, **the regulation of regulation**. In stark contradistinction to any naive conception of autonomy as the absolute self-sufficiency of a substantial subject, **this concept demarcates the paradoxical reality that environmental entanglement correlates with organismic (or systemic) self-regulation. Thus a system is open to ist environment in proportion to the complexity of its closure**.

This equation remains in force even—and indeed must remain in force especially—in the face of today's massive incursions of technics into the domain of the living. For if the human has always been posthuman in the sense that it has always involved an exteriorization or evolution by means other than life (as the work of(92) Jacques Derrida, André Leroi-Gourhan, and more recently, Bernard Stiegler, has shown), the massive contemporary acceleration in processes of posthumanization poses the prospect of a qualitative shift in the economy between autonomy and environmental entanglement. **Whether this shift entails the abandonment of autonomy as regulation of regulation is a crucial question facing cultural theorists today.**

One eloquent position here – that of Katherine Hayles in *My Mother Is a Computer* – contends that **recent technosciences of emergence and the model of the computational universe** they presuppose have definitively marked the historical limits, indeed the eclipse, of the cybernetic tradition:

> Even the most insightful and reflective of the cyberneticians stopped short of seeing that reflexivity could do more than turn back on itself to create autopoietic systems that continually produce and reproduce their organization. Heinz von Foerster's classic work *Observing Systems* shows him coming to the threshold of a crucial insight and yet not quite grasping it: the realization that **reflexivity could become a spiral rather than a circle, resulting in dynamic hierarchies of emergent behaviors**. By the time scientists began to use this idea as the basis for new kinds of technologies, cybernetics had already lost its utopian gloss, and new fields would go by the names of artificial life, complexity theory, and cellular automata. (Hayles, 2005, pp. 279-280)

As we see it, however, this evaluation seriously underestimates the force of von Foerster's account of **how recursive processes generate emergent complexity**.

At the core of Hayles's claim is a conviction that the **role of recursion** as understood by second-order cybernetics simply cannot account for the processes of emergence that are popping up everywhere in our world, whether one consults **the computational model developed by Wolfram (2002)** or the totalizing picture of **escalating ontogenesis promoted by Morowitz (2004)**.

The crucial question of her book is precisely **how the new kind of science that informs what she calls the regime of computation** can, in her words, "serve to deepen our understanding of **what it means to be in the world rather than apart from it, co-maker rather than dominator, participants in the complex dynamics that connect 'what we make' and 'what (we think) we are'**" (Hayles, 2005, p. 280).

While we concur with this desideratum, and would consider it central to what we are calling neocybernetics, we simply cannot endorse this position. For Hayles, **developing an understanding of our constitutive worldliness requires a transgression or dismissal of the boundaries separating any system from its environment**:

> boundaries of all kinds have become permeable to the supposed other. Code permeates language and is permeated by it; electronic text permeates print; computational processes permeate biological organisms; intelligent machines permeate flesh. Rather than attempt to police these boundaries, we should strive to understand the materially specific ways in which **flows across borders** create complex dynamics of intermediation. (Hayles, 2005, p. 280)

Boe: GSB - **Any indication implies duality, we cannot produce a thing without coproducing what it is not, and every duality implies triplicity: what the thing is, what it isn't, and the boundary between them. Thus you cannot indicate anything without defining two states, and you cannot define two states without creating three elements. None of these exist in reality, or separately from the others**.
http://www.uboeschenstein.ch/texte/spencer-brown-LoFVII.html

93 In our view, these formulations are simply too vague. It is not at all clear what exactly such permeation might amount to, given the very different operational fusions being asserted. In her zeal to leave closure in the dust *tout court*, Hayles seems to gloss over the very **differentiations out of which systems are generated to begin with**. This move short-circuits the machinery of emergence before emergence even gets started.

Neocybernetics contends that **it is precisely the injunction against such flows of *information* across the boundary demarcating an autopoietic or self-referential system from its environment that drives second-order systems theory's crucial insights into the operations of self-referential and recursive forms**.

It is not a matter of "policing" **operational boundaries**: not only are they self-producing and self-maintaining, they **are the condition of the possibility of systemic functions in the first place.**

The environment can perturb living, psychic, and social systems, but cannot *operationally in-form* them. More simply put, **environmental stimuli can trigger systems to restructure themselves, but cannot directly or causally impact their function**.

We can say, then**, that systems' observations of their environment are internally and autonomously constructed by their own ongoing self-productions**. In other words, **to maintain their autopoiesis, (self-referential) systems must remain operationally (or organizationally) closed to information from the environment**.

On that basis, they can construct their interactions with their environment *as* information. Luhmann (2002) writes with regard to the operation of communication in social systems: **"A systemstheoretical approach emphasizes the *emergence of communication* itself. Nothing is transferred"** (Luhmann, p. 160).

To forestall a misunderstanding that has dogged second-order systems theory since its inception, we need to insist upon the specificity of neocybernetics' complex, nuanced, and paradoxical understanding of **the concept of *closure***.

Once the paradigm shift is made from the physical to the life sciences, **the order-from-noise principle in self-organizing systems gives way to the openness-from-closure principle in autopoietic systems**.

To understand the stakes of this development, one must bring into play the fundamental **distinction between thermodynamic and autopoietic principles**. Thermodynamically, a system is either open or closed to energic exchange with its environment; by contrast, **autopoietic systems are both environmentally open to energic exchange and operationally closed to informatic transfer**.

According to this understanding, **operational closure—far from being simply opposed to openness—is in fact the precondition for openness, which is to say, for any cognitive capacity whatsoever**.

This generalized, von Foersterian correlation of closure with cognition informs Francisco Varela's development of neocybernetics – specifically, his development of the **openness-from-closure principle** – from its initial theorization in relation to autopoietic systems to the meta-autopoietic assemblages that, arguably, characterize contemporary society.

Boe: …**the order-from-noise principle in self-organizing systems gives way to the openness-from-closure principle in autopoietic systems**.

In their various characterizations of autopoiesis, Maturana and Varela correlate organizational closure with **interactional openness**: **it is an organism's (or system's) self-perpetuation that allows it to be structurally coupled to the environment**.

Thompson (2009) restates this core neocybernetic insight from the perspective of (94) Varela's later work bridging life and mind, neuroscience and phenomenology, through the concept of autopoiesis:

The self-transcending movement of life is none other than metabolism, and metabolism is none other than the biochemical instantiation of the autopoietic organization. That organization must remain invariant, otherwise the organism dies, but **the only way autopoiesis can stay in place is**

through the incessant material flux of metabolism. In other words, the operational *closure* of autopoiesis demands that the organism be an *open system*.[9] (Thompson, 2009, p. 85)

This nuanced concept of closure also informs Luhmann's remark that with secondorder systems theory, "**The (subsequently classical) distinction between 'closed' and 'open' systems [as that was previously defined in regard to allopoietic physical and mechanical systems under strictly thermodynamic regimes] is replaced by the question of *how self-referential closure can create openness***" (Luhmann, 1995, p. 9; italics added).

Arguments that assume closure to be the simple binary opposite of openness fall short of the letter and complexity of neocybernetic conceptualization.

Put another way, **in order for a system to perpetuate itself, it must maintain its capacity to reduce environmental complexity, which is to say, to process it not as direct input but as perturbation catalyzing (internal) structural change**.

As von Foerster's postulate of cognitive homeostasis has it (and this would certainly hold for autopoietic systems in general): "**The nervous system is organized (or organizes itself) so that it computes a stable reality**" (Foerster, 2003c, p. 225).

To Hayles's claim that neocybernetics cannot embrace the complexity of contemporary emergences and their permeation of systems boundaries, we reply that **these processes *can only be understood through the correlation of systemic closure and openness***. What is needed is a generalization of the openness-from-closure principle that is capable of addressing the full complexity of contemporary system operations and environmental couplings.

And in fact, various facets of neocybernetics—running the gamut from **Varela's work on living systems** to **Luhmann's account of communicational autopoiesis**—have developed such **an operational generalization by deploying recursivity to underwrite emergence**.

The following postulates are intended as initial steps toward specifying what we mean by **neocybernetic emergence** and toward generalizing its extension:

1. Neocybernetics requires a recognition that there are only two orders of cybernetics, or alternatively, that the shift from a first-order to a second-order cybernetics marks the passage to **a general form of recursivity** that *can* (contra Hayles) **spiral outwards and thereby create the new at successively higher levels**. Such a requirement finds exemplary expression in von Foerster's claim that second-order cybernetics is a cybernetics of cybernetics and that a "third- [or higher-] order cybernetics…would not create anything new, because by (95) ascending into 'second-order,' as Aristotle would say, one has stepped into the circle that closes upon itself" (Foerster, 2003b, p. 301.)

2. Neocybernetics facilitates **a concept of emergence that differs in at least one fundamental way from the concept of emergence central to contemporary technosciences and the regime of computation**. Whereas the latter understands *emergence as a movement from the simple to the complex* (cf. Wolfram's maxim: from simple rules, complex behavior [Wolfram, 2002]), neocybernetics views it **as a movement from the chaotically complex to the manageably complex**.

In line with what Luhmann calls ***decomplexification***, it is a given that **any particular system that emerges within an environment is necessarily less complex than that**

environment (since the latter will always contain *many other* systems). Indeed, one of the capital advantages of the **concept of the self-referential system** (as against the notion of the subject) is its delineation of such a system's capacity to manage environmental complexity, and indeed, to **derive its identity and its autopoiesis from its continual need to reduce the complexity of the environment by processing it through systemic constraints**.

A viable account of emergence that meets the terms of Hayles's objection—and the body of research upon which it draws—will show how neocybernetics can in fact account for the **interplay of complexification and decomplexification in systems that do more than simply maintain their thermal homeostasis or basal autopoiesis**. Such an account is precisely what lies at the heart of neocybernetics, and what differentiates it from recent technosciences of emergence and computational accounts of complexity is precisely its more fine-scaled and dynamic account of operational closure.

Here neocybernetics can endorse the objection raised by Ray Kurzweil against Wolfram's new science: to wit, that it explores the emergence of complex patterns at a first level of complexity, leaving aside the **crucial issue of how these patterns selforganize to create higher levels of complexity** (see Kurzweil, 2002). And, indeed, neocybernetics lends philosophical substance to this objection, since **the shift from first- to second-order systems theory is precisely what renders recursivity capable of self-organization and formal evolution**. Once again, it is von Foerster who makes explicit the link between neocybernetics and the commitment to the motif of closure: "**The essential contribution of cybernetics to epistemology is the ability to change an open system into a closed system, especially as regards the closing of a linear, open, infinite causal nexus into closed, finite, circular causality**" (Foerster, 2003a, p. 230).

This shift from an equivocal concept of openness to an **operational concept of openness-from-closure** underwrites a related shift from a representationalist to a constructivist epistemology and ontology. In this way, neocybernetics can address the wavering between **two senses of emergence—epistemological and ontological emergence**—that has plagued the computational model of emergence (see Silberstein & McGeever, 1999). Wolfram can only claim to furnish a model of epistemological emergence, even if (or when) he wants to claim more than that; that is why the principle of *computational equivalence* (which states that a computer simulation of a (96) complex process must be as complex as the process itself) furnishes the most powerful argument for his model of emergence.

By contrast, neocybernetics, precisely because it invests in **circular recursivity**, seeks to develop a mechanism for explaining what Hayles (glossing Morowitz) calls **dynamical hierarchical emergences**, which is to say, "how one dynamical level enchains and emerges from the next lower one through their intersecting dynamics" (Hayles, 2005, p. 30).

Here the extensive similarities between neocybernetics (cybernetics of cybernetics) and Morowitz's fourth (and to date final) stage of emergence (mind contemplating mind) are telling, since **recursivity** in both cases forms a powerful vehicle for the reduction of complexity that fuels emergence at the higher level.

As specified through recursivity, the pruning algorithms that allow selection of probable conditions from a transcomputable possibility-space function in a very similar manner to *reentry*, the neocybernetic mechanism specified by George Spencer-Brown's *Laws of Form*, the recursive introduction of a system-environment distinction into the system itself.

Following in the wake of these similarities and also of the technosciences of emergence, the task facing neocybernetics can be specified to be that of **showing how the ineluctable self-**

differentiation of a system that must maintain its autonomy over time can yield the emergence of the new, which is to say, **how it can yield emergence understood in its current usage as the appearance at the system's global level of properties that do not exist at the local level of a system's components**.

Another way to understand this specification returns us to our claim concerning the specificity of **the neocybernetic concept of emergence**, namely that, in contrast to **the technosciences of emergence**, it proceeds not (like some latter-day Herbert Spencer) from the simple to the complex, but rather **by way of system-specific and system-internal reductions of hypercomplexity to ordered complexity**.

Boe: vgl. Fuchs **Sinnsystem(e)**
- **system-specific and system-internal reductions of hypercomplexity to ordered complexity;**
- Varela's **conception of the surplus of significance** and in
- **Luhmann's account of contingent selectivity**
- **the idea that *selection* is key to instituting difference into what would otherwise remain undifferentiated chaos**
- **reconceptualizing human agency – selection!**

This is the meaning of von Foerster's statement that it is we who invent the environment that we perceive, and of similar claims appearing in Varela's **conception of the surplus of significance** and in **Luhmann's account of contingent selectivity**. Indeed, in their accounts of emergence, these claims all instance the operation of an epistemological constructivism at odds with the more positivist technoscientific account of Hayles. We have argued that the insistence on the value, indeed the necessity, of constructivism becomes all the more imperative in the wake of the unprecedented technological complexification of the environment that coincides with the massive dissemination of computational systems throughout society.

Epistemological constructivism may be a helpful, if not ultimately sufficient, resource for **reconceptualizing human agency** as technically-distributed agency. Nonetheless, even if contemporary environmental complexity has largely outstripped the capacity of systems to reduce it, the conceptualization of hybrid forms of agency—encompassing humans and technico-environmental processes—continues to invest in **the minimal Luhmannian commitment that shores up all the configurations of neocybernetics collected here: the idea that *selection* is key to instituting difference into what would otherwise remain undifferentiated chaos**.

Even if it is the case that environmental processes have independent agency in technically-distributed cognitive (97) processes, this reality does not in any way obviate the value of **partial and provisional closures, closures that cut across system-environment boundaries**, for facilitating observation of technically-distributed cognitive operations of **system-environment hybrids**.

Distinction and Assemblage

At a more general level, the epistemological constructivism of neocybernetics provides **new frames of observation disposing one to mark system/environment distinctions more rigorously**. This is an analytical option like any other, but arguably it is one with real purchase on the **ineluctable self-reference entailed by and embedded within all descriptions**.

The self-evident proposition at the **self-referential origin of systems theory** as a scientific discourse is: **There are systems**, followed immediately by its corollary: **There are self-referential systems**.

When Luhmann goes on to indicate that all the heterogeneous assemblages of biotic and metabiotic systems and their environments are just as self-referential as the self-reflective subject of Western metaphysics that privileged itself on its supposedly unique possession of reflexivity, **the neocybernetic description of systems cuts across the grain of classical logic**.

Whereas the term *reflexivity* retailed by Hayles, Morowitz, and others retains the subjectivist connotation of reflection in the mirror of the mind, we have preferred the considered posthumanist terms *recursion* and *recursivity* to underscore that **what is being named, from cells to servomechanisms to societies, are the recursive functions of operationally-closed observing systems**. However, even using the same neocybernetic model, there is an important difference in its theorization of biotic as opposed to metabiotic systems. As Luhmann points out, not all autopoietic systems use **meaning** as a way to **virtualize the system/environment relationship**. Living systems do not, but for those that do – psychic and social systems – it is the only choice.

Key tenets of neocybernetic logic thus run: 1. there are systems, 2. **observation is possible only on the part of an observing system**, 3. **systems are self-referential, and so, in their treatment of matters beyond themselves, paradoxical**, and 4. **that which is observed as paradoxical in our experience is not necessarily a cognitive aberration but is just as likely to be a necessary component of the possibility of any experience at all**.

If one presses this logic toward philosophical polemic, it might go like this: Many of the problems of modern social systems are exacerbated by faulty understandings of **the real systematicities of things**, and thus, **for all our vaunted rationality, by the subsequent unreal or invalid constructions (read, ideological mystifications) of causes and effects in the world**.

To better grasp the world that is their ostensible object, the organs of scientific knowledge must accommodate themselves to the recursive paradoxicalities of their own operation. In sum: Our understanding of the world comes by way of an assessment of the world's impact on systems, which is to say, on the very systems that give us cognitive purchase in the first place. (98)

In this excursion through neocybernetic emergence, we hope to have set aside a lot of the anachronistic semantics that have accreted to systems theory and to have replaced them with more viable presuppositions. For instance, one can rage against the system, but that rage will proceed on the basis of the momentary well-being of various affective, cognitive, and communicative systems. Neocybernetics underscores that **there are operational horizons that put ultimate limits on the disorder of both physical and cognitive systems**. At the same time, the evolution of systems feeds on anarchy—sometimes rage is an effective form of communicative irritation. This is just to say that neocybernetic systems theory at its best puts new eyes on and into the world, x-ray eyes that separate into multiple systems references ostensibly unitary constructions, nominal identities still freighted with cultural capital but lacking in substantial ontology.

Critics looking at neocybernetics who focus on this "negative" moment in its discourse tend to see it as a particularly soulless idiom of nihilistic deconstruction. What this critique clearly lacks is the conversion experience that reverses the sign of **systems-theoretical distinction-making** from subtractive to additive, and that, like deconstruction, factors the play of supplementarity into one's habits of discursive comprehension. For **what drives the work of thinkers like Luhmann and Varela is an**

interest in bringing an ever-complexifying world into the framework of cognition. What distinguishes the neocybernetic approach from other contemporary cultural theoretical positions is an appreciation of the difficulties and complexities involved in doing precisely that. It is our hope that our readers will get that neocybernetic message, **appreciate the importance of systems-theoretical distinction-making, and engage productively with second-order systems theory's rich potentials for further development.**