What Connects Biolinguistics and Biosemiotics?

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This paper reviews the background, fundamental questions, current issues, and goals of biolinguistics and biosemiotics. The purpose of this paper is to give a brief history of these movements, to clarify common objectives and areas of overlap, to evaluate recent articulations of their respective future agendas, and to address some aspects of focus and disciplinary prejudice that may stand in the way of productive collaboration concerning the biology of language.

Keywords: biolinguistics; biosemiotics; Chomsky; Jacob; Lorenz; Peirce; Sebeok; Uexküll

1. Origins of Biolinguistics and Biosemiotics

While the scholarly agendas of biolinguistics and biosemiotics may seem very different in scope, they unequivocally share a common interest in human language as a species-specific cognitive tool. They also share a philosophical core that is anchored in the concepts of Peircean *abduction* and Uexküllian *Umwelt* (cf. Augustyn 2009) on the one hand, and an interest in the building blocks of life and its underlying principles that has connected language to research in cell biology (cf. Barbieri 2010) on the other hand.

Uexküll's concept of *Umwelt* — the subjective species-specific world created by an organism — is central to the ethological approach to human language shared by biolinguists and biosemioticians; and both movements have interacted in different ways with molecular biology to explore the *Bauplan* of human language and/or the semiotic capacities of various species. Examining the ways in which these interests intersect and diverge in biolinguistics and biosemiotics is the main objective of this paper.

Like Peirce, Uexküll approached nature and culture through the analysis of signs and sign processes; and his concept of *Funktionskreis* has been reinterpreted as a general model of semiosis. The semiotics of Charles Sanders Peirce and Uexküll's *Umweltlehre* are regarded by many, but not by all practitioners, as the theoretical and philosophical core of biosemiotics. Peirce is equally important to the origins of Chomskyan biolinguistics, but most likely also not valued to the same degree by all of its current practitioners.

Contemporary reviewers referred to Jakob von Uexküll (1864–1944) as a *Kantian biologist* (Wirth 1928). Trained as a zoologist and physiologist, Uexküll

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first focused on the sense perception of organisms, mostly of marine animals. Throughout his career, Uexküll applied what he observed in his studies of muscular physiology to the semiotic capacities of the organism as a whole; and his *Umweltlehre* evolved into a general theory of life as semiosis. Uexküll is, therefore, generally regarded as the forerunner of ethology and comparative psychology; and Konrad Lorenz owed the foundational insights that informed his experiments with graylag geese, jackdaws, and dogs to Uexküll (G. von Uexküll 1964: 198).

Jakob von Uexküll's radical constructivism is exemplified in his statement that "[no] matter how certain we are of the reality that surrounds us, it only exists in our capacities to perceive it. That is the threshold we have to cross before we can go any further" (J. von Uexküll 1902: 213 [my translation]). Thure von Uexküll outlined the main aspects of Jakob von Uexküll's Umwelt theory as follows (T. von Uexküll 1982: 4–8):

(A) [True] reality (Jakob von Uexküll calls it *Natur*) that lies beyond or behind the nature that physicists, chemists, or microbiologists conceive of in their scientific systems reveals itself through signs. These signs are therefore the only true reality, and the rules and laws to which the signs and sign-processes are subject are the only real laws of nature. […]

(B) The methodology of Umwelt-research, which aims to reconstruct this 'creating' of [reality] […] means, therefore reconstructing the Umwelt of another living being. […]

(C) The aim of Umwelt research is to create a theory of the composition of nature […] [by exploring] the sign-processes that govern the behavior of living subjects.

Chomsky's interest in Uexküll and ethology was a result of discussing alternatives to the dominant paradigms in linguistics and behavioral psychology with Eric Lenneberg and Morris Halle in the early 1950s. The biolinguistic program, therefore, derives its general approach to human language from ethology and comparative psychology; and Konrad Lorenz played an important role in its evolution (Jenkins 2000: 10). Especially Eric Lenneberg's (1964) *Biological Foundations of Language* "anticipated many themes of the coming decades" (Jenkins 2000: 3); and Chomsky concluded in a famous interview that "[linguistics] is really a theoretical biology" (Sklar 1968: 218). Uexküll would have been pleased with biolinguists for "making [linguistics] a biological science" as he once suggested to a linguist friend in a letter (Kull 2001: 3). This is the point of view from which Sebeok's biosemiotics approaches human language.

Based on these common ideas on the biological foundations of language and thought, both Chomsky and Sebeok emerged from the dominant paradigms in linguistics in the middle of the 20th century to follow new theoretical paths in linguistics and semiotics. Both Chomsky and Sebeok's fundamental ideas about human language were connected to the work of ethologists and comparative psychologists like Uexküll, Lorenz, and Tinbergen (cf. Lenneberg 1964); and their general views on human language have been consistently similar. They both see

human language foremost as a cognitive tool (because the species was capable of *communication* before it emerged). Agreement on this issue is far from trivial and its pronouncement bound to raise eyebrows among many linguists. Sebeok called language a *secondary modeling system* that allows the species to create models of reality in addition to the species-specific perceptual system, the *primary modeling system* (cf. Anderson & Merrell 1991, Sebeok & Danesi 2000). He believed that language served primarily "the cognitive function of modeling, and, as the philosopher Popper as well as the linguist Chomsky have likewise insisted […], not al all for the message swapping function of communication. The latter was routinely carried on by nonverbal means, as in all animals, and as it continues to be in the context of most human interactions today" (Sebeok 1991: 334).

Chomsky likewise sees language as a tool of thought that is based on principles that are not specific to language. They consequently also share the view that language is an *exaptation*; and they both see organism–environment-interaction (i.e. species-specific *Umwelt*) as a crucial component of the growth of language in the individual. This is a view that separates them from a strong evolutionary psychology of language (e.g., Pinker 1994, 2003).

While the semeiotic of C.S. Peirce clearly provided the foundational philosophical background for the "vast life science" that Sebeok saw in his *global semiotics* (cf. Sebeok 2001b), the Peircean concepts of *abduction* and *habit-taking* also play an essential role in Chomsky's *generative grammar*. He recently referred to the analysis of the deep structure of abstract operations of formal grammar as a "Peircean logic of abduction" (Chomsky 2006: 86).

To different degrees, practitioners of both biolinguistics and biosemiotics connected with molecular biologists during the 1970s. An MIT conference in 1974 solidified the affinities between the work of French molecular biologist François Jacob and Chomsky's theory of *principles and parameters*. While this connection resulted in a reciprocal exchange of ideas between theoretical linguistics and molecular biology, Sebeok and his followers established their connection with biochemistry more indirectly by interpreting such work as Marcel Florkin's (1974) "intracellular semiotics" (Kull 1999: 387), the work of Sorin Sonea and Maurice Panisset (1983), and Lynn Margulis (1998) (cf. Sebeok 2001b). Sebeok's interaction with Thure von Uexküll (Jacob von Uexküll's son), the founder of psychosomatic medicine in Germany, established the field of *endosemiotics* (e.g., T. von Uexküll *et al.* 1993); and towards the end of the millennium, biosemiotics found two molecular biologists to carry the project forward along somewhat different trajectories; Marcello Barbieri's *code biology* on the one hand (e.g., Barbieri 2003), and Jesper Hoffmeyer's *biosemiotics* on the other hand (e.g., Hoffmeyer 2008).

The connection between cell biology and biosemiotics came from two distinct origins, but they both grew out of the desire of molecular biologists to overcome the limitations of mainstream biology to address fundamental questions revolving around concepts like *signal, information,* or *code*. The molecular biologist Jesper Hoffmeyer had turned to philosophy and connected with Sebeok in the early 1980s at a time when, after exploring the semiotic capacities of other animals in his *zoosemiotics* (e.g., Sebeok 1972), Sebeok wanted to establish a semiotics that sees life as semiosis on all levels. The biosemiotics

that Sebeok later considered to be his "principal contribution to semiotics" (Sebeok 2001b: 180) was one that included all levels of nature and culture beyond the boundaries that Umberto Eco had drawn in his *Theory of Semiotics* (Eco 1976), and he expanded semiotics to a vast life science down to the level of the cell. Eco had already drawn semiotics away from a focus on communication and established the primacy of signification, but declared *zoosemiotics* "the lower limit of semiotics" when drawing the "political boundaries" of the field (Eco 1976: 9). While some practitioners of semiotics welcomed Sebeok's global (bio)semiotics that extends across all levels of life, others see it as a perhaps premature extension of *zoosemiotics* to all life forms that does not account for the different types of semiosis that exist in the living world.

Jesper Hoffmeyer organized the first of the *Gatherings in Biosemiotics* in Copenhagen in 2001, unfortunately the year of Sebeok's death. After the fourth *Gatherings* in Prague, the *International Society for Biosemiotic Studies* was founded in 2005, with Hoffmeyer as its inaugural president. The Prague meeting in 2004 had brought together an energetic group of molecular biologists, theoretical biologists, embryologists, physicists, linguists, information scientists, philosophers of science, and others who agreed that the most fundamental characteristic of life is sign action/*semiosis*; and the movement gained the necessary moment-um to create an organization and found its journal *Biosemiotics* in 2005. The editor of this journal is the embryologist Marcello Barbieri, a scientist who had articulated a line of research on the *organic codes* of life he had previously called *semantic biology* (Barbieri 2003).

What separates these two distinct connections between molecular biology and semiotics is often reduced to an argument over whether *the sign* and *semiosis* (Sebeok/Hoffmeyer) or *codes* and *code-making* (Barbieri) should be considered primary in biosemiotics. Perhaps, the nature of these two currents that connect biosemiotics with molecular biology can best be characterized by different intellectual/scientific styles, one seeking a biology with a philosophical integrity that places the life sciences firmly within semiotic theory (Sebeok/Hoffmeyer), the other rooted in the natural sciences while at the same time promoting careful collaboration across the disciplines (Barbieri).

Meanwhile, the *International Network in Biolinguistics* had crystalized out of the work Chomsky, Halle, and Lenneberg had begun in the late 1950s. This scholarly organization had many precursors in different places at different times (cf. Jenkins 2000); but in its most recent configuration held its first meeting at the University of Arizona in Tucson (February 2008), organized by Massimo Piattelli-Palmarini. The online Journal *Biolinguistics* published its first volume in 2007. Both movements have recently articulated formative statements (Fitch 2009, Kull *et al*. 2009), which will be addressed in more detail after first establishing an important characteristic that undeniably connects biolinguists with biosemioticians.

2. Biolinguists and Biosemioticians Have Never Been Modern

In his essay *We Have Never Been Modern*, Bruno Latour lays out what he calls the Modern Constitution that separates "three regions of being" (Latour 1993: 39),

nature — *politics* — and *discourse* through the processes he calls *purification* and *mediation*. While the work of *purification* separates nature from society and keeps the natural sciences as the domain of explaining natural phenomena separate from the social sciences as the domain of explaining the social order of things; the work of *mediation* explains how "mixing biology and society" makes it possible that "[all] of nature and all of culture get churned up again every day" (p. 2). The work of *purification* is characterized by working within the strict disciplinary boundaries of the natural sciences, so that the facts of nature are, in fact, created in the laboratory. Practices of *purification* rely on "two different ontological zones: that of human beings on the one hand, and that of non-humans on the other" (p. 10). It is a consequence of this Modern Constitution that non-humans have come to make much better informants in the lab.

The work of *mediation* is the work of *hybrids*. The paradox of the Modern Constitution is that the separation of nature and society (= *purification*) both makes *mediation* possible, but marginalizes it and renders it invisible at the same time. But only *hybrids*, says Latour, "can change the future" (p. 11). Mainstream linguists and mainstream biologists who suffer from the illusions of the Modern Constitution practice purification so that nature and society must remain absolutely distinct. This includes the first illusion that even though we construct nature, nature is as if we did not construct it, and another one, that even though we do not construct society, it is as if we construct it (Latour 1993). More importantly, Latour shows us that the Modern Constitution entails, besides the dichotomy of *purification* and *mediation*, the separation between non-humans (as nature) and humans (as culture).

Hybrids who reject the Modern Constitution, because they practice *mediation* (such as, for instance, anthropologists who study non-Western cultures or ethologists who study the physiological and cognitive capacities of different species) are seen as outsiders of the purified disciplines of the mainstream. This becomes especially apparent when anthropologists study cultures in the West, or when ethologists, biologists, linguists, or semioticians study the cognitive capacities of humans.

Chomsky's and Sebeok's grounding in Peircean semeiotic and Uexküllian *Umwelt* theory clearly makes them *hybrids* (sensu Latour 1993). *They have never been modern*. The difficulty of their position within the field of linguistics (or semiotics, even though *purification* is much less of an issue there) is that their work is prone to gross misinterpretation, precisely because the mainstream lives by the illusions that uphold the Modern Constitution. As Latour explains, "[the] essential point of this Constitution is that it renders the work of mediation that assembles hybrids invisible, unthinkable, unrepresentable" (Latour 1993: 34).

This can be explained with the predominant folk-definition of *Universal Grammar*, an unfortunate misinterpretation that can be attributed to the artificial dichotomies that are the result of the disciplinary purification that wants to see the field of linguistics in the social sciences or the humanities (culture) rather than — as Chomsky and Sebeok would have it — as a domain of biology, that approaches the study of human language as a phenomenon of nature. The folk-definition of *Universal Grammar* is something like an equivalent of linguistic universals or the things that are shared by all languages, a definition that does

not depend on the ethological perspective and is not in contradiction with the laws of the Modern Constitution.

For most students of linguistics, it is difficult to understand Chomsky's definition of *Universal Grammar* right away as the properties of the initial state of the human faculty of language that are specific to the species. For those who live by the Modern Constitution, the *hybrid* character of this concept remains nebulous, "unthinkable, unrepresentable" (Latour 1993), because they want to ground everything in the Modern Constitution, keep language in the domain of culture, and the field of linguistics separate from biology. For those who understand the philosophical background behind the faculty of language as a combination of innate capacities, organism-environment interaction (*Umwelt*), and abstract principles that are not specific to the faculty of language (cf. Chomsky 2005: 6), the *hybrid* character of this concept is quite uncontroversial.

Modernity has made it impossible for some to take the ethologist's perspective on our species, to mediate instead of separating nature and culture. Maybe that fog will begin to lift when recent articulations of *posthumanism* or *posthumanities* will have penetrated the mainstream and hybrids gain critical mass in traditional academic disciplines such as linguistics and biology.

Chomsky's (2009 [1966]) *Cartesian Linguistics* likewise defies the paradoxes of the Modern Constitution, because it begins with the unresolved questions of the 17th century. Because the very title of Chomsky's *Chapter in the History of Rationalist Thought* is perpetually mischaracterized and misinterpreted, especially by those who don't care to read it and prematurely associate its title with a folk definition of the Cartesian mind/body dualism, the introduction to the 2009 edition explains that Descartes "was among the first to recognize the importance of this 'ordinary' form of linguistic creativity […] for the study of the human mind" (p. 1) that is the central focus of biolinguistics. This hybrid concept of language as a natural object therefore characterizes biolinguistics as a natural science (cf. Boeckx 2005).

On the one hand, the *cognitive revolution* of the mid twentieth century is a renewal and further development of the cognitive revolution of the 17th century, while another influential factor in the renewal of the cognitive revolution was the work of ethologists, a field that defies the principles of the Modern Constitution. For the biolinguistic program, Chomsky adapted "[the] framework of ethology and comparative psychology […] to the study of human cognitive organs and their genetically determined nature, which constructs experience — the organism's *Umwelt*, in ethological terminology — and guides the general path of development, just as in all other aspects of growth of organisms" (Chomsky 2006: x).

Sebeok's last articulations of biosemiotics appeared in the year of his passing in his collection of essays entitled *Global Semiotics* (Sebeok 2001b). He attributes the origin of biosemiotics, his "principal contribution to general semiotics" (p. 180), to his rediscovery of Uexküll's *Umweltlehre*, which inspired his definition of "[semiosis as] the processual engine which propels organisms to capture 'external reality' and thereby come to terms with the cosmos in the shape of species-specific internal modeling systems" (p. 15).

This non-species-specific terminology is the hallmark of Modeling Systems Theory, an approach he articulated in *The Forms of Meaning* together with Marcel

Danesi (Sebeok & Danesi 2000), characterizing biosemiotics or global semiotics, as a comprehensive life science of nature and culture; or "nature/culture", as Latour (1993) prefers to write. Sebeok, the linguist whose life work was to turn semiotics into a science of all life, obviously *has never been modern*.

3. The Search for the *Bauplan* of Human Language

Since the formation of their professional organizations, the *International Society of Biosemiotic Studies* and the *International Network in Biolinguistics* have articulated their goals and objectives and several publications stand out as foundational. For the former society, the core publications are the volumes published in a book series on Biosemiotics under the editorship of Marcello Barbieri and Jesper Hoffmeyer. The third volume in the series, *Essential Readings in Biosemiotics,* was edited by Donald Favareau as a rather copious anthology for a field that is, according to the editor, "nothing yet resembling a mature, by which is meant coherent [field]" (Favareau 2010: iii).

Favareau's expertise in the historical background as well as current issues of biosemiotics is evident in his 80-page introduction that takes the reader through "An evolutionary History of Biosemiotics". From Hellenic thought, through the Middle Ages, across Modernity, Favareau narrates the history of concepts in biosemiotics based on the following definition: "Biosemiotics is the study of the myriad forms of communication and signification observable both within and between living systems. It is thus the study of representation, meaning, sense, and the biological significance of sign processes — from intercellular signaling processes to animal display behavior to human semiotic artifacts such as language and abstract symbolic thought" (p. v).

The book has four parts: "Part 1: Sebeok's Precursors and Influences" includes excerpts from Jakob von Uexküll's (1940) *Theory of Meaning*, sections from Charles Sanders Peirce (1931–1958 [1866–1913]), Charles Morris's (1955) *Signs, Language and Behavior*, and Yuri Lotman's (1990) *Universe of the Mind*. "Part 2: The Biosemiotic Project of Thomas A. Sebeok" includes Sebeok's (2001) own account of "Biosemiotics: Its roots and proliferations" and texts by his collaborators Heini Hediger (1981) on "The Clever Hans Phenomenon", Martin Krampen's (1981) "Phytosemiotics", Thure von Uexküll's (1993) "Endosemiotics", Giorgio Prodi's (1988) "Signs and codes in immunology", Rene Thom's (1975) chapter "The animal mind" from his *Structural Stability and Morphogenesis*, and Anderson *et al.*'s (1984) "A semiotic perspective on the Sciences: Steps to a new paradigm". "Part 3: Independent Approaches to Biosemiotics" includes Kull's previously unpublished "Theoretical biology on its way to biosemiotics", Friedrich Rothschild's (1962) "Laws of symbolic mediation", Marcel Florkin's (1974) "Concepts of molecular biosemiotics and of molecular evolution", Gregory Bateson's lecture "Form, substance and difference" (included in Bateson 1972), Howard Pattee's (2005) article on "The physics and metaphysics of biosemiotics", and an excerpt from Terrence Deacon's (1997) *The Symbolic Species*. Lastly, "Part 4: The Contemporary Interdiscipline of Biosemiotics" includes Hoffmeyer & Emmeche's (1991) "Code-Duality and the semiotics of nature" and a chapter from Hoffmeyer's

(2008) book *Biosemiotics: An Examination in the Life of Signs and the Signs of Life*, an article on "Information and semiosis in living systems" by João Queiroz *et al.* (2005), an excerpt from *Readers of the Book of Life* by philosopher of science Anton Markoš (2002), Soren Brier's (2006) "Cybersemiotic model of communication", an excerpt from philosopher Günther Witzany's (2007) *The Logos of the Bios*, and a recent article by Marcello Barbieri (2008) on "Biosemiotics: A new understanding of life" that was published in *Naturwissenschaften*, outlining the coexistence of code-based bio-semiotics and sign-based (or interpretation-based) biosemiotics.

While Barbieri's paper ends by affirming that "all versions of biosemiotics share the view that semiosis is fundamental to life" (p. 791), biosemiotics today is unequivocally characterized by what Anton Markoš calls a "plurality of view" (p. 657); and — while Anderson *et al*. (1981) warned that "optimism for a general or unified approach is bound to invite scorn" (p. 404) — many among its practitioners share Jesper Hoffmeyer's hope for better "transdisciplinary communication" (p. 590) in the future.

For biolinguistics, the organization's website lists Turing's (1952) paper on "The chemical basis of morphogenesis", D'Arcy Thomson's (1945) *On Growth and Form*, and Eric Lenneberg's (1967) *Biological Foundations of Language* as its foundational texts. More recent articulations include Jenkins' (2000) *Biolinguistics* and his edited volume *Variation and Universals in Biolinguistics* (Jenkins 2004), Hauser *et al*.'s (2002) "The language faculty: What is it, who has it, and how did it evolve?", Hauser & Bever's (2008) "A biolinguistic agenda", Chomsky's (2005) "Three factors in language design" and his "Biolinguistic Explorations: Design, Development, and Evolution" (Chomsky 2007), Di Sciullo's paper "A biolinguistic approach to morphological variation" (2008) from a workshop on Linguistic Universals and Linguistic Fieldwork held at Harvard University, and Di Sciullo & Boeckx's (2011) edited volume *The Biolinguistic Enterprise: New Perspectives on the Evolution and Nature of the Human Language Faculty*.

Both movements received formative statements outlining fundamental questions and issues for the future in 2009. W. Tecumseh Fitch articulated the "Prolegomena to a future science of biolinguistics" (Fitch 2009), while biologist/semiotician Kalevi Kull collaborated with biological anthropologist Terrence Deacon, molecular biologists Claus Emmeche and Jesper Hoffmeyer, and the semiotic theorist Frederik Stjernfelt on the eight surprisingly brief "Theses on biosemiotics: Prolegomena to a theoretical biology" (Kull *et al*. 2009).

1. *The semiosic—non-semiosic distinction is coextensive with the life-nonlife distinction, i.e. with the domain of general biology.* […]
2. *Biology is incomplete as a science in the absence of explicit semiotic grounding.* […]
3. *The predictive power of biology is embedded in the functional aspect and cannot be based on chemistry alone.* […]
4. *Differences in methodology distinguish a semiotic biology from non-semiotic biology.* […]
5. *Function is intrinsically related to organization, signification, and the concept of an autonomous agent or self.* […]

6. *The grounding of general semiotics has to use biosemiotic tools.* […]
7. *Semiosis is a central concept for biology that requires a more exact definition.* […]
8. *Organisms create their* umwelten. […]

(Kull *et al*. 2009: 167–173)

Kull and his colleagues were able to agree on some fundamental ideas on "what biology needs to be focused on in order to describe life as a process based on semiosis" (Kull *et al*. 2009: 167). They consider one aim of the movement "to explain how life evolves through all varieties of forms of communication and signification (including cellular adaptive behavior, animal communication, and human intellect) and to provide tools for grounding sign theories" (ibid.).

At least the authors of this document seem united in their search for the basic concepts for a theoretical biology, although this document excludes the concepts associated with Barbieri's view that organic semiosis is defined by *coding*. According to Barbieri, coding and interpretation are both present in nature; however, while organic semiosis gave rise to the organic codes on the cellular level, interpretive semiosis, or interpretation, can only exist in organisms that build internal representations of the world, i.e. in organisms that have a nervous system (Barbieri 2011). While the "Theses on Biosemiotics" (Kull *et al*. 2009) present biosemioticians as united in their desire to transform biology away from mechanistic paradigms towards sign-based theories, they exclude from their agenda a view that sees two distinct semiotic processes on different levels of life (cf. Barbieri 2011).

Fitch's "Prolegomena to a future science of biolinguistics", in contrast, focuses on the problems that stand in the way of a unified approach to biolinguistics. Most may have expected from the prolegomena a unified biolinguistics and an inherently diverse biosemiotics, especially because the scope of biolinguistics appears to be decidedly narrower (because it is *only* concerned with the human language faculty). Jenkins (2000: 1) highlights the fundamental questions of biolinguistics as articulated by Chomsky:

(1) What constitutes knowledge of language?
(2) How is this knowledge acquired?
(3) How is this knowledge put to use?
(4) What are the relevant brain mechanisms?
(5) How does this knowledge evolve (in the species)?

These are questions that unequivocally interest many biosemioticians, especially those practitioners who value the theoretical perspectives provided by Peirce and Uexküll. While the overlap in foundational literature seems small at first glance, a closer look at Jenkins (2000), Chomsky's (2005, 2007) own recent articulations and the bibliographies of their foundational literature may convince many practitioners of biosemiotics with an interest in human language that they have lived with the wrong idea of biolinguistics for too long. Many of them may have been guilty of uninformed criticisms of Chomsky, "whose ideas so many scholars apparently love to hate" (Fitch 2009: 287).

Fitch gives a sobering assessment of the potential for a biolinguistic science, focusing foremost on the sociological, terminological and intellectual impediments. He criticizes the lack of collaboration between linguistic theory and neuroscience, and accuses neuroscientists for "a decade or so of somewhat self-indulgent neo-phrenology" (p. 284). He also sees challenges "concerning terminology, disciplinary turf wars, and struggles for dominance" (p. 285) that may exist among biosemioticians as well.

Among the real challenges, not sociological but intellectual in nature, Fitch points to the theoretical shortcomings in neuroscience and the lack of good collaboration with theoretical linguists, because neuroscientists still "do not understand how brains generate minds" and that "principles underlying brain development and evolution remain only dimly understood" (Fitch 2009: 285). Likewise, neuroscientists do not know how brains generate language, and there is very little collaboration between neurolinguists and theoretical linguists (cf. Andrews 2011).

An important issue for biolinguists, according to Fitch, consists of "questions of meaning" and what he calls "unresolved semiotic challenges [that] pose problems for any aspect of cognition". Maybe Fitch and those who agree with him would find more satisfying theories of meaning in the foundational literature associated with biosemiotics? When Fitch writes "[we] have a good theory of information (Shannon information theory), but we lack anything even approaching a good theory of meaning" (p. 285), he's looking for the same alternative to "many currently popular models and metaphors for understanding genes, brain and language [that] need to be abandoned if [biolinguists] hope to make any substantial progress" (p. 286) that many biosemioticians see in mainstream biology.

Most biosemioticians would see eye to eye with Fitch on that central challenge. In fact, nobody would agree more with this than Jesper Hoffmeyer, who turned to philosophy to address these issues in biology and became involved in biosemiotics after connecting with Sebeok in the 1980s. It is precisely the vagueness of concepts such as *information* or *signal* in biology that drove biologists to philosophy and semiotics and fueled the biosemiotic movement. For Hoffmeyer, "[biosemiotics] does not turn experimental biology to metaphysics but instead replaces an outdated metaphysics — the thought that life is only chemistry and molecules — with a far better, more contemporary, and more coherent philosophy. Life rather than natural law — and signs rather than atoms — must become natural science's fundamental phenomena" (Hoffmeyer 2008: 15).

While Barbieri has reached out to biolinguists to explore common interests and possibilities of collaboration (Barbieri 2010, 2011), Hoffmeyer has relied on popular misconceptions about Chomsky's biolinguistics that lead him, for instance, to reject Chomsky and prefer Bruner (1985) on the issue of language development. (cf. Hoffmeyer 2008) As one of the biosemiotic movement's most prolific and formidable articulators, it is unfortunate that he has turned his back on an intellectual movement that shares so many foundational philosophical parallels, and whose progress depends on much of the same issues and challenges as his own efforts in biology and biosemiotics.

What distinguishes Bruner from Chomsky is the fact that Bruner conducted

empirical research on mother-infant communication to gain a better understanding of language acquisition, while Chomsky has maintained consistently that three factors constitute the human faculty of language: (1) the genetic endowment, (2) organism–environment interaction (species-specific *Umwelt*), and (3) abstract principles not specific to the faculty of language (cf. Chomsky 2005, 2007). To say Bruner has the better theory of language development, because he chose to study mothers and infants in their homes is like accusing Chomsky for not focusing on what he chose *not* to focus on.

Moreover, while the empirical studies of mother-infant interaction make a worth-while research agenda, it is one that supports the Modern Constitution (sensu Latour 1993) in the sense that the homes of families in the New York area in the 1980s are bound to have outcomes that are culture-specific and relevant only for urban middle-class families in the West; while the abstract principles of human language the way they have been studied by biolinguists are not subject to this kind of cultural bias, because they belong to a research agenda that is built on a Galilean-style theory construction (cf. Boeckx 2005) that remains on the ethological level and defies the distinction between nature and culture, and in the sense of Latour (1993) *has never been modern*. To refuse to engage with what Chomsky *has* focused on, because of what he has chosen *not* to focus on (even though he never disputed its relevance to other research agendas) is like criticizing a pianist for never playing the violin.

4. Conclusion

Biolinguists may find ideas for addressing the 'semiotic challenge' (Fitch 2009) in the foundational texts for biosemiotics (e.g., Favareau 2010). Likewise, biosemioticians who are interested in human language simply cannot afford to bypass biolinguistics. Some foundational insights in linguistics have merit on that level of analysis that is the ethological/comparative psychological perspective, even though they may not tap into many physiological, affective, or social aspects associated with human language.

Linguists in the context of semiotic *Gatherings* therefore always run the risk of being perceived as naive or uninformed about the many layers of language and communication the abstractions of mainstream linguistics do not address. But good pianists can appreciate the violin even if they choose not to play it themselves.

Semioticians in the context of linguistics, likewise, have the challenges any *hybrid* faces in the 'mainstream'; but biosemioticians who are interested in finding the *Bauplan* for human language, should find capable collaborators among biolinguists. In both fields, there are likely to be "linguists and biologists, along with researchers in the relevant branches of psychology and anthropology, [who] can move beyond unproductive theoretical debate to a more collaborative, empirically focused and comparative research program aimed at uncovering both shared (homologous or analogous) and unique components of the faculty of language" (Hauser *et al*. 2002: 298).

In the spirit of such a collaborative, empirically focused and comparative

research program, Fitch (2009: 311) sees the future of biolinguistics in formulating testable hypotheses on the biology of language such as the following example concerning language acquisition:

> If human language acquisition is just a special case of a general innate capacity for acquiring culture (Tomasello 1999), then individual progress in acquiring language should be closely correlated, both temporally and across individuals, with their progress in other aspects of socialization and mastery of non-linguistic culture (cf. Markson & Bloom 1997).

Some skeptics may question whether that is, indeed, a good hypothesis; and others may argue over the best way to empirically test it. It may seem unsatisfying or uninspiring to see the big questions about language reformulated as hypotheses such as this one; and, more importantly, they can only be pursued within the institutional structures that allow linguists and psychologists to write grant proposals that are considered 'worthy' within the mainstream that will likely perpetuate the Modern Constitution (Latour 1993) for some time.

It will be difficult for the *hybrids* to establish new paths of collaboration that allow them to truly transcend the practices of *purification* that keep the disciplinary boundaries intact. In his *Biolinguistics*, Jenkins (2000: 18) quotes Medawar & Medawar's (1978: 166) anecdote of Keats denouncing Newton "for destroying all the beauty of the rainbow by reducing it to the prismatic colours". He proceeds by quoting Francois Jacob's famous explanation for why the outcomes of smaller questions are more promising than insisting on the big questions that has become the mantra of biolinguistics. Jacob explained that

> [science] proceeds differently. It operates by detailed experimentation with nature and thus appears less ambitious, at least at first glance. It does not aim at reaching at once a complete and definitive explanation of the whole universe, its beginning, and its present form. Instead, it looks for partial and provisional answers about those phenomena that can be isolated and well defined. Actually, the beginning of modern science can be dated from the time when such general questions as "How was the universe created? What is matter made of? What is the essence of life?" were replaced by such limited questions as "How does a stone fall? How does water flow in a tube? How does blood circulate in vessels?" This substitution had an amazing result. While asking general questions led to limited answers, asking limited questions turned out to provide more and more general answers.
>
> (Jacob 1977: 1161–1162)

While the big questions are what has brought researchers in so many different fields together in biosemiotics, decomposing their common interests into smaller explanatory hypotheses will be much more difficult for them to achieve. Jacob's mantra works for biolinguists; and they have a much better chance at progressing along their chosen path to gain a better understanding of the faculty of language. But the "semiotic challenge" (Fitch 2009) remains for biolinguistics; and it remains to be seen if future cross-disciplinary collaboration will bring forth any *hybrids* who "can change the future" (Latour 1993: 11).

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