

Biology, Linguistics, and the Semiotic Perspective on Language

Prisca Augustyn

Abstract This paper explores the relationship between biology and linguistics by tracing the corresponding parallel developments of phylogenetic thinking in the nineteenth century. The conception of *languages* and *species* as historical entities developed from a philosophical current that originated with philosophies of nature deriving predominantly from Kant, Goethe and Schelling. Following the epistemological and metaphysical trajectory of German *Naturphilosophie*, this paper explains how J. von Uexküll carried this biosemiotic approach to biology and language into the twentieth century while linguistics aligned its methods with psychology and other social sciences. Sebeok's contributions to linguistics and semiotics throughout the twentieth century were characterized by his commitment to biosemiotics, maintaining a close connection to biology and the anti-psychologism associated with the semiotic perspective on language. In several key aspects, Sebeok's views are shown to be compatible with Chomsky's biolinguistics.

Keywords Linguistics • Biology • J. von Uexküll • Th.A. Sebeok • Biosemiotics • N. Chomsky • Biolinguistics

The Nineteenth Century Construction of *Languages* and *Species* as Historical Entities and the Philosophical Origin of Biosemiotics

Most linguists today assume that the tree-diagram as a diagrammatic representation of descent relationships between languages grew in the field of biology with Charles Darwin's theory of evolution.¹ Many would be surprised to learn that it was actually the other way around. Nineteenth century linguists and biologists were connected by a shared attitude towards the living world that influenced the methods they chose to study it. Darwin noted in 1871 that the "formation of different languages and of

¹ Darwin 1859.

P. Augustyn (✉)
Florida Atlantic University, Boca Raton, FL, USA
e-mail: augustyn@fau.edu

distinct species, are *curiously parallel*... We find in distinct languages striking homologies due to community of descent, and analogies due to a similar process of formation".² By then tree diagrams had been used in linguistics and philology for over half a century.³

Before tree-diagrams were introduced in biology, a hierarchical system dominated in the field of animal classification, represented in the Aristotelian *scala naturae*. Up until the seventeenth century the belief persisted that organisms could arise through spontaneous generation from nonliving matter. Similar beliefs existed about linguistic diversity through myths such as the *Tower of Babel*, where the diversification of languages is represented as a spontaneous divine intervention in human affairs. As a result, questions about species lineages and historical relationships didn't arise for a long time. But even Ancient Greek philosophers, upon taking a closer look at historical records of their language, noticed *growth* and *change*. Socrates (469 BC–399 BC) was worried about the *decline* of Greek since Homer (730 BC) in the same way the eighteenth century English grammarians Robert Lowth⁴ and Lindley Murray⁵ were worried about the *degeneration* of English since William Shakespeare (1564–1616).⁶ Today there is a similar concern about the influence of digital media on the "low standards" in grammar and style among younger generations and the negative effects on the assumed "integrity" of our languages.

While language purists and popular belief still maintain illusions of fixed standards today, nineteenth century linguists focused on *growth* and *change* and devoted their energy to documenting and analyzing the historical evolution of languages. Ancient texts became the *fossil record* of dead languages (like Latin, Greek, Sanskrit, or Gothic) that were unequivocally understood to be the *progenitors* of modern languages such as German or English. The idea that one language evolved from another (problematic as it may be upon closer examination) was acceptable and for the most part uncontroversial.

It was understandably more acceptable to think of languages as *evolving* from one into another instead of being *created ex nihilo* than it was for living organisms. After all, the eighteenth and nineteenth centuries (at least in Germany) were a time when professors were regularly expelled from their university appointments for atheism. However, those who are familiar with the *natural organicism* of Johann Wolfgang von Goethe know that evolutionary thought existed long before Darwin. Goethe's incessant search for the *Urpflanze* as a precursor to Darwin's work on plant evolution in *The Origin of Species* (1859) attests to the acceptability of phylogenetic thinking about plants preceding phylogenetic thinking about animals. Phylogenetic thinking about languages was uncontroversial even in the nineteenth century.

²Darwin 1871, pp. 89–90.

³Where several manuscripts existed that were copies of an older manuscript, the *stemma* diagrams helped philologists establish a record of which manuscript came first and provided the basis of other, later manuscripts.

⁴Lowth 1762.

⁵Murray 1795.

⁶Atkinson and Gray 2005.

The pioneer of linguistic typology, Wilhelm von Humboldt (1767–1835), had proposed a predominantly hierarchical classification of languages. The perception of inflectional languages (such as the Germanic and Semitic languages) as the most “perfect” was going to last throughout the nineteenth century; and, unfortunately, parallel hypotheses were made about the peoples who spoke them.

The intellectual profiles of Wilhelm von Humboldt, the linguist, and his younger brother, Alexander von Humboldt (1769–1859), the biologist/naturalist exemplify the close relationship between the study of language and other phenomena of living things. Their attitudes towards *life* and the scientific study of *all that lives* unequivocally derived from the philosophical current that is the bedrock of biosemiotic thought. Like many of their contemporary biologists and linguists, their metaphysics, scientific attitudes and methods were anchored in the *Romantic Biology* or *natural organicism* of Immanuel Kant, Johann Wolfgang von Goethe, and Friedrich Wilhelm Joseph von Schelling that sees nature as a creative force and creation at once, where *perfect form* is found in plants and animals as in poetry or art. The nineteenth century biologist was an artist as much as the artist was a naturalist. Nature was seen as artful as much as art was considered a part of nature. Historian of science Robert J. Richards explains that

[Alexander von Humboldt] believed that the unity of form underlying the diverse profusion of life, [...], could be expressed in biogeographical calculations, with which even his casual essays bulged. Fat numbers alone, though, could not adequately portray the face of nature – only the art of narrative, the poetry of description, could convey to discriminating sensibilities her active, vital features. Behind Humboldt’s declarations about the obligation of the naturalist to convey a certain feeling for nature lay the epistemological and metaphysical structures erected by Kant, Schelling, and Goethe.⁷

The complexity of Nature was believed to reveal itself only to the scientist/artist or scientist/poet whose subjective experience is capable of discovering, articulating and representing its underlying principles and capture its form through his own creativity. The ability to perceive and appreciate nature was integral to its scientific discovery as well as its artistic representation. The Humboldt brothers were not the only close relationship among important practitioners of linguistics and biology whose *Naturphilosophie* goes back directly to the metaphysics of Kant, Goethe, and Schelling; but they were celebrity practitioners of a *Romantic biology* that influenced linguists and biologists throughout the nineteenth century and, as we shall see, constitutes the prehistory of the semiotic perspective on language.

It is well known that Charles Darwin and Ernst Haeckel, an important articulator of Darwin’s theory of evolution in the German-speaking world, were dedicated readers of the work of A. von Humboldt.⁸ That all nineteenth century intellectuals read Kant and Goethe, at least in the German-speaking world, is uncontroversial. But Darwin also exchanged ideas directly with no lesser than the author of the *Stammbaumtheorie*, the Jena linguist August Schleicher (1821–1868). Schleicher also happened to be – not surprisingly for a nineteenth century intellectual – a passionate

⁷ Richards 2004, p. 32.

⁸ Cf. Richards 2002 and 2008.

botanist, and also a close friend of Haeckel in Jena.⁹ That Schleicher considered *languages to be living organisms* is not a mere analogy or metaphor, but instead represents a deep conviction that languages are part of the evolution of life.

It is well known that Schleicher and Haeckel, fellow progressive thinkers and naturalists, enjoyed exercising together at the Jena *Turnverein* and compared notes on how to best represent their intellectual work. More importantly, their theories also had a shared philosophical integrity that characterized a *Romantic biology* and a *Romantic linguistics*.

This integrated view of the living world is expressed in a famous quote attributed to Goethe that served as the epilogue for Haeckel's *Generelle Morphologie der Organismen* (1866). It might have served equally well for Schleicher's *Über die Bedeutung der Sprache für die Naturgeschichte des Menschen* (1865): "There is in nature an eternal life, becoming, and movement. [Nature] alters herself eternally, and is never still. [Nature] has no conception of stasis, and can only curse it. [Nature] is strong, her step is measured, her laws unalterable. [Nature] has thought and constantly reflects – not as a human being, but as nature. [Nature] appears to everyone in a particular form. [Nature] hides herself in a thousand names and terms, and is always the same".¹⁰ Jakob von Uexküll (1864–1944) carried this approach to biology into the twentieth century, when he described *nature as a composer listening to her own composition*.¹¹ In fact, Uexküll's terminology borrowed from musicology that can also be found in the work of Karl Ernst von Baer and many others, characterizes the scientist/artist as uniquely capable of the profound perception and representation or articulation of the living world. Uexküll used the term *Merkring*¹² for a person of high perceptive and articulatory capabilities. The equivalent of the biologist/artist/poet just like the Romantic ideal that nineteenth century intellectuals saw personified in Goethe.

This holistic view of natural phenomena derived from Goethe captures the spirit of nineteenth century biology and linguistics. Uexküll unequivocally understood linguistics to be part of biology when he wrote to a linguist friend that he was on the right path "towards making [linguistics] a biological science".¹³ The distinct metaphysics that connected Haeckel and Schleicher, and also informed Uexküll's biology in the early twentieth century, approached natural phenomena neither from a vitalistic nor a mechanistic perspective. This approach is characteristic of the philosophy of nature that sprang from the early Romanticism of these Jena intellectuals. Upon reading Darwin's *Origin of Species*, Schleicher declared in his *Die Darwinsche Theorie und ihre Bedeutung für die Sprachwissenschaft*:

The dualism, which one conceives as the opposition of mind and nature, content and form, being and appearance, or however one wishes to indicate it – this dualism is for the natural scientific perspective of our day a completely unacceptable position. For the natural scien-

⁹Cf. Richards 2008.

¹⁰Goethe, quoted in Richards 2008, p. 111.

¹¹Cf. Uexküll 1992.

¹²Apparently it was Fedi Ditmar who invented the term according to Uexküll (1957, p. 61).

¹³Cf. Kull 2001, p. 3.

tific perspective there is no matter without mind [Geist] (that is, without the necessary power determining the matter), nor any mind without matter. Rather there is neither mind nor matter in the usual sense. There is only one thing that is both simultaneously. To accuse this opinion, which rests on observation, of materialism is as perverse as charging it of spiritualism.¹⁴

The comparative method practiced by Schleicher and his fellow linguists has direct parallels in the work of nineteenth century biologists identifying homologies in the physiologies of sponges, siphonophores and other organisms that exist in great diversity to establish their relatedness. Indeed, the comparative physiology of sponges contributed to Haeckel's progress in providing evidence for Darwin's theory. Just as Haeckel compared the body structures of radiolarians and siphonophores, Schleicher and his fellow linguists compared texts in related languages. Manuscripts that were copies of the same text in different but related language variants served as the *fossil fragments* of language.¹⁵

Schleicher believed that the developmental history of languages was a main feature of the development of human beings. More particularly, he was convinced that because there are considerably more linguistic fossils than geological fossils, historical language data could provide valuable evidence for the theory of evolution in general. Schleicher was certain that the same processes of competition of languages, the extinction of forms, and the development of more complex languages out of simpler roots suggested mutual confirmation of the basic processes governing such historical entities as species and languages. Finally, since the various language groups were believed to have descended from more primitive forms, Schleicher suggested that language provides analogous evidence that more advanced species descended from simpler organisms. Schleicher intended that these contributions of linguistics to biological theory support an assumption that the pattern of language descent perfectly reflects the pattern of human descent. The monistic point of view (which Schleicher assumed in his commentary on Darwin's *Origin*) held that language was simply the material side of mind and thought.¹⁶

Haeckel believed that Darwin had advanced powerful evidence (embryology, biogeography, systematics) but he agreed with Darwin's translator into German, Heinrich Bronn, that analytic evidence was desirable. Schleicher thought linguistics could furnish such evidence. Language descent, he proclaimed, was an empirically well-established phenomenon; and he considered the linguist's genealogical tree a perfect model for depicting the evolution of plant and animal species.

Schleicher in his *Zur vergleichenden Sprachgeschichte* (1848) employed a morphological classification of languages that goes back to W. von Humboldt's typology of isolating, agglutinating, and flexional languages. Schleicher, however, did not believe that these types evolved from one another; rather, he thought that they were

¹⁴Schleicher 1863, quoted in Richards 2008, p. 105.

¹⁵While it is obvious that the analogy between texts and fossils is more problematic than this comparison allows for, a critique of the comparative methods in linguistics and biology would certainly lead beyond the objectives of this paper.

¹⁶Cf. Richards 2008, p. 257; Schleicher 1863.

indicative of different groups of human beings. He therefore classified the Germanic and Semitic languages (as flexional languages) as corresponding to the most highly evolved groups of languages indicative of the most highly evolved mental capacities. Haeckel used this line of thinking to argue for the polyphyletic human origin. He believed that languages probably developed only after the species of speechless *Urmenschen* had already split into several separate species or kinds. Within each human species, Haeckel thought, language evolved independently. Haeckel relied on and referred to Schleicher explicitly for this analysis.¹⁷

Schleicher also maintained, that “the formation of language is for us comparable to the evolution of the brain and the organs of speech”.¹⁸ The idea that the human brain evolved with language is popular among evolutionary theorists today and possibly also among many linguists. Both Darwin and Schleicher would have unequivocally agreed with Terrence W. Deacon’s theory of the *coevolution of language and the brain*.¹⁹ In *The Descent of Man*, Darwin wrote: “A great stride in the development of the intellect will have followed, as soon as, through a previous considerable advance, the half-art and half-instinct of language came into use; for the continued use of language will have reacted on the brain, and produced an inherited effect; and this again will have reaction on the improvement of language”.²⁰ Schleicher used the bifurcation of the lines in his tree diagram (*Stammbaum*) to signify both the period of time that separates the linguistic data whose phylogenetic relationship he was describing and the degree of separation from the assumed *progenitor*. The general principle of establishing relationships between languages based on shared innovations from here on, as with all poorly defined entities, initiated a long succession of debates between *lumpers* and *splitters*. Historical linguists today know that while some phenomena can be described by a bifurcation in a tree-diagram, many do not. Schleicher’s student Johannes Schmidt proposed the wave diagram (similar to a Venn diagram in mathematics) as an alternative explanatory model for change. Without going further into the problematic definition of languages as discrete historical entities, the clear lines and bifurcations of Schleicher’s tree-diagrams stand in stark contrast with John McWhorter’s recent definition of languages as “jerry-rigged splotches doing the best they can despite countless millennia of slow-but-sure kaleidoscopic distortion”.²¹

At least from a diachronic perspective, the concept of species in biology is apparently equally problematic. The philosopher John Wilkins who recently explored the definitions of the concept *species* came to the conclusion that “there are $n + 1$ definitions of ‘species’ in a room of n biologists”.²² One could likewise state that there are $n + 1$ definitions of “language” in a room of n linguists.

¹⁷ Richards 2008, p. 259.

¹⁸ Schleicher 1848, p. 258.

¹⁹ Deacon 1997.

²⁰ Darwin, quoted in Richards 2008, p. 262.

²¹ McWhorter 2011, p. 12.

²² Wilkins 2010.

The *Romantic* biology and *Romantic* linguistics derived from Kant, Goethe, and Schelling unequivocally represent the metaphysics of Uexküll's *Umwelt* theory that inspired the biosemiotics of Thomas A. Sebeok, Jesper Hoffmeyer²³ and others whose thought traverses equally well the phenomena of living things.²⁴ Their work is representative of a holistic view that preserves a Kantian metaphysics characteristic of nineteenth century biology and linguistics for a semiotic perspective on life.

Linguistics in the Twentieth Century and the Prehistory of Biosemiotics

Jakob von Uexküll preserved in the twentieth century a semiotic approach to all natural phenomena that was increasingly perceived as an anachronism when in the middle of the twentieth century biology was revolutionized by the emerging field of genetics and linguists aligned their methods and approaches with the social sciences (in particular sociology and psychology). The fundamental differences between a semiotic perspective and the emerging mainstream methods in the social sciences, and psychology in particular, become especially clear in light of the debates about *psychologism* around the turn of the twentieth century. The historian of philosophy Robert Lanier Anderson explains the connections between anti-psychologism and neo-Kantianism at the beginning of the twentieth century²⁵ in the German context as a struggle between diverging schools of thought. Uexküll, the Kantian biologist, represents an anti-psychologism that is characterized by Frederik Stjernfelt²⁶ as a fundamental necessity for any semiotic perspective on the natural world. Even though the debates among philosophers at the beginning of the twentieth century were admittedly more convoluted than can be addressed in the context of this chapter, “[o]n one significant construal, psychologism is the fallacy of reducing a normative rule of reasoning to an exceptionless, descriptive psychological law”.²⁷ Stjernfelt²⁸ explains the fallacy of psychologism with a caricature:

What is this “psychologism” that anti-psychologism takes as its critical target? [Generally], it is the idea that the content and structure of thought and signs form part of the domain of psychology – so that the study of minds and brains forms the primary or even the only way of accessing these issues. A basic problem in psychologism is that it immediately allows for relativism. If one mind holds one thing to be true while another prefers another, who are we

²³Hoffmeyer 1993[1996] and 2008.

²⁴For instance, Hoffmeyer (2007) illustrates concepts such as *semiotic causation*, *semiotic emergence*, and *semiotic scaffolding* in evolution with the movement of an *Escherichia coli* cell, a reproductive disorder in amphibians, and the development of the word *spam* in English respectively.

²⁵Lanier Anderson 2005, p. 288.

²⁶Stjernfelt 2013.

²⁷Lanier Anderson 2005, p. 292.

²⁸Stjernfelt 2013, p. 77.

to judge, when psychology is taken to be the deepest or even the only access to those claims? Psychology studies psychic processes in general with no distinction as to whether particular claims made by those psyches are true or false, and the truth or falsity of a claim may not be decided from investigating the psychological process bringing forth that claim. To make a caricature: If mathematical entities were really of a psychological nature, then the truth about them should be attained by means of psychological investigations. The upshot of psychologism would thus be that a proper way of deciding the truth of the claim that $2+2=4$ would be to make an empirical investigation of a large number of individual, psychological assessments of that claim. So, if we amass data of, say, 100,000 individual records of calculating $2+2$, we might find that a small but significant amount of persons take the result to be 3, which would give us an average measure of around 3.999 as the result. This might now be celebrated as the most exact and scientific investigation yet of the troubling issue of $2+2$, far more precise than the traditional, metaphysical claims of the result being 4, which must now be seen as merely the coarse and approximate result of centuries of dogmatic mathematicians indulging in mere armchair philosophy and folk theories, not caring to investigate psychological reality empirically.

During the twentieth century, questions about language were increasingly understood as psychological entities that should be studied empirically, rather than by making “metaphysical claims” about language as a human sign system from a semi-otic perspective. The affinities of the field of linguistics with psychology were famously articulated in a *Course in General linguistics (CGL)*²⁹ between 1911 and 1914. This attempt to define and determine a new linguistics grew out of a sense of unease and dissatisfaction that the discipline concerned with human language was focusing too much on the historical development during the nineteenth century, and lacked the proper units of systematic description other scientific fields had established:

From a practical point of view, it would be of interest to begin with units; to determine units, and recognize the various kinds of units by providing a classification. It would be necessary to examine what the basis is for division into words. For the word, in spite of being so difficult to define, is a unit that compels recognition by the mind. It has a central role in the linguistic mechanism. (But a discussion of that topic alone would fill a book.) Then one would proceed to classify smaller units, larger units, and so on. By determining in that way the elements to be dealt with, a science of linguistics would fully achieve its goals, having related all relevant phenomena in its domain to one first principle. It cannot be said that this problem has ever been tackled, or that the scope and difficulty of it have been realized. Where languages are concerned, people have always been satisfied to work with poorly defined units.³⁰

The *word* as an imprecise and awkward unit was unsuitable for a “serious” scientific analysis of language that steered steadfastly away from philology, the study of texts in historical languages that dominated linguistics throughout the nineteenth century. Linguists looked with envy and hope to the periodic table of elements in chemistry. And anyone familiar with the organization of the IPA (International Phonetic Alphabet) will appreciate the similarities in the visual representation of the

²⁹ Saussure 1916.

³⁰ Saussure 1916 [1986, p. 109].

periodic table of elements and what Chomsky called *the phonetic capabilities of man*³¹ (more on that later).

It is interesting to note that at the time the *CGL* failed to characterize an ideal unit of description (the soon to be invented *phoneme*), an American anthropologist apparently had no difficulty in identifying and cataloguing the speech sounds of indigenous languages of North America.³² Ironically, the man who failed at characterizing this ideal linguistic abstraction we call the *phoneme*, was later also blamed for the abstractions associated with so-called *structuralism* in spite of his visionary understanding of linguistics as part of a larger “social psychology” he called *semiology* as “a science that studies the role of signs as part of social life. It would form a part of social psychology, and hence of general psychology. We shall call it *semiology* (from the Greek *semeion* ‘sign’). It would investigate the nature of signs and the laws governing them”.³³ This alignment of linguistics with the methods of psychology and its ensuing unavoidable *psychologism* actually contributed to the marginalization of the semiotic perspective on language that inherently requires anti-psychologism.

The careful reader of the *CGL* will notice the author’s apparent despair over the inadequate theoretical concepts in linguistics and hopeful speculation of future semiology within psychology. It was precisely the affinities between linguistics and psychology that alienated the study of language from biology and from the semiotic perspective throughout the twentieth century. While some see psychology as a bridge between biology and linguistics through fields like evolutionary psychology, neurolinguistics, and brain science, the persistent psychologism only intensified in the context of cognitive science during the last decades of the twentieth century and continues well into the twenty-first century.

But first, it was the ensuing productive critique of the *CGL*³⁴ that brought about the invention of the *phoneme* and other abstractions in phonology and phonetics (such as the *distinctive feature*) that by mid-century became the envy of the social sciences. Following Nikolai Trubetzkoy, Roman Jakobson carried the torch of phonology from Prague to New York. Linguists and anthropologists experimented with phonology-inspired studies in different fields; and there was a great flurry of enthusiasm about all that linguistics had to offer. In the meantime, psychology and behaviorism had become the dominant frameworks in the American context, and linguists had followed right along.³⁵ Linguistics further flourished and linguistics departments were founded and funded profusely in the wake of WWII and the successes of code-breakers and other promising military applications of linguistic insights. It was a steady continuation of linguistic specialization that moved linguistic inquiry

³¹ Chomsky and Halle 1968.

³² Boas 1911.

³³ Saussure 1916 [1986, p. 15].

³⁴ E.g., Trubetzkoy 1939.

³⁵ E.g., Bloomfield 1933.

away from the semiotic perspective towards the empirical methods of psychology and the social sciences.³⁶

As noted by Stjernfelt, “[a]nother implication of psychologism may be that signs and their meaning are nothing more than the individual psychic or neuronal phenomena supporting them or associated with them”.³⁷ This assumption is the basis of most psycholinguistic and neurolinguistic research since the 1980s. To illustrate the dominant psychologism in psycholinguistics, consider the work on the question “Why are abstract concepts hard to understand?”.³⁸ The basis of this type of research is the gathering of behavioral evidence by using psycholinguistic methods of measuring reaction times when reading sentences on a computer screen. In these experiments, subjects read sentences like “*All rifles are shot guns*” versus sentences like “*All ideas are thoughts*”. They then have to press one of two buttons; one for agreement, another one for disagreement; the pertinent empirical data, of course, being the reaction time. These types of psycholinguistic studies have become the norm in terms of funded research in linguistics and continue to become more and more sophisticated in terms of the technologies and equipment used to measure reaction time and other behavioral and physiological evidence.³⁹ Anyone familiar with semiotic theory would agree that these are not the type of questions that would come from a semiotic perspective on language, nor would a semiotic perspective seek the behavioral or physiological evidence to answer any questions pertaining to the differences between abstract and concrete concepts.

Stjernfelt considers “[anti-psychologism] [as] basic for semiotics as such. During the founding period of modern semiotics in the decades around 1900, the refusal to take signs to be reducible to psychological phenomena was crucial for the establishment of logical and semiotic phenomena and structures as autonomous objects of research”.⁴⁰

Here two American linguists, whose work is characterized by the anti-psychologism that constitutes the semiotic perspective on language, stand out: Sebeok and Chomsky.

³⁶ Some of the articulations in the *CGL* also became the target of other types of criticism. Jacques Derrida (Derrida 1967) could have articulated his *Grammatology* in a positive way based on the semiotic perspective he gleaned from Peirce, but he chose to couch his work in a critique of the “linguist from Geneva”, thereby denying the Saussurean legacy of semiology.

³⁷ Stjernfelt 2013, p. 77.

³⁸ Schwanenflugel 1991.

³⁹ E.g., Barber et al. 2013.

⁴⁰ Stjernfelt 2013, p. 77. It should be noted that in the twentieth century, some linguists became uncomfortable with linguistic abstractions and critiques came from inside the field. For example, John Rupert Firth criticized linguistics for its exclusion of the *context*. Michael Halliday formulated a social semiotics. The most irreverent and far-reaching criticism of linguistic abstractions is probably Roy Harris’ *integrationist* linguistics that takes into consideration all the aspects of linguistic exchanges that *phonemes*, *morphemes* or *syntagms* cannot capture. Firth’s *context*, Halliday’s *social semiotics*, Harris’ *integrationism*, and Gunther Kress’ *multimodality* are all reactions to a linguistics estranged from a semiotic perspective on language.

Sebeok, Chomsky, and the Semiotic Perspective

Sebeok and Chomsky share an intellectual trajectory that began with a re-evaluation of Uexküllian *Umwelt* theory and Peircean semiotics in the 1950s. Their biosemiotic/biolinguistic perspective on language anchored an anti-psychologicistic linguistics firmly in biology and ethology.

While the scholarly agendas of biolinguistics and biosemiotics are quite different, they share a common interest in human language as a species-specific cognitive tool. They also share a philosophical core in the Peircean *abduction* and the Uexküllian *Umwelt*⁴¹ that connects them with a view of the living world that is characteristic of the *Naturphilosophie* of Kant, Goethe, and Schelling. Uexküll's concept of *Umwelt* – the subjective species-specific world created by an organism – is central to this approach to human language. Uexküll's son presented his father's *Umweltlehre* as an undogmatic, empirical type of biology by translating the following passage into twentieth century English:

[...] da die Tätigkeit unseres Gemüts das einzige uns unmittelbar bekannte Stück Natur ist, sind seine Gesetze die einzigen, die mit Recht den Namen Naturgesetze tragen dürfen.⁴²

[A]s the activity of the mind is the only aspect of nature immediately known to us, its laws are the only ones which may rightly be called laws of nature.⁴³

Chomsky's interest in Uexküll and ethology goes back to his time as a graduate fellow at Harvard working with Morris Halle and Eric Lenneberg in the 1950s.⁴⁴ The biolinguistic program, therefore, derives its general approach to human language from ethology; and Konrad Lorenz played an important role in its evolution.⁴⁵ Especially Lenneberg's *Biological Foundations of Language* (1964) "anticipated many themes of the coming decades"⁴⁶; and Chomsky concluded in a famous interview that "[linguistics] is really a theoretical biology".⁴⁷

While the cognitive revolution of the mid-twentieth century is generally associated with Chomsky's progress in the understanding of language as a generative system, Chomsky points out that "another influential factor in the renewal of the cognitive revolution was the work of ethologists".⁴⁸ In the preface to the third edition of *Language and Mind* (2006), Chomsky writes: "[The framework of ethology] could be adapted 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

⁴¹ Cf. Augustyn 2009.

⁴² Uexküll 1928, p. 40.

⁴³ Uexküll 1981 [1987, p. 149].

⁴⁴ Cf. Jenkins 2000, p. 1.

⁴⁵ *Ibid.*, p. 10.

⁴⁶ *Ibid.*, p. 3.

⁴⁷ Sklar 1968, p. 213.

⁴⁸ Chomsky 2006, p. x.

aspects of growth of organisms”.⁴⁹ This is also the point of view from which Sebeok’s biosemiotics approaches human language. Sebeok moved from the field of Finno-Ugric studies to semiotics to explore the signifying abilities of all organisms – via zoosemiotics to biosemiotics – to promote the view that all life depends on semiosis. For Sebeok, Uexküll was the “chief architect”⁵⁰ of biosemiotics, whose origin was “rooted in no antecedent semiotic theory or practice at all; it was, rather, connected to the thought of Plato, Leibniz, especially Kant, Goethe, and a handful of biologists, such as Johannes Müller and Karl Ernst von Baer”.⁵¹ To understand the importance of Uexküll’s *Umweltlehre* for Sebeok’s biosemiotics, it is worth quoting Sebeok’s personal account of his first encounter with Uexküll’s *Theoretical Biology* whose problematic translation he had already leafed through as a teenager in 1936:

In the mid 1960s, when at last I read the authentic German version, I came to believe that Ogden, the very animator of Anglo semiotics in the twentieth century, had either known little or no German or, with all his polymathic gifts, had failed to understand what *Theoretische Biologie* was really about: not biology, not psychology, not physiology, but semiotics. What’s more, it unfolded a wholly unprecedented, innovative theory of signs, the scope of which was nothing less than semiosis in life processes in their entirety. It created and established the basis for a comprehensive new domain: we now call it *Biosemiotics*.⁵²

Sebeok attributed the fact that the notion of *Umwelt* did not reach the Anglo-American and international intellectual community much earlier to the inadequate translation of Uexküll’s *Theoretische Biologie* (1920).⁵³ When Sebeok read the German original, he found it “if not pellucid, nonetheless electrifying”⁵⁴ and hereafter recognized in Uexküll the originator of biosemiotic theory in the twentieth century. *Umwelt*, in Sebeok’s working definition, “is a model generated by the organism”⁵⁵ to which language adds a secondary, cognitive dimension. Based on the affinities between Sebeok’s and Chomsky’s approach to linguistics, their semiotic perspective on language can be characterized by the following basic assumptions:

- (a) *The cognitive capacities of humans are species-specific (as are the semiotic capacities of all organisms)*

Chomsky and Sebeok share the view that an analysis of human language begins with ethology and the Uexküllian principle that all organisms create their own *Umwelt* based on their species-specific capacities. This determines what questions should be asked about language and what are considered permissible hypotheses. Chomsky explained the role ethology played in the articulation of his biolinguistic program:

⁴⁹ *Ibid.*

⁵⁰ Sebeok 2001, p. 70.

⁵¹ Cf. Sebeok 1998, p. 32.

⁵² *Ibid.*

⁵³ Cf. Uexküll 1928.

⁵⁴ Sebeok 1998, pp. 32–34.

⁵⁵ Sebeok 2001, p. vii.

[It] seems that most complex organisms have highly specific forms of sensory and perceptual organization that are associated with the *Umwelt* and the manner of life of the organism. There is little reason to doubt that what is true of lower organisms is true of humans as well. Particularly in the case of language, it is natural to expect a close relation between innate properties of the mind and features of linguistic structure; for language, after all, has no existence apart from its mental representation. Whatever properties it has must be those that are given to it by the innate mental processes of the organism that has invented it and that invents it anew with each succeeding generation, along with whatever properties are associated with the conditions for its use. Once again, it seems that language should be, for this reason, a most illuminating probe with which to explore the organization of mental processes.⁵⁶

His fellow Harvard graduate Lenneberg, in his *Biological Foundations of Language*, had referred to Uexküll's *Umwelt und Innenwelt der Tiere* to address the species-specificities of all behavior:

The interaction of integrated patterns of all these different potentialities produces the cognitive specificities that have induced von Uexkuell [**sic**], the forerunner of modern ethology, to propose that every species has its own world-view. The phenomenological implications of this formulation may sound old-fashioned today, but students of animal behavior cannot ignore the fact that the differences in cognitive processes (1) are empirically demonstrable and (2) are the correlates of species-specific behavior.⁵⁷

There is some irony in Lenneberg apologizing for his *Biological Foundations of Language* sounding “old-fashioned” in the 1960s when the “phenomenological implications” quite obviously reflect the principles of the *Naturphilosophie* that Uexküll had tried so hard to preserve in biology.

It is representative both of Chomsky's fame and Sebeok's ambitions to unify a vast variety of semiotic perspectives, that one can find frequent references to Chomsky in Sebeok's work,⁵⁸ but not vice versa. Their only documentable “collaboration” is an essay on primate studies in an anthology edited by Sebeok and his wife Jean Umiker-Sebeok.⁵⁹ Both Sebeok and Chomsky challenged prominent primate studies of the 1970s, because they both believed that no valuable insights about human language or primate cognition would be gleaned from teaching sign-language to a chimpanzee or a bonobo. It took many unhappy primates practicing abstract symbol recognition and ASL before most linguists and psychologists came to the conclusion that chimps and bonobos have *their own* communication systems that are specific to their species; and that scientific efforts to understand primate cognition had to be refocused on those *species-specific sign systems*.

(b) *Language is primarily a cognitive tool (rather than a communication system)*

The importance of this fundamental idea about human language shared by Chomsky and Sebeok cannot be emphasized enough. They both see human language foremost as a tool of thought, because the species was capable of

⁵⁶Chomsky 2006, p. 83.

⁵⁷Lenneberg 1964, p. 372.

⁵⁸E.g., Sebeok 1977, p. 181 and 2001, pp. xix, 22.

⁵⁹Sebeok and Umiker-Sebeok (eds.), 1980.

communication before it emerged. Sebeok put it like this: “[L]anguage – consisting of a set of features that promotes fitness – had best be thought of as having been built by selection for the cognitive function of modeling, and, as the philosopher Popper as well as the linguist Chomsky have likewise insisted [...], not at 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”.⁶⁰ The implications for what linguistics ought to be concerned with are far from trivial; and the importance of this basic assumption cannot be emphasized strongly enough. Chomsky readily admits that this view is considered “idiosyncratic” by most linguists, but is perfectly compatible with Sebeok’s definition of language as 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*).⁶¹

(c) *Language is an exaptation*

For Chomsky, as for Sebeok, language is a tool of thought that is based on principles that are *not* specific to language. Chomsky confidently relates these “principles not specific to the faculty of language” to the Galilean intuition that “nature is perfect, from the tides to the flight of birds, and that it is the task of the scientist to discover in just what sense that is true”.⁶²

Sebeok and Chomsky consequently share the view that language is an *exaptation*⁶³; 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.⁶⁴

While questions of evolution were never central to Chomsky’s theoretical work, he considers the diversity of the roughly 6,000 languages on Earth to be superficial as his work focuses on the abstract principles that underlie their grammars.

The notion of optimal design in the Minimalist approach, exemplified by the analogy between language and a *snowflake* within biolinguistics can therefore be understood as the central unifying principle that sees language as a natural object.⁶⁵ Darwin and Schleicher could not have agreed more.

(d) *Linguistics is theoretical biology (and habit-taking/abduction are real processes)*

Chomsky outlined his preferred path in linguistics in his review of Burrhus Frederic Skinner’s *Verbal Behavior* (1959). In this, he exposed the inadequacy of the predominant behaviorist approaches to issues of mind in general, and the learning of language in particular. He stressed, albeit in a footnote, concerning the

⁶⁰ Sebeok 1991, p. 53.

⁶¹ Cf. Andersen and Merrell 1991; Sebeok and Danesi 2000.

⁶² Chomsky 2006, p. 178.

⁶³ Sebeok 2001, p. 29; Boeckx and Piatelli-Palmarini 2005, p. 460.

⁶⁴ E.g., Pinker 1994 and 2003.

⁶⁵ Boeckx and Piatelli-Palmarini 2005, p. 461.

“unknown character and complexity” of the human “hypothesis formulating ability” – a notion that he later clearly articulated as Peircean *abduction* – “the necessity for carefully analyzing the strategies available to the organism as a complex information-processing system”.⁶⁶

The laws and principles of this *philosophical grammar*, he wrote, “are not formulable in terms of even the most elaborate extension of the concepts proper to the analysis of behavior and interaction of physical bodies, and they are not realizable by even the most complex automaton”.⁶⁷ Chomsky envisioned “a psychology that begins with the problems of characterizing various systems of human knowledge and belief, the concepts in terms of which they are organized and the principles that underlie them, and that only then turns to the study of how these systems might have developed through some combination of innate structure and *organism-environment interaction*”.⁶⁸ He cautioned psychologists already in 1967 not “to relate the postulated mental structures and processes to any physiological mechanisms or to interpret mental function in terms of ‘physical causes’”⁶⁹ but, instead, to explore the creative/generative principles of language use. With this fundamentally anti-psychologistic perspective, he regarded the segmentation and classification techniques practiced by the structural linguists of his time as “at best limited to the phenomena of surface structure [that] cannot reveal the mechanisms that underlie the creative aspect of language use and the expression of semantic content”.⁷⁰

The important aspect of ethology for Chomsky’s philosophical grammar “is its attempt to explore the innate properties that determine how knowledge is acquired and the character of that knowledge”.⁷¹ Chomsky, like Sebeok, looked to Peirce in order to explain the problem of development “rather like that of explaining successful abduction”.⁷² He clarifies his view concerning the acquisition of language as an ideal example of the human *hypothesis-formulating ability*:

The way in which I have been describing acquisition of knowledge of language calls to mind a very interesting and rather neglected lecture given by Charles Sanders Peirce more than 50 years ago, in which he developed some rather similar notions about acquisition of knowledge in general. Peirce argued that the general limits of human intelligence are much more narrow than might be suggested by romantic assumptions about the limitless perfectibility of man [...]. He held that innate limitations on admissible hypotheses are a precondition for successful theory construction, and that the “guessing instinct” that provides hypotheses makes use of inductive procedures only for “corrective action.” [...] To understand how knowledge is acquired, in the rationalist view that Peirce outlined, we must penetrate the mysteries of what he called “abduction”.⁷³

⁶⁶Chomsky 1959, p. 57.

⁶⁷Chomsky 2006, p. 6.

⁶⁸*Ibid.*; italics mine. – P.A.

⁶⁹*Ibid.*, p. 12.

⁷⁰*Ibid.*, p. 20.

⁷¹*Ibid.*

⁷²*Ibid.*, p. 84.

⁷³*Ibid.*, pp. 79–80.

Chomsky outlines the tasks for the biolinguistic framework, first, “to construct generative grammars for particular languages that yield the facts about sound and meaning”, and second, “to account for the acquisition of language”.⁷⁴

What has been a constant throughout the 50 years of the biolinguistic approach is its anchoring in the concept that language depends on a unique interplay of innate faculties and organism-environment interaction, and a “genetically determined instinct” of formulating hypotheses that Chomsky sees explained in Peircean abduction.

Sebeok’s linguistics likewise begins with the idea that at the core of this secondary modeling system are abstract principles that can only be explained through semiotic analysis. His work is openly grounded in Peircean semiotics and he shared what Chomsky considered “the preferred path” in linguistics to be theoretical biology. Peircean abduction, likewise, is at the heart of the biosemiotic enterprise. This core principle that defines the biosemiotic perspective outlined by Sebeok, resonates in Hoffmeyer’s assertion that “[i]t lies at the heart of biosemiotics and of Peircean cosmological philosophy that ‘habit taking’ or interpretation are real processes in the world, and therefore that belief in the law of necessity is unfounded”.⁷⁵

(e) *Language is a natural object*

Sebeok and Chomsky refute the common distinction between nature and culture. They are *hybrids* in the sense of Bruno Latour’s analysis of what he calls the Modern Constitution. In his essay *We Have Never Been Modern* (1991),⁷⁶ Latour lays out the Modern Constitution that separates “three regions of being”,⁷⁷ *nature – politics – and discourse* through the processes he calls *purification* and *mediation*.

The paradox of the Modern Constitution is that the separation of nature and society (= *purification*) makes *mediation* possible, but marginalizes it and renders it invisible at the same time. But only *hybrids*, says Latour, “can change the future”.⁷⁸ Mainstream linguists and mainstream biologists who suffer from the illusions of the Modern Constitution practice purification so that nature and society must remain distinct. This includes the illusion (1) that even though we construct nature, nature is as if we did not construct it, and another (2) that even though we do not construct society, it is as if we construct it.⁷⁹ More importantly, Latour shows us that the Modern Constitution entails, besides the dichotomy between *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 other species) are seen as outsiders of the purified disciplines of the mainstream. This becomes especially

⁷⁴Chomsky 2007, p. 14.

⁷⁵Hoffmeyer 2004, p. 73.

⁷⁶Latour 1991 [1993].

⁷⁷*Ibid.*, p. 39.

⁷⁸*Ibid.*, p. 11.

⁷⁹Latour 1991 [1993].

apparent when anthropologists study cultures in the West, or when ethologists, biologists, linguists, or semioticians study the cognitive capacities of humans.

Chomsky and Sebeok's grounding in Peircean *semeiotic* and Uexküllian *Umwelt* theory clearly makes them *hybrids*.⁸⁰ 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, "[t]he essential point of this Constitution is that it renders the work of mediation that assembles hybrids invisible, unthinkable, unrepresentable".⁸¹

This can be explained with the predominant folk-definition of *Universal Grammar (UG)*, 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 *UG* 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 accept Chomsky's definition of *UG* 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",⁸² 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. This is also because most of biology follows the Modern Constitution in the form of evolutionary psychology. For those who understand the philosophical background behind the faculty of language as a combination of (1) innate capacities, (2) organism-environment interaction (*Umwelt*), and (3) abstract principles *not* specific to the faculty of language,⁸³ 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. Chomsky's *Cartesian Linguistics (1966)*⁸⁴ likewise defies the paradoxes of the Modern Constitution, because it begins with the unresolved questions of the seventeenth 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

⁸⁰ *Sensu* Latour 1991 [1993].

⁸¹ Latour 1991 [1993, p. 34].

⁸² *Ibid.*

⁸³ Cf. Chomsky 2005, p. 6.

⁸⁴ Chomsky 1966 [2009].

of linguistic creativity [...] for the study of the human mind”.⁸⁵ Connecting biolinguistics to the questions Descartes addressed at the end of the sixteenth century declares this perspective on language and mind scientifically pre-Modern.

Chomsky’s *cognitive revolution* of the mid-twentieth century is a renewal and further development of the cognitive revolution of the seventeenth century, while another influential factor in the renewal of the cognitive revolution was the work of ethologists, ethology being a field that defies the principles of the Modern Constitution. Sebeok, the linguist whose life work was to turn semiotics into a science of all life, obviously *has never been modern*. He would certainly agree that the fundamental questions of biolinguistics articulated by Chomsky⁸⁶ have yet to be answered:

1. What constitutes knowledge of language? (Plato’s problem)
2. How is this knowledge acquired? (Humboldt’s problem)
3. How is this knowledge put to use? (Descartes’ problem)

To these three fundamental questions, the following two have been added cautiously:

4. What are the related brain mechanisms?
5. How did language evolve in the species?

Chomsky’s preferred path in linguistics steered away from physiological and behavioral evidence for a long time, slowly and cautiously considering such evidence for what are considered permissible hypotheses within biolinguistics. In particular, Chomsky has been critical of the many confident pronouncements coming from neuroscience about how the “brain produces language”. Chomsky’s collaborator Tecumseh Fitch recently expressed this kind of skepticism towards physiological evidence when he accused neuroscientists for “a decade or so of somewhat self-indulgent neo-phrenology”.⁸⁷ Like in all “academic tribal societies”, biolinguistics is plagued by challenges “concerning terminology, disciplinary turf wars, and struggles for dominance”.⁸⁸ The same is true for biosemiotics.

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 “principles underlying brain development and evolution remain only dimly understood”.⁸⁹ Likewise, neuroscientists do not know how brains generate language, and there is very little collaboration between neurolinguists and theoretical linguists.⁹⁰

⁸⁵ *Ibid.*, p. 1.

⁸⁶ Jenkins 2000.

⁸⁷ Fitch 2009, p. 284.

⁸⁸ *Ibid.*, p. 285.

⁸⁹ *Ibid.*

⁹⁰ Cf. Andrews 2011.

An important issue for biolinguists, according to Fitch, are “questions of meaning” and what he calls “unresolved semiotic challenges [that] pose problems for any aspect of cognition”.⁹¹ 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”,⁹² he is looking for an 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”⁹³ that many biosemioticians see in mainstream biology.

Most biosemioticians would see eye to eye with Fitch on that central challenge, although they may not all agree on how to best connect biolinguistics and biosemiotics.⁹⁴ Hoffmeyer, who turned to philosophy to address these issues in biology would agree that it is precisely the vagueness of concepts such as *information* or *signal* in biology that drove biologists to philosophy and semiotics, fueled the biosemiotic movement and helped crystalize its central theses.⁹⁵ According to 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”.⁹⁶ To be sure, even though the “ideas and the personalities who embody and propagate them, are in [Sebeok’s] view kept asunder at one’s peril”,⁹⁷ biolinguistics and biosemiotics are what he would have considered to be “complementary domains”⁹⁸ because they unequivocally share an anti-psychologistic perspective on language that is rooted in semiotic theory.

When the biologist/philosopher Andreas Weber anticipates a “revolution of the life sciences”,⁹⁹ it becomes very clear that what Weber is hoping for is that biology (along with other fields) may *return* to a view of living organisms that is in agreement with the monist metaphysics of nineteenth century *Romantic biology* and the anti-psychologism of Kantian biologists like Jakob von Uexküll. That was the intellectual climate that gave rise to the concept of ecology¹⁰⁰ and the idea that the analysis of human language can make a direct contribution to a natural history of the genus *Homo*.

⁹¹ Fitch 2009, p. 284.

⁹² *Ibid.*, p. 285.

⁹³ *Ibid.*, p. 286.

⁹⁴ E.g., Barbieri 2010.

⁹⁵ Cf. Kull et al. 2009.

⁹⁶ Hoffmeyer 2008, p. 15.

⁹⁷ Sebeok 1998, p. 25.

⁹⁸ *Ibid.*, p. 24.

⁹⁹ Weber 2008.

¹⁰⁰ Haeckel 1866.

References

- Andersen, M., & Merrell, F. (1991). *On semiotic modeling*. Berlin: Mouton de Gruyter.
- Andrews, E. (2011). Language and brain. Recasting meaning in the definition of human language. *Semiotica*, 184(1–4), 11–32.
- Atkinson, Q., & Gray, R. D. (2005). Curious parallels and curious connections – Phylogenetic thinking in biology and historical linguistics. *Systematic Biology*, 54(4), 513–526.
- Augustyn, P. (2009). Uexküll, Peirce, and other affinities between biosemiotics and biolinguistics. *Biosemiotics*, 2(1), 1–17.
- Barber, H., Otten, L. J., Kousta, S.-T., & Vigliocco, G. (2013). Concreteness in word processing: ERP and behavioral effects in a lexical decision task. *Brain & Language*, 125, 47–53.
- Barbieri, M. (2010). On the origin of language: A bridge between biolinguistics and biosemiotics. *Biosemiotics*, 3(2), 201–223.
- Bloomfield, L. (1933). *Language*. Chicago: University of Chicago Press.
- Boas, F. (1911). *Handbook of American Indian languages*. Washington, DC: GPO.
- Boeckx, C., & Piatelli-Palmarini, M. (2005). Language as a natural object; Linguistics as a natural science. *The Linguistic Review*, 22, 447–466.
- Chomsky, N. (1959). A review of B.F. Skinner's verbal behavior. *Language*, 35(1), 26–58.
- Chomsky, N. (1966 [2009]). *Cartesian linguistics. A chapter in the history of rationalist thought*. Cambridge: Cambridge University Press.
- Chomsky, N. (2005). Three factors in language design. *Linguistic Inquiry*, 36(1), 1–22.
- Chomsky, N. (2006). *Language and mind*. Cambridge: Cambridge University Press.
- Chomsky, N. (2007). Biolinguistic explorations: Design, development, and evolution. *International Journal of Philosophical Studies*, 15(1), 1–21.
- Chomsky, N., & Halle, M. (1968). *The sound patterns of English*. New York: Harper & Row.
- Darwin, C. R. (1859). *On the origin of species by means of natural selection or the preservation of favoured races in the struggle for life*. London: John Murray.
- Darwin, C. R. (1871). *The descent of man, and selection in relation to sex*. London: John Murray.
- Deacon, T. W. (1997). *The symbolic species*. New York: W.W. Norton & Co.
- Derrida, J. (1967). *De la Grammatologie*. Paris: Éditions de Minuit.
- Fitch, T. (2009). Prolegomena to a future science of biolinguistics. *Biolinguistics*, 3(4), 283–320.
- Haeckel, E. (1866). *Generelle Morphologie der Organismen*. Berlin: Georg Reimer.
- Hoffmeyer, J. (1993 [1996]). *Signs of meaning in the universe*. Bloomington: Indiana University Press.
- Hoffmeyer, J. (2004). Uexküllian Planmäßigkeit. *Sign Systems Studies*, 32(1–2), 73–97.
- Hoffmeyer, J. (2007). Semiotic scaffolding of living systems. In M. Barbieri (Ed.), *Introduction to biosemiotics. The new biological synthesis* (pp. 149–166). Dordrecht: Springer.
- Hoffmeyer, J. (2008). *Biosemiotics: An examination into the life of signs and the signs of life*. Scranton: University of Scranton Press.
- Jenkins, L. (2000). *Biolinguistics. Exploring the biology of language*. Cambridge: Cambridge University Press.
- Kull, K. (2001). Jakob von Uexküll. An introduction. *Semiotica*, 134(1–4), 1–50.
- Kull, K., Deacon, T., Emmeche, C., Hoffmeyer, J., & Stjernfelt, F. (2009). Theses on biosemiotics: Prolegomena to a theoretical biology. *Biological Theory*, 4(2), 167–173.
- Lanier Anderson, R. (2005). Neo-Kantianism and the roots of anti-psychologism. *British Journal for the History of Philosophy*, 13(2), 287–323.
- Latour, B. (1991 [1993]). *We have never been modern*. Cambridge, MA: Harvard University Press.
- Lenneberg, E. H. (1964). *Biological foundations of language*. New York: Wiley.
- Lowth, R. (1762). *A short introduction to English grammar with critical notes*. London: Dodsley and Cadell.
- McWhorter, J. (2011). *What language is (and what It Isn't and what It could be)*. New York: Gotham Books.

- Murray, L. (1795). *English grammar adapted to the different classes of learners*. Philadelphia: J. and W. Paul.
- Pinker, S. (1994). *The language instinct. How the mind creates language*. New York: Harper Perennial.
- Pinker, S. (2003). *The blank slate*. New York: Penguin.
- Richards, R. J. (2002). The linguistic creation of man: Charles Darwin, August Schleicher, Ernst Haeckel and the missing link in evolutionary theory. In M. Dörries (Ed.), *Experimenting in tongues: Studies in science and language* (pp. 21–48). Stanford: Stanford University Press.
- Richards, R. J. (2004). *The romantic conception of life: Science and philosophy in the Age of Goethe*. Chicago: University of Chicago Press.
- Richards, R. J. (2008). *The tragic sense of life. Ernst Haeckel and the struggle over evolutionary thought*. Chicago: University of Chicago Press.
- Saussure, F. de (1916). *Cours de linguistique générale*. Lausanne/Paris: Payot.
- Saussure, F. de (1916 [1986]). *Course in general linguistics*. La Salle: Open Court.
- Schleicher, A. (1848). *Zur vergleichenden Sprachgeschichte*. Bonn: H.B. König.
- Schleicher, A. (1863). *Die Darwinsche Theorie und die Sprachwissenschaft*. Weimar: Böhlau.
- Schleicher, A. (1865). *Über die Bedeutung der Sprache für die Naturgeschichte des Menschen*. Weimar: Böhlau.
- Schwanenflugel, P. J. (1991). Why are abstract concepts hard to understand? In P. J. Schwanenflugel (Ed.), *The psychology of word meanings* (pp. 223–250). Hillsdale: Lawrence Erlbaum Associates.
- Sebeok, T. A. (1977). *A perfusion of signs*. Bloomington: Indiana University Press.
- Sebeok, T. A. (1991). In what sense is language a primary modeling system? In T. A. Sebeok, *A sign is just a sign* (pp. 49–58). Bloomington: Indiana University Press.
- Sebeok, T. A. (1998). The Estonian connection. *Sign Systems Studies*, 26, 20–41.
- Sebeok, T. A. (2001). *Global semiotics*. Bloomington: Indiana University Press.
- Sebeok, T. A., & Danesi, M. (2000). *The forms of meaning*. Berlin: Mouton de Gruyter.
- Sebeok, T. A., & Umiker-Sebeok, J. (Eds.). (1980). *Speaking of apes. A critical anthology of two-way communication with man*. New York: Plenum.
- Sklar, R. (1968). Chomsky's revolution in linguistics. *The Nation*, 9 September 1968, (pp. 213–217).
- Stjernfelt, F. (2013). The generality of signs: The actual relevance of anti-psychologism. *Semiotica*, 194, 77–98.
- Trubetzkoy, N. (1939). *Grundzüge der Phonologie* [Travaux du Cercle Linguistique de Prague 7].
- Uexküll, J. von (1928). *Theoretische Biologie* (2nd Rev. ed). Berlin: Verlag von Julius Springer.
- Uexküll, J. von (1957). *Niegeschaute Welten*. München: Paul List Verlag.
- Uexküll, T. von (1981 [1987]). The sign theory of Jakob von Uexküll. In M. Krampen, K. Oehler, R. Posner, T. A. Sebeok & T. von Uexküll (Eds.), *Classics of semiotics* (pp. 147–179). New York: Plenum.
- Uexküll, T. von (1992). Preface to *A stroll through the worlds of animals and men: A picture book of invisible worlds*. *Semiotica*, 89(4), 319–391.
- Weber, A. (2008). *Alles Fühlt. Mensch, Natur, und die Revolution der Lebenswissenschaften*. Berlin: Berlin Verlag.
- Wilkins, J. (2010). What is a species? Essences and generation. *Theory in Biosciences*, 129(2–3), 141–148.