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Article abstract

Biosemiotics and biolinguistics share some common origins in comparative psychology and ethology, both viewing language as a species-specific cognitive capacity whose main purpose is not communication but thought. From this perspective, biosemiotics should be at the center of cognitive science. However, biolinguistics and biosemiotics (or linguistics and semiotics) have been marginalized in the context of cognitive science and neuroscience; nonetheless there are currents in mainstream linguistics and cognitive science operating from a biosemiotic perspective without overtly articulating their research agendas as such. I believe that the future success of the biosemiotic movement will depend on recognizing and connecting with those research agendas.

From Ethological Linguistics to Animal Linguistics and Ecolinguistics

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Introduction

Biosemiotics undeniably appears to reside in the margins of the disciplines of linguistics and cognitive science in terms of the number of direct references in publications, at conferences, and institutional representation. The body of theoretical approaches that are considered foundational to (bio)semiotics are not generally seen as part of the canon of linguistics or cognitive science. One could say that this is a matter of perspective or bias that reflects ideological trends and power structures that govern research, higher education, politics, and the media. From a certain perspective that can be characterized as *ethological linguistics*, however, the study of human language as one particular kind of sign system within the study of sign processes in living systems that is (bio) semiotics, represents a central objective of linguistics and cognitive science. Not many linguists or cognitive scientists take that ethological perspective, but some do, as argued in this paper knowingly or unknowingly, with great impact.

With the ascent of the field of cognitive science in the late 20th century, even the institutionalized field of linguistics appears to have lost its central position when it comes to the study of language and the mind, because by mere statistics of citations and media exposure neuroscience has become central to cognitive science; and linguistics seems to have drifted to the margins (Andrews 2011).

However, there are currents in linguistics operating from an ethological perspective without overtly articulating their theoretical founda-

tions or research agendas as informed by or adhering to the theoretical foundations of (bio)semiotics that continue to contribute to compelling research on language and the mind. There have also been noticeable shifts in several areas of linguistics in recent decades that indicate an increasing appreciation of ethological perspectives in the language sciences with or without overt connection to (bio)semiotics.

This article deals with the currents from and shifts towards (bio) semiotic approaches in the language sciences, both overt and covert, that go back to ethology. Some of them are cautiously articulating the (bio)semiotic origin of their revised agendas, such as the field of animal studies (or animal linguistics), as part of the expanding domain of linguistics towards other species. In the field of animal studies, the (bio) semiotic shift manifests itself as a reorientation within the domain of linguistics regarding the sign systems of other species, whether in the context of comparative psychology or ethology through Uexküll's notion of *Umwelt*, or a wider conception of ecolinguistics, whose scope and objectives are currently being rearticulated (Stibbe 2017).

Other areas of theoretical linguistics have long been proceeding based on (bio)semiotic principles without overt articulation, coming from an ethological perspective. One example for this is experimental phonetics and laboratory phonology (e.g. Ohala 1996, 2004, Kharlamov *et al.* 2015). In relation to the theoretical linguists who are finding new ways to study the human faculty of language through the structure of natural languages and the linguistic capabilities of the human body/mind, an argument can be made for the relevance of the basic perception/action model of Uexküll's *Funktionskreis* to many areas of current interest in linguistics and cognitive science.

Ethology and Linguistics

If we take Sebeok's discovery of the work of Jakob von Uexküll (1920) and his subsequent articulation of (bio)semiotics to be the beginning of an intellectual movement, the (bio)semiotic trajectory in relation to linguistics can be traced from the early 20th century when Sebeok and other linguists turned to ethology. It is important to note that some important figures in semiotics, Myrdene Anderson among them, insist that there is no real difference between semiotics and biosemiotics; and the parenthetic spelling *(bio)semiotics* in this context is used to refer to the particular intellectual current that begins with Sebeok's discovery and later informed rediscovery and application of the work of Jakob von Uexküll throughout the 20th century.

Sebeok was a young student when he discovered Uexküll's *Theoretische Biologie* (1920) in 1936 in a book series compiled under the editorship of I.A. Richards, a key figure at the time in semantics and the philosophy of language. Ogden & Richards' *The Meaning of Meaning* (1923) is considered to be the first reaction to the writings of both

Saussure and Peirce, who are believed to have developed their respective lines of thinking independently. The most popular item to come of this, generally accepted in mainstream linguistics as an important theoretical concept, is the so-called "semiotic triangle" or "triangle of reference" that has become a ubiquitous diagrammatic representation of the process of semiosis, whether presented as such or not. In linguistics, this diagram has become central to semantic theory, usually without overt attribution to Peirce as the originator of the triadic model of sign action.

Another Peircean concept, widely accepted in linguistics is the type/token distinction (CP 4.537), essential to 20th and 21st century corpus linguistics or any data-intensive approach in the language sciences. The concept of the type/token ratio is now more important than ever, as data-intensive and statistical analysis has become increasingly important to research agendas involving Big Data. This also is usually never attributed to Peirce or (bio)semiotic theory.

The lectures of Ferdinand de Saussure and the many nebulous concepts such as *value* and *opposition* made an indirect but important contribution to the development of phonology in the course of the 20th century, but are for the most part only presented as such in texts about the history of the discipline. (e.g. Joseph *et al.* 2001) Without these ideas, however, theoretical concepts such as the *phoneme* would not have been articulated in the same fashion by Trubetzkoy (1939) and later by Jakobson, Fant & Halle (1952). Therefore, phonology is generally also not a field one directly connects with (bio)semiotic theory even though one could say that the key concepts of Saussurean semiology and their interpretation by 20th century linguists like Trubetzkoy and Jakobson played an important part in its development.

One current of phonetics/phonology that has gained considerable momentum in the 21st century that takes the ethological perspective seriously is what Ohala (2004) called "scientific phonetic" as opposed to a mere "taxonomic phonetics". If taxonomic phonetics is just a kind of inventory-taking and categorizing of speech sounds and their articulatory and acoustic properties, *scientific phonetics* is concerned with the phonetic abilities of the human body/mind from an ethological perspective that can yield insights that are relevant to cognitive science. "Besides these typical external differences between taxonomic and scientific phonetics there is a profound philosophical difference. The 'scientific' approach implies, as do all other sciences since the Renaissance that any given theory, including whatever one believes most fondly, may be erroneous but that by gathering data in a rigorous way such error may be minimized or avoided. In contrast, taxonomic phonetics thrives through conformit" (Ohala 2004 : 134). Phonology, generally considered to be the 'nuts and bolts' of linguistics clearly favors taxonomic phonetics, because it derives from it an inventory of abstractions deployed in phonological theories. While taxonomic phonetics has provided stability and

conformity to theoretical phonology throughout the 20th century, it is in *scientific phonetics* that real progress has been made in understanding the production and perception of human speech (*cf.* Ohala 2004). It is precisely the instability and constant retooling of *scientific phonetics* that yields scientific progress and yields new insights on the phonetic abilities of humans. It is this scientific phonetics that operates from an ethological perspective.

In a paper addressing the signaling of emotion in the voice, Ohala (1996 : 1812) explained that "[the] comparative study of the expression of emotions has, in fact, reaped a rich harvest. There are remarkable similarities – both macro- and micro- patterns – in the expression of emotions in humans and various non-human species. This is particularly true among species able to exploit some of the same signaling modalities as humans, *i.e.* the vocalauditory channel and facial expressions". The scientific phonetics originated by Ohala remained in the margin of linguistics throughout the 20th century, because it was unstable as a paradigm, it had to constantly be revised with every innovation in research tools and methods. What we find in textbooks still today about phonetics and phonology is the reliable conformity of taxonomic phonetics in the service of phonological theory that makes Ohala's ethological semiotic perspective (e.g. comparing human facial expressions and vocalauditory abilities to those of primates) appear to be marginal. This marginalization of scientific phonetics is evident in Ladefoged's review of 50 years of phonology, where Ohala's scientific phonetics received barely more than an honorable mention (*cf.* Ladefoged 2004).

At the beginning of the 20th century, Sebeok was a young multilingual, operating in English with an inherited interest in the Finno-Ugric languages as a native speaker of Hungarian. His early and lifelong interest in natural languages as species-specific sign systems and subsequent focus on biology and zoology is well-documented in his autobiographical and historiographical writings (Sebeok 1997, 1998), and also explained more recently by Favareau (2015). Sebeok's discovery of the work of Jakob von Uexküll marks the beginning of Sebeok's interest in linguistics from an ethological perspective. His career as an expert in Finno-Ugric linguistics took a wide angle in the 1950s, incorporating the questions concerning human language as a species-specific sign system, placing linguistics at the center of semiotics and cognitive science.

As an example that illustrates the explanatory power of this kind of ethological thinking, consider the concept of *object permanence* in developmental psychology as a human cognitive milestone that was described by Jean Piaget. Before becoming a key figure in human child development, Piaget also had a keen interest in biology and zoology. He knew that object permanence as a cognitive ability is present in some animals (e.g. dogs and crows), but not in others (e.g. snakes). If a dog follows a mouse that disappears into a hole in the ground, the

dog knows that the mouse still exists even though it can no longer be observed, while snakes do not have the working memory to reckon with the permanent existence of the mouse after it disappeared. Such are the differences in the varying species-specific cognitive abilities among animals to make sense of the world. Recognizing oneself in the mirror is a similar issue. Some animals have this ability (e.g. dolphins) while others (e.g. dogs) do not. This kind of comparative psychology across the species is the ethological perspective that parallels Sebeok's (and other linguists') ethological perspective on language.

Jakob von Uexküll spent his entire life studying the semiotic abilities of different animals and came to the conclusion 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" (Uexküll 1902 : 213 [my translation]). His wife Gudrun von Uexküll succinctly described the moment when Uexküll's concept of *Umwelt* became clear to her :

> I remember standing in front of a beautiful beech tree in the Heidelberg forest and it finally became clear to me : This is not a beech tree, but *my* beech tree! I have constructed it with my sense perception in all its details. What I see, smell or taste are not any objective characteristics of the tree, but instead they are the perceptions of my sense organs that I externalize to construct it. That was the fundamental insight that was necessary to explore the subjective worlds of organisms. (Gudrun von Uexküll 1964 : 164 [my translation])

To the 21st century ecolinguist this personal anecdote characterizes Uexküll's *Umwelt* as a cognitive/semiotic concept that is fundamental to the human abilities to construct what we call *nature* through our species-specific sense-perception on the one hand; but also with language on the other hand. Language, from the ethological perspective, is part of the species-specific human abilities to construct subjective models of the world. This is the basic premise of Modeling Systems Theory (MST) that characterizes language as a secondary system that humans have in addition to a primary modeling system they share to some degrees with other animals (*cf.* Anderson & Merrell 1991).

The origin and nature of the connections between linguistics and ethology that lead linguists like Sebeok, Chomsky (e.g. 1957, 1967), and Lenneberg (1964) to the work of Jakob von Uexküll in the 1950s resulted in a set of basic principles concerning the study of human language (*cf.* Augustyn 2013) :

1. The cognitive capacities of humans are species-specific (as are the semiotic capacities of all organisms)
2. Language is primarily a cognitive tool (rather than a communication system)
3. Language is an exaptation (exploiting cognitive principles not specific to language)

4. Linguistics is theoretical biology
5. Language is a natural object

Chomsky's critique of behaviorism that is often referred to as the *cognitive revolution* of the 1950s and 1960s likewise is compellingly captured in the Uexküllian notion of *Umwelt* :

> [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. (Chomsky 2006 : 83)

The linguists who forfeited the ethological wide-angle of biolinguistics for narrower perspectives, concentrating only on the scientific questions in particular subfields (e.g. phonology, morphology, syntax, and semantics of natural languages), may have never considered the human language faculty in this way at all. An ever increasing interest in applied linguistics (over theoretical linguistics) has quite simply made the field so much larger and so much more diverse that the inherently underlying ethological perspective on the human faculty of language no longer appears to be at the center of the discipline (*cf.* Favareau 2015). There are so many specialized subfields, both in theoretical and applied linguistics, that many linguists never have to leave the frog's view to even consider more general questions concerning human language (as articulated by the biolinguistic agenda). They do not take the view of Chomsky's imaginary *Martian scientist* and may never have to ask (Jenkins 2000) :

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

If linguistics is to play a role in cognitive science, these are undeniably the central questions (*cf.* Andrews 2011).

Modern Linguistics

Most linguists today do not see their field directly connected to biology, but rather aligned with psychology or the social sciences. The ethological perspective on language is foreign to them. This attitude

pushes ethological/(bio)semiotic perspectives on human language further out to the margins from their point of view. Bruno Latour's critique of the 'modern' sciences explains this through the widespread illusion of a separation between *nature* and *culture* that is typical of mainstream linguists as of other scientists (Latour 1998). Following this illusion, language although it is a natural object, is seen as part of culture and therefore to be dealt with exclusively in the humanities and social sciences. Noam Chomsky's biolinguistics and Sebeok's (bio)semiotics do not entertain the modern illusion. For them, language did not evolve in humans for the purpose of communication (which is still a widely held opinion and is a direct consequence of the modern illusion).

From a (bio)semiotic perspective, language is considered a secondary modeling system (Anderson & Merrell 1991) that has evolved in humans in addition to a primary modeling system of species-specific sense perception and signification. This derives directly from looking at other animals and the way their species-specific perception and action profile helps them construct the world in which they exist.

Animal Linguistics

Animal studies played a crucial role for the cognitive revolution in linguistics in the 1950s. Chomsky's critique of behaviorism (1957) that is articulated in his review of B.F. Skinner's *Verbal Behavior* (1957) is grounded precisely in the argument that language is a species-specific biologically determined behavior that cannot be analyzed based on behaviorist concepts that were the result of animal studies. This means that even though behaviorism is derived from studies with animals (in the famous Skinner box experiments) there was no ethological interrogation of the cognitive capacities of the animals involved, since the Skinner box mechanically delivered the stimulus and the appropriate reward for the desired behavior to the animal in question, whether it was a rat or a pigeon was irrelevant. The Skinner box experiments only focused on the learning mechanisms the behaviorist framework assumed to be universal laws of behavior across species.

For Chomsky, a theory of human language acquisition cannot be based on the insights gained from behaviorist theories of learning not only because behaviorist theories of learning had been derived from studies with other animals, but also because there are no universal laws of learning; and human language as a species-specific biologically determined behavior warrants a different theory of learning than other human behaviors. First-language acquisition as a biologically-determined behavior (similar to walking) requires a theory of learning different from learned behaviors (e.g. playing a musical instrument) where instruction and positive and negative reinforcement are actually necessary and helpful. This is the chief argument for the innateness hypothesis and the concept of Universal Grammar (the initial state of the human faculty

of language). Lenneberg's (1964) definition of biologically determined behavior is helpful to make this clear : Like walking, acquisition of language is biologically determined, because it requires no instruction and it arises before it is necessary. While Skinner's *Verbal Behavior* (1957) made no direct reference to the animal studies that established the behaviorist paradigm, the resulting theoretical concepts were incompatible with the theory of acquisition of biologically determined behaviors such as language, and were therefore rejected by (bio)linguists.

This means that while Chomsky and Sebeok were approaching human language from an ethological perspective, Skinner's animal studies merely assumed that all behaviors are learned by the same mechanisms across species. This false assumption about how behaviors are learned (whatever they may be) also informed the long-term studies with primates beginning in the 1970s in which chimpanzees and bonobos where raised in families learning rudimentary sign language or artificial symbol systems invented for the purpose of studying the linguistic abilities of primates (e.g. Terrace, 1979; Savage-Rumbaugh 1986). Naturally, Chomsky and Sebeok were opposed to language studies with primates, because they knew that there was nothing to be learned from these studies about human language or the cognitive capacities of primates. (Sebeok & Umiker-Sebeok 1980) In an interview about his opposition to primate studies, Noam Chomsky explained :

> Humans can be taught to do a fair imitation of the complex bee communication system. That is not of the slightest interest to bee scientists, who are rational, and understand something about science : they are interested in the nature of bees, and it is of no interest if some other organism can be trained to partially mimic some superficial aspects of the waggle dance. And one could of course not get a grant to teach grad students to behave like imperfect bees. When we turn to the study of humans, for some reason irrationality commonly prevails - possibly a reflection of old-fashioned dualism - and it is considered significant that apes (or birds, which tend to do much better) can be trained to mimic some superficial aspects of human language. But the same rational criteria should hold as in the case of bees and graduate students. Possibly training graduate students to mimic the waggle dance could teach us something about human capacity, though it's unlikely. […] Would it be of any interest to train grad students to more or less mimic apes? We would learn nothing about apes from the fact that grad students can be trained to more or less mimic them - try to get an NSF contract to study that- just as we learn nothing about humans from the facts that apes can be trained to mimic humans in some respects. Language is a notorious failure, exactly as any biologist and paleo-anthropologist would have expected. But if, say, Nim had succeeded, we would still have learned nothing about language acquisition, gaining neither more nor less wonderment, though we would have a biological problem. Namely, if apes have this fantastic capacity, surely a major component of humans extraordinary biological success (in the technical sense), then how come they haven't used it? It's as if humans can really fly, but won't know it until some trainer comes along to teach them. Not inconceivable, but a biological problem, and about the only conceivable scientific consequence of the ape-language experiments,

> except what they might teach us about ape intelligence by training apes to deal with problems that are outside their normal cognitive range. This is all sentimentality of the worst sort. (Cicchiaro 2007/2008)

It took several decades until primate researchers reoriented their focus towards the species-specific sign-systems, vocal and non-vocal, and primates were no longer brought up in the homes of researchers, but instead studied in more species-appropriate semi-wild habitats (e.g. Halloran 2012) or in the wild (e.g. Goodall 2010).

It is unfortunate that Uexküll's very basic premise that each animal species has a specific way of interacting with its environment that is articulated in the notion of *Umwelt* took so long to permeate the mainstream sciences. Maybe the wide distribution of documentaries like P*roject Nim* (Marsh 2011) or *Blackfish* (Cowperthwaite 2013) have caused the reevaluation of our relationship with other intelligent animals and their own signifying abilities that is commensurate with our own intelligence as a species? Many popular books have recently articulated a revised understanding of the signifying abilities of dogs to get away from the human tendency to anthropomorphize other animals and dispel false assumptions concerning dogs' understanding of human language (e.g. McConnell 2003; Horowitz 2009; Bradshaw 2011; Miklosi 2015; etc.). In her bestselling book *Inside of a Dog*, Alexandra Horowitz attributes her approach to studying dog behavior to the work of Jakob von Uexküll :

> The scientific study of animals was changed by a German biologist of the 20th century named Jakob von Uexküll. What he proposed was revolutionary : anyone who wants to understand the life of an animal must begin by what he called their *Umwelt*, their subjective or "self world". *Umwelt* captures what life is like as the animal. Consider, for instance, the lowly deer tick. And you probably consider the tick as a pest, period. Barely even as an animal. Von Uexküll considered, instead, what it might be like, from the tick's point of view. (2009 : 20f)

A little background : ticks are parasites. Members of Arachnida, a class that includes spiders and other eight-leggers, they have four pairs of legs, a simple body type, and powerful jaws. Thousands of generations of evolution have pared their life to the straightforward : birth, mating, eating, and dying. Born legless and without sex organs, they soon grow these parts, mate, and climb to a high perch – say, a blade of grass. Here's where their tale gets striking. Of all the sights, sounds and odors of the world, the adult tick is waiting for just one. It is not looking around : ticks are blind. No sound bothers the tick : sounds are irrelevant to its goal. It only awaits the approach of a single smell : a whiff of butyric acid, a fatty acid emitted by warm-blooded creatures (we sometimes smell it in sweat). It might wait here for a day, a month, or a dozen years. But as soon as it smells the odor it is fixed on, it drops from its perch. Then a second sensory ability kicks in. Its skin is photosensitive, and can detect warmth. The tick directs itself towards warmth. If it's lucky, the warm sweaty smell is an animal, and the tick

grasps on, and drinks a meal of blood. After feeding once, it drops, lays eggs, and dies.

The point of this tale of the tick is that the tick's self-world is different than ours in unimagined ways : what it senses or wants; what its goals are. To the tick, the complexity of persons is reduced to two stimuli : smell and warmth – and it is very intent on those two things. If we want to understand the life of any animal, we need to know what things are meaningful to it.

Those who are familiar with the work of Jakob von Uexküll appreciate the centrality of *the tale of the tick* for the notion of *Umwelt*. It is from this starting point that Alexandra Horowitz explains the perception and action profiles of dogs for a better understanding of how they signify and interpret human signs. It needs to be acknowledged that one of the most important lines of research that has come from Jakob von Uexküll's own research center in Hamburg, Germany, concerns the training of guide dogs for the visually impaired (*cf.* Magnus 2015). There is no question that dogs respond to verbal commands whether they are guiding the visually impaired or in other everyday interactions with humans. However, their ability to process human language in addition to the sign system that is the human body is indicative of the canine ability to interpret the vocalizations of another species that deserves scientific attention.

The largest dog behavior lab in the world is housed at the Department of Ethology at the Eötvös Loránd University in Budapest, Hungary. In a recent study, a team of neuroscientists investigated how human language is processed by dogs (Andics *et al.* 2016). Their fMRI experiments with dogs suggest that dogs process the meaning and affect of human speech separately (in a way that is similar to humans), favoring the left hemisphere of the brain to process word meaning and the right hemisphere to process the emotion expressed in the voice. Their research also suggests that dogs only get the full benefit of a human vocal praise if the utterance is composed of both the word they know as an expression of praise and the intonation of excitement in the human voice. This may not be surprising to anyone who lives and interacts with a dog, but it represents a compelling ethological approach to animal linguistics.

Alexandra Horowitz points out that some "[researchers] tend to speak of the species as though all members of the species were identical" (2009 : 8) . Her view of the individual mind/brain being shaped by the unique signifying abilities of the individual is a shift in the direction of the (bio)semiotic point of view not shared by all in the mainstream scientific community. Horowitz explains : "The results of many well-performed experiments may eventually allow us to reasonably generalize to *all dogs*, period. But even then, the variations among individual dogs will be great : your dog may be an unusually good smeller, may never look you in the eye, may love his dog bed and hate to be touched"

(2009 : 9). While this makes sense to anyone who has lived with more than one dog, it calls into question the confident generalizations made about human minds/brains regarding such fundamental questions as to whether there is a particular part of the brain involved in processing particular aspects of language(s) that has been a central hypothesis in neurolinguistics. If we look at all animals under the assumption that they construct their own subjective self-world according to the perception/action profile that is specific to their species, based on their unique experiences, individual brain scans and images immediately loose at least some of their generality and explanatory power for the species.

There is a fortunate ethical shift that goes along with this view of animals as subjective agents constructing their reality according to their species specific semiotic abilities entering the mainstream. It may not be a coincidence that the same era that has brought us the rediscovery of Jakob von Uexküll's *Umwelt* in a bestselling book on dog behavior more than half a century after Chomsky and Sebeok have discovered his work in the 1950s, has brought the end of many animal shows in theme parks and circuses. *Sea World* is now phasing out all orca shows and breeding programs by 2019 (Bomey 2016).

It is safe to assume that this particular decision was initiated by the 2013 documentary *Blackfish*, in which several former trainers not only express their remorse for participating in the inhumane breeding and training of orcas for commercial purposes that have cost the lives of many whales and humans over the decades. They also consistently refer to the *languages* of orcas and describe distinct vocalizations in particular situations. If only people who were interested in orcas as much as these trainers had been given the ability to study these animals in the wild instead of merely contributing to the commercial exploitation of their intelligence.

One example of such research in the wild is Denise Herzing's *Wild Dolphin Project* at Florida Atlantic University that has been going on for 30 years. Recently, Herzing (2016) tested a wearable device that allows her to generate dolphin calls to interact with a pod of dolphins she has been following for many years in the Bahamas. This device was developed by Thad Starner, founder of the Animal Computer Interaction Lab at Georgia Tech University. Instead of studying Dolphins in captivity, Denise Herzing has been able to observe and record the same group of animals and interact with them through computer generated whistles.

It appears that the 21st century has finally acknowledged the complexity and systematicity of the signifying abilities of other intelligent animals such as whales and dolphins. At least some scientists have found ways to investigate animal languages with an attitude that Andreas Weber has articulated in his book *Alles Fühlt* (2008) as a direct response to the work of Jakob von Uexküll, of which Weber is a direct intellectual heir. Is humanity reevaluating the relationships with other species on

a much larger scale than small academic currents have anticipated? Is there going to be the new biology that Weber and other biosemioticians have articulated for a long time that reaches beyond genes and neurons?

> I have spent many semesters studying what life really is. I have dissected frogs in stuffy lecture halls, cloned bacteria in cluttered labs, and pulled worms out of the muck near the Baltic Sea to understand how life actually works. I even got a PhD in Biology, but I always felt like something was missing. It always seemed like as researchers and modern scientists we were overlooking something essential about plants and animals. It is as if we were blind for precisely what drew us to study living organisms in the first place. [...] We are overlooking important aspects of nature, because science has presented it to us in a way that has excluded its most beautiful aspect, because it only focused on objective facts instead of seeing organisms as subjects. Science prefers abstractions and excludes all semiotic aspects of life. That is the real cause of all environmental disaster. We are extinguishing life, because we are missing its real character. We can be cruel, because our understanding of life is incomplete. [...]. (Weber 2008 : 23 [my translation])

According to Jesper Hoffmeyer (1996 : 59), "[...]one can never hope to understand the dynamic of the ecosystem without allowing for some form of *umwelt* theory". For Hoffmeyer, a revolution of the life sciences begins with a biology that is rooted in semiotics. This new biology :

> [...] 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)

Sign Systems across Species

The inclusion of the sign systems of other species in the field of linguistics may seem questionable to some linguists, especially those who see the field aligned with (human) psychology and the (human) social sciences, maintaining the illusionary separation of culture and nature. But a recent job posting from the University of Wollongong, Australia (Ecolinguistics 2016) attests to a reorientation and opening of the field that includes the sign systems of other species without overtly articulating it as a (bio)semiotic agenda :

> The position description is very open as to the area of linguistics that the candidate might specialize in, but applications from scholars with strengths in ecolinguistics and especially those who might make a contribution to animal studies using linguistics would be very well received. There is an emerging research concentration in animal studies across our faculty and our new Head of School (Professor Fiona Probyn-Rapsey, starting this month) is the current Chair of the Australasian Animal Studies Association. We expect to consolidate research and teaching around that area in the near future.

One might ask what type of training a linguist who specializes in other animals may need? This may be harder for older generations among linguists to imagine than the younger colleagues. Most recent graduates

from North American linguistics programs have more than sporadic field work experience and have been trained in language documentation. 21st century linguists are usually trained to document a previously unstudied linguistic system as half of the world's languages are facing extinction within the next centur. (*cf.* Crystal 2002). Some predictions are even more pessimistic. To at least document all extant languages, the young theoretical linguists of today have all had to do their share of documenting endangered languages. This means going into the field and eliciting from an informant basic information on the sounds, morphology, and syntax of their language. If they are lucky, there is assistance from someone who can act as an interpreter with at least rudimentary knowledge of the language to be documented. But sometimes that is not the case. The documentary *The Linguists* (Kramer *et al.* 2008) shows examples of this process.

While we were discussing Optimality Theory in phonology as graduate students in the late 1990s, the phonetics lab of John Ohala was an anomaly, because he was studying the human articulatory apparatus from an ethological perspective when most of phonology was practiced in abstract theoretical discussions. Ohala probed the human speech organs and analyzed the human articulatory capacity in action, often in self-experiments. In contrast today, undergrads read and analyze spectrograms on their laptops using free software like PRAAT. Experimental phonetics is now well integrated into the armamentarium of linguistic research methods thanks to the pioneering work of John Ohala, whose approach played an important role in opening the field of linguistics up to look beyond the species to gain insights from an ethological perspective. Going beyond mere taxonomic phonetics (merely describing and categorizing speech sounds) Ohala's *scientific phonetics* studies human articulatory and auditory abilities with the same curiosity about the physiological/cognitive characteristics with which Jakob von Uexküll studied the sense perception of sea urchins.

One example of 21st century scientific phonetics is a recent study that shows that "speech sounds are not always perceived in accordance with their acoustic–phonetic content. For example, an early and automatic process of perceptual repair, which ensures conformity of speech inputs to the listener's native language phonology, applies to individual input segments that do not exist in the native inventory or to sound sequences that are illicit according to the native phonotactic restrictions on sound co-occurrences" (Kharlamov *et al.* 2011).

This study with Russian and Canadian English speakers shows that listeners may perceive phonetically distinct sound sequences as equivalent when the native language system provides robust evidence for mapping multiple phonetic forms onto a single phonological representation. Russian speakers often delete the /t/ sound in /stn/ clusters and perceive the surface forms [sn] and [stn] as equivalent to a single

phonological form /stn/. In other words, the deletion of the /t/ is something Russian speakers are used to, but Canadian English speakers are not. Canadian English speakers perceive [sn] and [stn] clusters as phonologically distinct. So when asked to listen to the difference between artificial words like [asna] and [astna], it is harder for Russian speakers than for English speakers. The researchers call this inability to hear the difference a "perceptual repair mechanism that is engaged automatically at a prelexical level to ensure immediate encoding of speech inputs in phonological term" (Kharlamov *et al.* 2011).

In other words, our perception of speech sounds is determined by the phoneme inventories and phonotactic rules of the language(s) we speak. This constant feedback between action and perception is one of the most fundamental models of organism-environment interaction that originated with Uexküll's animal studies. Like walking on a rocky path requires a constant feedback loop between feeling the surface and placing the next step; or like playing a string instrument is a constant feedback between hearing and making the sound like all our action is at the same time a constant evaluation of past experience. These and all phenomena of organism-environment interaction can be explained with the basic perception/action model of Uexküll's *Funktionskreis*.

Uexküll formulated a fundamental law of neuromuscular regulation (also sometimes referred to as the *principle of negative feedback*) that explains how any outside impulse to the body of an organism is received by the muscles and nerves that are already engaged, forming a feedback loop of perception and action that is fundamental to all organism/environment interaction. This basic law underlies all semiotic abilities, including our perception and production of speech sounds.

The concept of "perceptual repair" (Kharlamov *et al.* 2011) is a cognitive equivalent of physiological perception/action feedback that attests to the soundness and explanatory power of Uexküll's *Funktionskreis* that is relevant to phenomena related to language and cognition without being articulated or recognized as such.

Today's laboratory phoneticians and experimental phonologists may not have heard of (bio)semiotics, but scientists who are contributing to established fields like experimental phonetics and laboratory phonology are making progress in areas that only 10 or 15 years ago would have been considered peripheral. It should be exciting to discover that the theoretical models that are central to (bio)semiotics have become relevant to research agendas in linguistics and cognitive science such as experimental phonetics. I believe that the future success of the (bio) semiotic movement will depend on recognizing and connecting with research agendas where fundamental models like Uexküll's *Funktionskreis* can provide explanatory hypotheses.

The Politics of Uexküll's *Funktionkreis*

Uexküll's *Funktionskreis* is a model of perception/action that is relevant to all levels of organism-environment interaction. Just like the phonemes we use in the language(s) we speak influence how we perceive speech sounds, our ability to form beliefs depends on established cognitive habits. The compatibility between semiotic theory and Lakoff's cognitive linguistics has long been applied by Marcel Danesi (e.g. 2004) among many others, but Lakoff's recent connections between cognitive linguistics and neuroscience in *The Political Mind* (2009) explain how individuals form beliefs based on their existing cognitive habits that Lakoff now claims are physiological circuits in the brain. If we hear something over and over, like the cognitive metaphor *taxes are a burden* that are represented in linguistic concepts like *tax relief*, Lakoff claims that we form physical connections in the brain between the idea of taxes and the negative concept of a burden that we need to be relieved from. So every time we hear something said about taxes, the physical circuit is activated and strengthened and that is how we form our beliefs. If we want to exploit our secondary modeling system that is language to change these beliefs, we have to create new circuits and not invoke the old ones, or, as Lakoff says, we need to "reframe the debat" by creating new metaphors that will result in new circuits forming in the brain. (Lakoff 2009)

This inherently semiotic model of thought habits and beliefs stands in stark contrast with the view that we are determined to have certain attitudes and beliefs by our genes. The semiotic approach to how we see the world, on the other hand is congruent with Lakoff's (e.g. 2009) theory of cognitive metaphor that sees our beliefs as resulting from our organism-environment interaction. According to this inherently semiotic view, we create our model of the world by constantly negotiating perception and action, forming beliefs through the neuronal connections that are the result of our secondary modeling system that is language. Most of the emerging ecolinguistics movement is anchored in this view.

Ecolinguistics

How we form our beliefs about the world is central to the movement of ecolinguistics that is currently in the process of establishing its goals. The ecolinguistic movement initiated by Arran Stibbe, Alwin Fill and Peter Mühlhäusler have used the tools from cognitive linguistics to address the ways in which humans construct their reality of the natural world through narratives of the "environment", including other species.

For instance, concepts such as the *forest* depend on cultural narratives (Augustyn 2013) rather than merely matching a set of potential referents with a concept according to general lexical semantics. Everyone would agree that the meaning of the concept *forest* depends on more than a certain concentration of trees. This ability is precisely what

Gudrun von Uexküll recognized when she realized that the beech tree in front of her was constructed with her sense perception, because "[what] I see, smell or taste are not any objective characteristics of the tree, but instead they are the perceptions of my sense organs that I externalize to construct it" (Gudrun von Uexküll 1964 : 164 [my translation]).

Exolinguistics

In the science fiction film *Arrival* (Villeneuve 2016), a linguist is recruited to study the language of an alien species who have landed on Earth. The film portrayed rudimentary techniques of linguistic field work pertaining to documenting an unknown language. While it was encouraging to see a linguist entrusted with analyzing the signifying abilities of an alien species, shouldn't the linguist in question not have been one with some experience in analyzing the signifying abilities of other species on Earth?

At a time when Denise Herzing's *Wild Dolphin Project* has successfully analyzed dolphin whistles using pattern-discovery algorithms to extract meaningful features with some success in translating dolphin whistles (*cf.* Hodson 2014), should the linguist studying an alien language not at least look beyond human languages?

In a recent paper on how to analyze non-human types of intelligence, Herzing explains that "[intelligence] has historically been studied by comparing nonhuman cognitive and language abilities with human abilities. Primate-like species, which show human-like anatomy and share evolutionary lineage, have been the most studied. However, when comparing animals of non-primate origins our abilities to profile the potential for intelligence remains inadequate" (Herzing 2014 : 676).

Based on her research on the signs of wild dolphins, Herzing proposed "a new approach to profile a variety of organisms along multiple dimensions including *EQ – Encephalization Quotient, CS – Communication Signal complexity*, *IC – Individual Complexity*, *SC – Social Complexity* and *II – Interspecies Interaction*. Because Earth species are found along a variety of continuums, defining an intelligence profile along these different trajectories rather than comparing them only to human intelligence, may give us insight into a potential tool for quickly assessing unknown species. The application of profiling nonhuman species, out of world, will be both observational and potentially interactive in some way. Using profiles and indicators gleaned from Earth species to help us develop profiles and using pattern recognition, modeling and other data mining techniques could help jump start our understanding of other organisms and their potential for certain "type" of intelligence" (Herzing 2014 : 676).

It is safe to assume that any understanding of extraterrestrial species will most likely be preceded by a better understanding of the signifying

abilities of other intelligent species on Earth.

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Abstract

Biosemiotics and biolinguistics share some common origins in comparative psychology and ethology, both viewing language as a species-specific cognitive capacity whose main purpose is not communication but thought. From this perspective, biosemiotics should be at the center of cognitive science. However, biolinguistics and biosemiotics (or linguistics and semiotics) have been marginalized in the context of cognitive science and neuroscience; nonetheless there are currents in mainstream linguistics and cognitive science operating from a biosemiotic perspective without overtly articulating their research agendas as such. I believe that the future success of the biosemiotic movement will depend on recognizing and connecting with those research agendas.

Keywords : Biosemiotics; Biolinguistics, Psychology; Ethology; *Umwelt*

Résumé

La biosémiotique et la biolinguistique partagent des origines communes en psychologie comparative et en éthologie, deux disciplines qui considèrent le langage comme une capacité cognitive propre à une espèce et dont la finalité n'est pas la communication, mais la pensée. De cette perspective, la biosémiotique devrait se retrouver au centre des sciences cognitives. Toutefois, la biolinguistique et la biosémiotique (ou la linguistique et la sémiotique) ont été marginalisées par les sciences cognitives et les neurosciences. Il y a cependant des tendances dans la linguistique

et les sciences cognitives conventionnelles d'opérationnaliser une perspective biosémiotique, sans pour autant le faire de façon explicite. Je crois que les succès à venir de la biosémiotique dépendront de son aptitude à reconnaître ces programmes de recherche et de s'y lier.

Mots-clés : Biosémiotique; biolinguistique; psychologie; éthologie; *Umwelt*

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