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The Role of Languaging in Human Evolution

An approach based on the theory of natural drift

Abstract: The notion of languaging provides a new understanding of the intimate relationship between sociality and language. In this paper, I address the evolutionary emergence of language by subscribing to the autopoietic theory of natural drift (Maturana and Varela 1987; Varela et al. 1993; Maturana and Mpdozis 2000) I show that this systemic approach to evolution can offer the ideal epistemological background to evaluate the role of languaging throughout hominization. The central idea is that the languaging-based way of living acted as an attractor for the evolutionary process. This claim relies on three interrelated assumptions: 1) behavioral and relational habits may channel the course of genetic and structural change; 2) recursive coordination and specific forms of sociality set the systemic conditions for *coexistence-through-languaging* to be conserved over generations; 3) the conservation of these systemic conditions gives rise to a spiraling, positive-feedback process that involves body, cognition, and culture.

Keywords: evolutionary biology; hominization; language origins; sociality

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1 Introduction

This paper aims to outline a theoretical counterblast to the predominance of neo-Darwinian and cognitivist approaches to language evolution. To this end, it explores the relation between language and hominization from a systemic, autopoietic point of view. Whereas many accounts take an adaptationist point of departure, and hence emphasize chance genetic mutation and the active role of natural selection in human evolution, I discuss the crucial role played by behavioral and relational habits. In recent years, the idea that modern human beings are the result of a culturally driven evolutionary process has become increasingly accepted. The account that I offer is, in many aspects, sympathetic with the social theories of language evolution (see, for instance, Dor et al. 2014).

It differs, however, in that it subscribes to a unique evolutionary and linguistic framework by resorting to the autopoietic theory of natural drift (NDT) and the radical conception of language as languaging. In so doing, it lays out a phylogenetic approach to language that builds into its theoretical foundations both the biological and sociocultural dimensions as a way of understanding our species-specific way of living.

The distinctive features of this approach are best appreciated if one bears in mind the monological, reified conception of language as a system (or a code). Characterizing language as languaging emphasizes the radically relational, multidimensional and distributed nature of linguistic activity. As a theoretical notion, languaging was first introduced by Maturana in 1983. It is increasingly taken up by scholars in linguistics who recognize that language is first and foremost coordination on multiple levels and timescales (Cowley 2011; Kravchenko 2011; Thibault 2011; Raimondi 2014; Cowley and Markos 2019). In keeping with the autopoietic paradigm, I have claimed that this approach allows the inherently interactional nature of linguistic phenomena to unveil with regards to their "bio-logical" matrix (Raimondi 2019). From this point of view, meaning-making is an interactional achievement that involves cognitive, affective, and experiential dimensions by drawing on bodily resources whose patterns and constraints are the result of a given ontogenetic and cultural history. Maturana (1978, 1988) argued that this process crucially relies on recursive coordination as a specific form of co-orientation while doing things together. In other words, linguistic coordination between individuals takes place in such a manner that the operational components of the established domain of coordination are recursively combined in the generation of new coordination. Hence, languaging needs to be conceived as part of an ongoing process, not as isolated items of behavior (Maturana and Varela 1987); as such, it unfolds as "a manner of living in recurrent interactions in a flow of coordinations of coordinations of consensual behaviors" (Maturana and Verden-Zöller 2018: 30).

Based on the latter, it becomes clear that languaging is uniquely pervasive of every aspect of human life. It underlies human agency in that it cannot be separated from the activities it brings about. Thus, languaging exceeds the boundaries of the linguistic domain of analysis. Each single event of coordination sets, and builds upon, operational interdependencies between individuals that produce ubiquitous effects on their existence as living beings. This leads to a radically relational understanding of human actions as pieces of coordination, inherently interdependent and complementary (Raimondi 2019). Being generated through recursive coordination, all sociocultural activities are constituted through a process where individual action takes effect through the action of the others. As a result, languaging, human agency and sociality, can be thought of as distinct yet intertwined Borromean rings.

How can this view of language contribute to providing a new understanding of human evolution? The current paper aims to connect such notions as languaging and recursive coordination with explanatory frameworks from evolutionary biology. It outlines an embracing theoretical context for the study of the relation between sociality and language throughout hominization. Although discussed by Maturana and colleagues (Maturana and Varela 1987; Maturana and Verden-Zöller 2008), the evolutionary role of languaging was not taken up by further studies (with a few exceptions: see Andresen 2014).

The paper is organized as follows. In section 2, a brief review of the contemporary debate on language origins is outlined. In sections 3 to 5, I lay out the autopoietic evolutionary epistemology and delineate it from the adaptationist and gene-centered approaches. In particular, I show the role played by socio-interactional factors in evolution. Sections 6 to 9 spell out the consequences for the study of language evolution and hominization.

2 The origins of language: The current debate

Inquiry into language origins was famously banned by the *Société de linguistique de Paris* in 1866. The question of the origin and evolution of language has gained renewed attention at the end of the twentieth century. The contemporary debate is one of the most passionate in human and cognitive sciences. Language evolution is today a well-established interdisciplinary field. Much of the excitement stems from the relevance of the topic for better understanding both language and Homo sapiens, and the wider problem of unraveling the process of human origins (hominization). Whereas the topic has provided a meeting place for linguists, paleoanthropologists, psychologists and biologists, there is no general agreement yet among researchers (Christiansen and Kirby 2003). In the absence of cogent and uncontroversial evidence, the last decades have seen a profusion of hypotheses and scripts. This is because, in trying to reconstruct how language first evolved, scholars are at odds with one another on all the fundamental questions: “what” (what the phenomena are whose evolution is to be reconstructed), as well as “when,” “how,” and “why.”

The reason is that most of the accounts are underpinned by opposite theoretical assumptions and epistemological convictions. Scholars often differ in their understanding of “language” (a neural module for some, a cultural tool for others) or pay attention to distinct aspects or functions of it; they also resort to different evolutionary frameworks (some prefer explanations based solely on chance genetic mutation, others endorse gene-culture coevolution; some see evolution as gradual process, others take up a saltationist view, etc.); finally, they offer divergent interpretations of the fossil and archeological record.

Overall, three lines of research are intertwined, focusing respectively on (1) the genetic, anatomical, neurobiological, and cognitive transformations over the course of the evolution of the genus *Homo*; (2) the socio-ecological constraints (the *good reasons* for natural selection to choose a given phenotypic trait); (3) the first forms of language and their development (Raimondi 2017; see also Gontier 2017). The first research avenue investigates the evolution of cerebral correlates (such as neocortex), peripheral correlates involved in vocal articulation, genetic mutations, among others. Paleoanthropological and genetic studies try to reconstruct how neurocognitive evolution has enabled the emergence of language. The second area of research provides speculations about distinctive benefits associated with the emergence of language and culture. Adaptive scenarios are provided as an attempt to reveal the "true" function of language as well as its survival value with respect to selection – in other words, the ultimate reason for its emergence (see, for instance, Dunbar 1996; Dessalles 2007). Finally, the third research avenue covers such topics as glossogenesis (the evolution of language from its precursors to the development of grammaticalized and morpho-syntactically complex languages: for instance, Bickerton, 1990). It also includes the “gestural vs. vocal” origins controversy (Corballis 2002; Tomasello 2008; Kendon 2017). More generally, approaches differ in the ways they address some problems rather than others.

It is well beyond the scope of this paper to compare all these positions. Overall, none of them are completely consistent with the autopoietic approach which I will discuss below. Up to a few years ago, most of the scenarios embraced the outdated, adaptationist and gene-centered version of evolution as the only legitimate scientific framework and use it as a ready-to-use interpretation scheme (Lassègue et al. 2009). However, evolutionary thinking has changed enormously over the past decades, making it quite clear that the traditional neo-Darwinian explanation of evolution based on genetic mutation, adaptation and natural selection needs to be reconsidered. A group of biologists is therefore moving toward an “extended synthesis” to overcome the reductionist tenets of the “modern synthesis” (Gontier 2017). With a whole array of promising new research areas and theories emerging (evolutionary developmental theory, research on epigenetic heredity and genetic accommodation, etc.), it seems possible to develop a new approach to evolution.

It has to be acknowledged that, in the last years, a multitude of social approaches to language origins have challenged traditional evolutionary explanations. Interestingly, most of these studies (Tomasello 2008; Levinson 2006a, 2006b; Enfield and Levinson 2006; Dor et al. 2014) reject both the modular view of language as a biological faculty (Hauser et al. 2002; Pinker 2003) and the neo-Darwinian schemes used by the advocates of the reductionist approach. Instead, they generally support the theory of gene-culture coevolution (see Deacon 1997; Richerson and Boyd 2005), while also subscribing to a socio-ecological perspective of hominization. Adherents of this approach hold that social and cultural relationship needs to be placed center-stage in order to explain how language evolved. According to them, since language is a social artifact, it cannot be treated as an intracranial nor a genetic affair. Its origins are related to very specific social and cultural transformations: “to be language-ready, the brain must be social to an unusual degree; and for the human brain to be that social, human society must have gone through an unusual evolutionary dynamic” (Dor et al. 2014: 3). In emphasizing the role played by social dynamics in the process of evolution, scholars draw on recent discoveries about “social cognition” and social learning in comparative and developmental psychology (Tomasello 2008). Based on the latter, they provide a “socio-cognitive” evolutionary scenario where the emergence of mindreading capacities and disposition to cooperation in our ancestors allowed the development of complex social interactions and activities, thus leading to the creation of linguistic communication. Although I concur with the need for a renewed understanding of the relationship between sociality and language, the notion of languaging is incompatible with the socio-cognitivist conception of language as a code use to convey intentions (see section 9).

In order to overcome the limits of neo-Darwinian explanations, this paper make use of the autopoietic NDT. I believe that not only does NDT provide valuable insight into the ongoing revision of the received view of evolution, but it also brings new perspective in our understanding of language origins.

3 The theory of natural drift

First introduced by Maturana and Varela in 1987, NDT has been a few years ahead of the current reorientation in evolutionary biology in questioning dominant assumptions. In this much changed epistemological environment, the time seems right to evaluate what NDT has to offer. Not only does it present a systemic view of living beings and their evolution, it also reverses our understanding of the causal relationships between genes, cognition, behavior and language. While drawing on previous research in evolutionary biology, the so-called “Santiago School of Biology” presents an original and coherent theory, whose epistemological background is the autopoietic theory. NDT addresses the most controversial aspects of the traditional neo-Darwinian model (genetic determinism and adaptationism) and offers a theoretical framework to understand the evolutionary path making, that is to say, the phylogenetic constitution and ramification of lineages. The notion of natural drift plays a major role in both Varela's and Maturana's works. As they show in both joint and individual works (Maturana and Varela 1987; Varela et al. 1991; Maturana and Mpdozis 1987, 2000; Maturana and Verden-Zöller 2008), evolution can be thought of as the spontaneous result of the *phylogenetic structural drift* of living beings. However, NDT has not been as successful as the notions of autopoiesis and enaction. Yet, according to Varela, evolution as natural drift is the biological counterpart of cognition as enaction (Varela et al. 1993). As a matter of fact, adaptationism in evolutionary biology and representationalism in cognitive science operate within a similar explanatory framework. Just as enaction aims to replace the notion of “representation” in cognitive science, natural drift can take over the role played by adaptation in biology (Varela 1986).

NDT relies on the assumption that living beings are autopoietic systems (Maturana and Varela 1980, 1987). By definition, living systems exist insofar as they maintain both their *structural organization* (i.e. *molecular autopoiesis*) and *adaptation* (i.e. the relation of operational congruence between the living system and the medium in which it realizes itself). The maintain of these two conditions of existence is the spontaneous result of a systemic dynamic that involves both organism and medium. Over the course of their “structural coupling,” organism and medium continuously interact and change together, in accordance to their inherent autonomy and within the limits of their respective structural plasticity. Because of their constitutive inter-relation, there is a necessary structural congruence between them that is maintained through the uninterrupted dynamic of interactions – until the congruence it is lost, and the organism dies.

From this theoretical standpoint, the individual history of a living being unfolds moment by moment as a systemic process. Every ontogeny, as an individual history of structural change, can be conceived as a drift. NDT use the notion of *ontogenetic drift* to refer to the fact that living beings change continuously following the flow of interactions with their medium, and that their structural drift is necessarily bounded by the conservation of autopoiesis and adaptation. Moreover, since organisms operate as part of the medium of other organisms, they follow congruent drifts. To put it in more general terms, *living beings and their medium co-drift* over the course of their history of structural coupling. It can be easily observed that the notion of drift applies to individual ontogenies as well as to lineage phylogeny. Maturana and colleagues call *phylogenetic drift* the historical process that consists of successions of co-ontogenetic drifts. Natural evolution is the historical, spontaneous phenomenon of ramification with downstream consequences that leads to the generation, conservation and extinction of lineages. Drawing on the latter, NDT provides a reconceptualization of adaptation and natural selection, as well as a renewed view of the relationship between genes and phenotype.

4 Adaptation and natural selection revisited

According to Maturana, Varela and Mpodozis, adaptation is not a variable, but it is rather on the contrary an invariant. This is because, as we have seen, adaptation is the constant relation of congruence between organism and its medium, and is therefore a condition of existence of living beings. In other words, as long as it exists, a living system can never be out of adaptation (otherwise it dies). Thus, it is not the optimization of adaptation, but the conservation of adaptation that is central (Varela 1986; Thompson 2007). Accordingly, we should think of biological adaptation in absolute rather than relative terms. Maturana and Mpdozis challenge such adaptationist concepts as “fitness” and “optimal adaptive value,” claiming that they only exist as observer's expectations – “bio-logically” speaking, organisms cannot be thought of as better adapted than others. All living beings are adapted as long as they are alive. And, conversely, the loss of the systemic conditions which are necessary to ensure adaptation coincides with death or, at the level of the population of a given lineage, with extinction.

As a consequence, natural selection cannot be considered as an external force whose goal is to optimize fitness. According to Maturana and Mpodozis, natural selection is nothing else than the result of differential survival; as such, it is a consequence of natural drift, and cannot be seen as its generative mechanism: “what evolutionary biologists call natural selection while observing differential survival when comparing populations in different moments of their history, is in fact the result of the process of production and conservation of lineages under conditions of systemic conservation of autopoiesis and adaptation through reproduction, that we have called natural phylogenic drift, and not the result of the action of any force” (Maturana and Mpodozis 2000).

This systemic understanding of adaptation and natural selection stems from the constitutive codetermination between organism and medium. It requires to acknowledge that organism and medium constitute a systemic unity, made of many interdependencies (Maturana and Varela 1987; Varela et al. 1991). Accordingly, natural drift does not occur as the result of an external force (i.e. selective pressure); it occurs because the operational and relational network of interdependencies that specifies all organism-medium unities undergoes a spontaneous process of transformation. Each lineage is characterized by a *particular systemic configuration* "*organism-medium*" that specifies its identity as such. Maturana and Mpodozis (2000) argue that when a new lineage appears, what first emerges, and is then conserved over generations, is a new, specific *ontogenetic phenotype -ontogenetic niche relation*. The *ontogenetic phenotype* of a species refers therefore to the entire course of phenotypic transformation that an individual belonging to a given species undergoes over its ontogeny. In other words, it covers all the dimensions that constitute the life cycle of a given species. It follows that the ontogenetic phenotype is the *specific way of living* through which a given organism conserves its autopoiesis and adaptation, realizing its existence as a particular class of living being. As we will see, the notion of ontogenetic phenotype is central to the explanatory framework provided by Maturana and Mpodozis.

Current evolutionary epistemology has criticized the notions of adaptation and natural selection in multiple ways. In particular, NDT shares with the Developmental Systems Theory (DST) the idea that living beings' ontogeny and phylogeny are the result of unified networks of interdependent process that occur at multiple scale (Oyama et al. 2001). In order to avoid reductionism, Oyama and colleagues claim that biology needs to take into consideration the interactions between these levels. Evolutionary epistemology needs therefore to think in terms of "developmental systems" (i.e. global ontogenetic configurations that include genes, environments, and epigenetic factors) as the units that are conserved or modified throughout evolution. Natural evolution consists in a succession of developmental systems. From the standpoint of DST, heredity does not depend on the transmission of static genetic information from one generation to the next, but rather on the reproduction of patterns in ontogeny, as configurations of interrelated developmental resources besides the genes: that is to say, *entire developmental system*. In other words, organisms not only pass down genes, but environments as well. The notion of developmental system is therefore clearly close to the autopoietic notion of *ontogenetic phenotype - ontogenetic niche relation*. Altogether, DST and NDT subscribe to a systemic understanding of biology and reject the idea that organism and medium possess predetermined properties. For both theories, biologic explanations should overcome classic dichotomies (heredity and environment, nature and nurture, etc.): the opposition between inner and outer causal factors is replaced by a *co-implicative relation*, since organism and medium mutually specify each other.

5 Genes as followers in evolution

When it comes to the role of genes, NDT rejects genetic determinism, by taking an issue with the following neo-Darwinian tenets: 1) ontogeny is determined by genes; 2) evolution is guided by the process of genetic change. Not only does the NDT reconsider the role of genes in determining phenotypic traits (genes code for proteins, not organisms), but it also rethinks the effective role of genetic variation throughout evolution. Maturana and Mpodozis make two major evolutionary claims: 1) lineage phylogeny is not guided by genetic mutations, but rather by behavior, and 2) speciation takes place not in a gradualist fashion, but by sudden jumps. In other words, NDT basically turns the traditional neo-Darwinian understanding of evolution on its head. During the second half of the twentieth century, evolution has often been seen as a two-stage process: the first stage is the production of chance genetic variation; the second one is the sorting of the variants by natural selection. Adherents to this view believe that selective pressure act on the genetic variety of a population, producing a *gradual*, adaptive shift in a population over generations, which leads eventually to the emergence of new species. However, many biologists have come to realize that evolution can occur by a multitude of processes, including epigenetic mechanisms (Jablonka and Lamb 2005; West-Eberhard 2003). In particular, after the advent of evo-devo and the discovery of epigenetic heredity and genetic accommodation, it has become clear that the mechanisms involved in the ontogenetic development may often generate drivers in evolutionary processes.

NDT considers that the genome is part of the total genotype (i.e. the initial structure of an organism that includes all the molecular components, not only genes). Although the initial structure is a starting point that determines the domain of all the possible developmental pathways followed by an organism over the course of ontogeny, phenotypes are not predetermined by genes. They emerge "epigenetically"[1], as the result of the interplay between the structures of

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[1] In keeping with Maturana and Mpdozis, in this paper I refer to the continuous process of transformation that occurs moment by moment over ontogeny as "epigenesis," in order to avoid the preformationist metaphor behind the term "development."

the organism and the medium. Therefore, the total genotype does not specify the development of the living system, it only establishes an epigenetic field (i.e. a domain of possible epigenesis). Yet, only one of the epigenetic pathways is realized over the course of the ontogeny, as the result of a systemic process that relies on a particular history of structural interactions. Thus, what genes do is to participate in the "systemic reproduction" of a specific ontogenetic phenotype - ontogenetic niche configuration (a specific developmental system, as Oyama would put it) and, in so doing, participate in the conservation of a lineage over generations. In the words of Oyama, "ontogenetic means are inherited, phenotypes are constructed" (2000: 71).

Let us go through the main implications of this approach. First, the effect of a genetic mutation depends on the developmental system as a whole. Second, genes are channeled by the drift of the ontogenetic phenotype – ontogenetic niche relation, rather the other way around. Although the *genetic drift* occurs independently from the drift of ontogenetic phenotype, the actual participation of genes in the realization of a given ontogeny is bounded by the systemic conservation of the ontogenetic phenotype – ontogenetic niche. As a result, genetic variations that do not interfere with the conservation of the ontogenic phenotype that defines a lineage "can be conserved in it as irrelevant inclusions, or will be lost, or will be co-opted in the epigenetic realization of the species' fundamental manner of living" (Maturana and Verden-Zöller 2008: 20). Third, the emergence of a new lineage takes place a systemic process, not a genetic one. Genetic drift occurs all the time, but the variations that do not affect the epigenetic realization of a given ontogenetic phenotype remain "hidden" (a phenomenon often called "neutral genetic change"). How does speciation occur, then? According to Maturana and Mpdozis, a new lineage appears when a *substantial variation* of the ontogenetic phenotype that defines an existing lineage begins to be conserved from generation to generation. They refer to this process as the *phylogenetic shift of the ontogenic phenotype*. In order to be conserved, the new way of living must ensure the systemic conditions under which it can be repeated. As we will see below, behavior plays an important role in this process. Finally, Maturana and Mpodozis claim that the emergence of a new lineage takes place as a rapid, discontinuous *saltatory process*. NDT is therefore saltationist: the formation of lineages takes place not in a gradualist fashion, but rather through fast, discontinuous evolutionary leaps.

To sum up, genes are followers in evolution. This theoretical assumption is consistent with current research in biology. The discovery of epigenetic heredity (Jablonka and Lamb 2005) has revealed that DNA replication is not the only inheritance mechanism. In addition, epigenetic plasticity and environmental induction, rather than genetic variation, are frequently at the root of phenotypic novelty, leading to genetic accommodation (Dor and Jablonka 2014).

6 How natural drift is channeled by behavioral habits

One of the major claims of NDT is that behavior guides the natural drift of living beings. This is not surprising since the relation between organism and environment receives a renewed attention in NDT. The focus is shifted from internal and external forces to the domain of existence of the organism as a whole. The operational domain of existence of living beings becomes therefore an important site of both ontogenetic and phylogenetic explanation. In this framework, behavior is referred as the flow of interactions and relations that take place in the course of the encounter between organism and its medium. Simply put, behavior is the domain of the relational epigenesis. Behavior constitutes an important aspect of the ontogenetic phenotype in specifying its relational and operational processes. From the autopoietic point of view, organisms' living and becoming cannot be distinguished from the uninterrupted flow of operations (that is to say, behaviors) they bring about while interacting with their medium.

In which sense, then, behavior guides evolution? As a matter of fact, behavioral habits correspond to an animal's daily life. Habits clearly play an important part in the specification of the systemic conditions in which animals live, and contribute to maintain the epigenetic features of the parental way of living over generations. As a result, habits can contribute to securing the conditions necessary for them to be repeated over generations. At the same time, under some circumstances, behavior can produce radical shifts in the way of living of existing lineages. It has become increasingly accepted that active choices and their results have evolutionary consequences. Behavioral and neural plasticity allow animals to expose themselves to new conditions that may open up possibilities for phenotypic novelty and evolutionary changes. By their behavior, animals change the material and the social conditions with which they and their descendants have to cope and thereby affect the subsequent course of evolution (Bateson 2005). When this happens, NDT claims, the new behavioral habit *operates as an attractor* for the new organism-medium co-drift. In other words, if the new behaviors can be repeated over generation, the stabilization of the organism-medium relational configuration henceforth conserved opens up for a whole range of transformations involving genes, phenotypes, and medium.

This understanding of speciation can be articulated as follows. First, the ontogenetic phenotype that defines the new lineage sets systemic boundary conditions for its realization and conservation over generations; if these conditions are lost, the lineage comes to an end. Second, as a consequence of the previous point, the conservation of behavioral habits that are crucial for the new ontogenetic phenotype acts as an attractor for the subsequent structural and organismic change. The new drift co-opts all the genetic and epigenetic variations that respond to the new ontogenetic constraints, thus facilitating the systemic realization of the manner of living and its reproduction over generations. This means that the longer a lineage continues, the more the total genotype shifts toward a facilitation of the epigenetic realization of the ontogenic phenotype which defines it. Third, this historical dynamic of drift between genes, behavior and medium results necessarily in the remarkable congruence between the phenotype (often seen as “adaptations”) and the way of living of a given lineage.

Plenty of evidence in evolutionary biology indicates that major changes in behavior and cognition can take place without any changes in the genes. For example, it has been showed that epigenetic transmission can play an important role in initiating processes that give rise to evolutionary novelty, leading thus to genetic accommodation (Jablonka and Lamb 2005).

7 The languaging-based social life as an attractor for human evolution

How did our ancestors become languaging living beings? We have noted that, in order to provide an account for the origin of a lineage, it is necessary to identify the most essential habits that were conserved over generations. The ontogenetic phenotype that specifies the identity of modern Homo sapiens is the languaging-based, cultural mode of life. Moreover, if we accept the idea that behavioral habits channel the course of evolution, the interactional – relational domain becomes a crucial site for explanation. As we have seen, interactions guide the becoming of all living beings. This is especially obvious with social species.

It can be hypothesized that, over the evolution of the genus Homo, languaging-based interactions become the predominant mode of coordination between individuals. Embracing recursive coordination as the operational and relational matrix of their living, our ancestors gave rise to the drift that resulted in our lineage. The central idea is that social coexistence based on recursive coordination has significantly channeled human evolution. Coexistence-through-languaging acted as an evolutionary attractor for the genetic, anatomical, cognitive and cultural drift. Linguistic coordination is highly suited for such an evolutionary process. It allows for limitless recursion in the coupling of behavioral and cognitive capacities with the social transformations they generate.

Let me go through the evolutionary implications of this hypothesis. The consolidation of recursive coordination as the fundamental ground for interaction has important systemic consequences because of its inherent generative power, and of the intense forms of sociality and interdependence that result from it. Over generations, recursive coordination through languaging dramatically enlarged the scope of possible forms of social interaction. This opens a realm of possibility for variation in the activities through which the group remains unified. The incremental augmentation of networks of coordination and interdependence between individuals led to the generation of new classes of sociocultural activities as well as new cognitive capacities. This interactional configuration encourages cooperative, socially learned behaviors.

Furthermore, it is clear that the languaging-based way of living is the result of a shift in the ancestral primate ontogenetic phenotype. In keeping with Maturana and Verden-Zöller, episodes of languaging began to be systematically conserved over generation, as a substantial aspect of the ontogenetic phenotype; in so doing, “everything began to change in the history of that new lineage around the conservation of languaging as the manner of living that defined it” (Maturana and Verden-Zöller 2008: 33). New behavioral patterns are made possible by neural plasticity. At the same time, in giving rise to new habits and preferences, new behaviors transform the social and physical environment, and can trigger important changes in anatomy and cognition in ways that are eventually genetically accommodated.

The whole evolutionary process can be thought of as a positive-feedback loop that gives rises, on the one hand, to new forms of sociocultural activities (enhancing the material and relational interdependence between the members of the group) and on the other hand, to neurobiological and anatomical evolution. The genetic changes that led to the characteristics of modern humans have been channeled by the process of hominization, which lasted over a few millions of years. It is now widely acknowledged that the main changes in our ancestors’ habits relate to the use of tools, social and cultural life, and language. The main morphological transformations include, among others, the evolution of the vocal apparatus and an increase in brain size. It is also generally agreed that there are clear interactions between these changes. Based on the latter, the emergence of the first forms of coexistence-through-languaging needs to be dated back to the emergence of *Homo habilis*. This assumption is supported by evidence and is gaining increasing consensus in the scientific community. Fossil and archeological record shows the long evolution of the anatomical correlates of language, as well as of cooperative and cultural activities. The evolution of the brain, body, language and sociality are all intimately linked to each other and cannot be understood in isolation.

In a recent article, Dor and Jablonka make a similar claim in arguing that "first we invented language, then language changed us" (2014: 16). According to them, language-related evolution was a phenotype-first adaptation. The creation of a new realm of communication dragged individual cognitions and genes into a co-evolutionary dynamic that eventually produced languages and language-compatible minds. However, their account differs from the one I offer in that they claim that language must have been preceded by specific adaptations for social cognition (see above, section 9).

8 Consequences for hominization

Gene-centered approaches to evolution fail to acknowledge the systemic, behavior-driven process of drift. Over the last decades, modular accounts of language have presented an evolutionary explanation based on genetic mutation, which implies a recent, hazardous emergence of language. In this view, the evolution of the structural substrate for language has occurred independently from the actual cognitive operations and behaviors they give rise to (i.e. speech and social activities). Linguistic abilities are the result of a single genetic mutation. Our ancestors discovered to possess these cognitive capacities and found a way to use them. In keeping with this view, Tattersal argues that "[...] by the time *Homo sapiens* became symbolic, it already possessed the peculiar form of the vocal tract that allows articulate speech. Clearly, this structure evolved initially in some context other than language" (2008: 103).

Quite on the contrary, I have indicated that we have good reasons to believe that body, cognition and behavior coevolve. The relation between them is a co-implicative one, and can hardly be captured by gene-centered explanations. In order to explain the evolution of some of the most relevant anatomical and cognitive features of Homo sapiens, we should reconstruct how the consolidation of the languaging-based way of life produced a set of operational constraints for the drift of the phenotype-niche configuration. NDT shows that the history of structural transformations facilitates the conservation of the most fundamental feature of the ontogenetic phenotype, which entails species-specific evolutionary pathways for the bodily structures associated with it. Empirical evidence may support the claim that the origins of linguistic coordination lie much further back than the emergence of Homo sapiens.

Different sources of evidence point to this conclusion. The analysis of fossilized parts of the vocal and auditory apparatus seems to suggest that speech is an old trait of our lineage. Archeologists and paleontologists acknowledge that the evolution of human skills for speech has taken place over a very long period of time. Phonation-related organs have followed a process of continual evolution for over one million years. Phonation has undergone a specific evolution, including the permanent descent of the larynx, the enlargement of the oral cavity and the modulation of vocal tone, the transformation of the respiratory tract (MacLarnon and Hewitt 2004) and of the mandibular muscles that are responsible for locution (Kent 2004). It is therefore unlikely that speech burst on the scene in the last few thousand years (Johansson 2005).

Similar arguments apply to brain evolution. The development of our ancestors' cognitive and behavioral plasticity up to the emergence of Homo sapiens is clearly related to encephalization and the evolution of neocortex. The increase in brain size began from the Homo genus onwards, approximately two million years ago. Prefrontal cortex is one of the regions of the cortex that experienced the greatest expansion over the course of evolution. It is mainly involved in higher functions, including those relating to temporal organization of goal-oriented actions in the areas of behavior, cognition, and language. It is widely acknowledged that this process was due to iterative coevolution between the social mode of life and neurobiological structures. Brain evolution entails such a metabolic cost that it could not have occurred without the appropriate socio-ecological conditions. It can be assumed that the appropriate stimulation for brain transformation has been provided social activities based on recursive coordination. Languaging allows the emergence of new forms of "doing things together," thus triggering structural changes and the emergence of new cognitive capacities. Moreover, cultural evolution is cumulative (Tomasello 1999). This account of brain evolution is roughly consistent with the one provided by the advocates of gene-culture coevolution, claiming that individuals began to be selected for their ability to adapt to changing cultural niches.

Finally, evidence suggest a correlation between the emotional preferences required by languaging-based activities and structural changes in our ancestors. Since affective and relational attitudes connote the interactional domain, it is safe to assume that emotional dispositions, neurobiological changes and anatomical transformations are evolutionarily intertwined. Importantly, one of the evolutionary mechanisms that leads to encephalization is the heterochronic process of hypermorphosis. Hypermorphosis refers to the extension of the ontogenesis of an organ beyond its ancestral form, with the effect of increasing it. Hypermorphosis may occur as part of a developmental slowdown and delayed maturation (Zollikofer and Ponce de Léon 2010). Because of this, hypermorphosis of the brain (and the resulting synaptic plasticity) has sometimes been associated with human "neoteny" (Gould 1977, 2000), which relates to prolonged and delayed development, thus leading to paedomorphic features. Human paedomorphic features include round skull, hairless face and body, small teeth. As a matter of fact, modern human beings retain to adulthood the juvenile features of their ancestors. Moreover, human adult morphology and cognitive plasticity are coupled with specific emotional and social dispositions that are not usual in adult primates. Emotional interdependence, mutual trust and tolerance between adults of both sexes characterize the relational domain of human groups. Interestingly, similar modifications in both physiology and behavior can be observed in experimental research on "domestication syndrome" in other animals (Hare et al. 2012). Experimental breeding of a variety of mammals with selection for nonaggressive behavior lead to a paedomorphic morphology (including variations in cranial shape, dentition, brain size,), tameness, and increased problem-solving abilities.

It can therefore be hypothesizing that the living through languaging has encouraged the conservation of a *juvenile relational space*, characterized by intense sociality and mutual trust, which resulted in reduction of aggressiveness, enhanced curiosity and collaborative exploration. Physiological transformations have been therefore channeled by these emotional and relational habits. Collaborative innovation and juvenile emotional habits are thus inextricably linked. In a similar vein, scholar have discussed the possibility of self-domestication by humans (Hurford 2007; Jablonka et al. 2012). In keeping with Maturana and Verder-Zoller (2008), we can assume that a major phylogenetic shift took place when recursive coordination became a precondition for child upbringing. This view is consistent with the evo-devo approach, which highlights how very early behavioral changes in ontogeny lead to evolutionary change (Björklund and Rosenberg 2005).

9 The coevolution of sociality and language

The last section has made clear that sociality needs to be acknowledged as a fundamental factor to understand the emergence of language. There could in fact be no language as we know it based on bland forms of social interaction. As a matter of fact, a languaging-based lifestyle requires more than episodic cooperation, but rather a specific sociality based on mutual trust and emotional preferences for collaborative activities.

Most of the socio-cognitive theories to language evolution have for some time argued that a specifically human sociality played a part in hominization. However, their conception of language as a communication technology explicitly relies on the idea that language *presupposes* capacities for social cognition (i.e. understanding others' mental states, sharing perspectives and intentions). According to them, these capacities have evolved in before language. They appeared in the context of mutualistic collaborative activities (planning and coordinating a hunt, collaborative foraging). This assumption in shared by all the adherents of the socio-cognitive framework. In their scenario, our ancestors managed to efficiently communicate and collaborate without language. For instance, Tomasello (2008, 2011) argues that language has evolved from pre-existing communicative activities based on prelinguistic, "natural" gestures.

The socio-cognitive approach sees language as a cultural artifact that we use to convey intentions. Language, as we know it today, is conceived as a tool that allows complex forms of communication between individuals endowed with mindreading capacities. Then, it could not have been invented in the absence of a few previous conditions: the evolution of new forms of cognition and the emergence of creative collaboration and "prelinguistic" communication. However, if we conceive language rather as languaging, it is clear that the "prelinguistic" social activities described by socio-cognitivists build upon recursive coordination and thus, upon languaging. This is because recursive coordination brings about the cognitive and operational distinctions that are necessary for mutual co-orientation. From a conceptual point of view, languaging (in any form or modality) cannot be seen as something that adds up to the "pre-existing" sociocultural activities described by the advocates of the "culture and sociality first" scenario. Because they assume that social cognition and sociocultural activities are the necessary precursors of language, socio-cognitive accounts do not fully see how languaging, social cognition and joint activities are necessarily intertwined. Linguistic activity is not a form of joint action between others. Languaging rather refers to the fundamental operations that constitute all human social activities. It is not something that humans *use*, it is rather something that humans *do*, giving rise to flows and networks of relational and operational interdependencies that create their Umwelt. Since semiotic resources (sounds, gestures, movements, etc.) specify forms of coordination and regulate distributed action, they cannot be thought of as logically secondary to human collective practices: the latter cannot exist without the former because they constitute different aspects of the same cognitive and behavioral co-orientation process.

It is a reasonable assumption that simple forms of protolanguage have emerged well before the grammaticalized, morpho-syntactically and functionally complex languages. Yet, "protolanguaging" *is* a form of languaging. Even though holophrastic communication differs greatly from modern linguistic activity (with respect to the cognitive operations they require and the range of activities they bring about), they rely on the same operational principle, that is to say, recursive coordination. Fossil record leads many researchers to claim that protolanguage has a time-depth of two million years ago, which entails that Erectus and Neanderthal possessed it (Sinha 2015; Dediu and Levinson 2018). There is no compelling reason to suppose that languaging emerged with Homo sapiens. Quite on the contrary, as shown in the last section, archeological evidence supports the idea that multi-modal languaging has guided anatomical and neurobiological transformations. Moreover, it can be assumed that a key step in this process has been the emergence of "dialogue" or "conversation," as a new space for co-action that overcomes simple hortative coordination (i.e. orders, requests), thus allows the construction of more complex activities (Raimondi 2019).

10 Conclusion

This paper seeks to reconcile the notion of languaging with phylogenetic explanations of the origin of language and social and cultural abilities more generally. It does so by connecting languaging with evolutionary biology and specifically with the theory of natural drift. In keeping with NDT, the major claim is that the consolidation of a languaging-centered way of living acted as an attractor for the phylogenetic drift. Thus, languaging did not evolve by neo-Darwinian adaptation. I have showed that, from the autopoietic point of view, speciation occurs when new behavioral preferences are systemically maintained generation after generation, becoming the species-specific way of living of the new class of living beings.

Based on the latter, I have stressed that hominization must have been entangled from the very beginning in a co-evolutionary spiral with transformations in the relational and structural domain. Daily coexistence through recursive coordination led to increasingly complex forms of social activities. Over two million years, the phylogenetic drift of genus *Homo* has systemically co-opted all the genetic changes that could ensure the conservation and the expansion of such fundamental habits. As we have seen, specific anatomical and physiological transformations can be correlated to specific cognitive and relational dimensions of coexistence-through-languaging. Human evolution can be thought of as a systemic, positive-feedback process that involved genes, cognition, and medium.

Finally, this paper presents an argument against socio-cognitive theories of language origins. In particular, I have discussed the fallacy of postulating the logical and phylogenetical primacy of social cognition over semiotic resources. Contrary to this assumption, I have argued that our ancestors' sociocultural activities emerged from the first forms of recursive coordination.

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Bionote

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