To appear in *Beyond the meme*, ed. by William Wimsatt & Alan Love. University of Minnesota Press.

## The Evolution of Language as Technology: The Cultural Dimension

Salikoko S. Mufwene

University of Chicago

### Abstract:

Must accounts of the phylogenetic emergence of language be framed exclusively in terms of biological or cultural evolution? Assuming that languages are communication technologies whose emergence and manipulations presuppose a brain especially rewired, at some stage of the hominine evolution, to be capable of particular mental activities that set humans apart from non-human primates and other animals, the role of biological evolution can hardly be disputed. The late emergence of the modern brain enabled the emergence of modern language. On the other hand, variation in the ways different populations have structured their respective languages, just like variation in the ways they prepare their foods, produce their musics, and articulate their religions (among other things), underscores the cultural dimension of the emergence of language. Linguistic systems and practices too are ways of doing things and behaving that are specific to particular populations. Human cultures too presuppose a particular brain unique to humans. Thus, biology and culture are not mutually exclusive in the evolution of human languages and other aspects of human cultures. I argue that human cultural phenomena (which include languages) are consequences of a particular biological evolutionary trajectory that is specifically human and produced a uniquely human brain. Cultures do not produce languages; rather, the emergence of the latter contributes to shaping cultures in particular ways that vary from one population to another.

#### Keywords:

Universal Grammar (UG), language organ, mind, naming, predication, recursion, scaffolding

#### 1. Introduction

Debates on the phylogenetic emergence of language have generally included the question of whether this protracted process has been driven by biology or culture, as if the two conditioning factors (which I characterize as ecological) were mutually exclusive. For some, such as Bickerton (1990, 2010) and Chomsky (2010), language could not have emerged in mankind without the prior emergence of a "biological endowment for language" also called "Universal Grammar "(UG), or the "language organ" (originally also identified as the "language acquisition device"), which facilitated the seemingly saltatory event.<sup>1</sup> For some others such as Evans & Levinson (2009) and Everett (2012), this evolution is primarily cultural, assuming that cultural evolution proceeds differently from biological evolution, in respects other than speed of change and learning with modification.<sup>2</sup>

Texas Linguistics Forum 58: 92-117 Proceedings of the 23rd Annual Symposium about Language and Society-Austin April 17-18, 2015 @ Mufwene 2015

<sup>&</sup>lt;sup>1</sup> It is not evident that Chomsky and Bickerton have the same conception of UG (*pace* Baptista (2012), which Bickerton (1984ff) has also identified as the "Language Bioprogram" and explained as the biological blue print for language development. Taken literally, these names are not as synonymous as they have been assumed to be among some linguists. UG cannot be conceived of physically or biologically, except regarding the fact that the brain and the mind (with the latter depending on the wiring of the former), are the outcomes of biological evolution. I submit that UG must be situated in the mind, the state of the brain in activity. The Language Bioprogram is close in meaning to "biological endowment for language" in the sense that the latter refers more transparently to the biological-evolution conditioning for the mental capacity of mankind. As for the "language organ," the term suggests that there is some part of the brain, perhaps discontinuous, that is (exclusively) responsible for language. As Lieberman (2012) aptly explains, the brain functions like a car engine, which works not because of one particular component that specializes for one particular function but because of the interconnections between different parts that are interdependent. (See also Arbib 2012.) Besides, none of those interconnections between parts of the brain is for language alone, no more than a particular gene has been identified that would be for language only. One particular thing that makes the "Language bioprogram" interesting is that, conceived of as a blueprint, it suggests that ontogenetically an individual must reach a particular level of cognitive development before he/she can learn a language. Its conception is thus close to the "Evo-Devo" trend in studies of biological evolution, but it is not clear whether it should also be analogized to an elusive organ in the human brain even in some discontinuous structure. Since the current literature has capitalized on UG, which, according to Chomsky and his followers, is the catalyst for the emergence of Language in mankind and what facilitates the putatively "effortless" acquisition of any human language by a modern human child, I will stick to this term in this essay.

<sup>&</sup>lt;sup>2</sup> Note that, capitalizing on animal biology, the literature suggests that biological transmission is vertical and unidirectional (proceeding from parents to offspring), whereas cultural transmission (whose validity is disputed by, e.g., Fracchia & Lewontin 1999), is essentially horizontal and bidirectional, as it depends on learning. I submit that languages, and therefore cultures, must be analogized to viruses, for which interactions, rather than mating, drive

The issue I wish to raise here is whether, both biological and cultural evolution are not equally predicated on: 1) variation, which presupposes a population/species with organisms that are similar on the family-resemblance model; 2) heredity/inheritance, which presupposes generations, with the later ones inheriting or learning genes or techniques (or construction materials) from earlier ones; and 3) differential reproduction (Lewontin 1970), with different gene-recombinations producing organisms that are not identical or members of a population not reproducing their culture in exactly the same way one from the other. There are indeed differences in the specific ways materials or information are/is inherited, relying chiefly on the transmission of units in animal biology but on learning with modification in culture. This state of affairs entails differences in how reproduction must be interpreted for biology and culture, notwithstanding inter-specific differences within biology and within culture that reflect differences in ontogenetic properties of particular species or cultural domains. For instance, practices in material culture, such as weaving or face painting, are not learned exactly in the same ways as those in non-material culture, such as religion or governance. However, it is not evident that one must posit a theory of cultural evolution that is so different from that of biological evolution, so that one would have to claim either that language is the outcome of biological evolution only or that it is exclusively a product of cultural evolution.

## 2. Biology and culture are not mutually exclusive in the evolution of language

Along with scholars such as Jackendoff (2010) and Sperber (2010), I argue that biology and culture are not mutually exclusive in the phylogenetic emergence of language, with biology

evolution, with polyploidy rather than mating playing an important role in how selection may resolve competition. I consider both mating and interactions as the counterparts of interbreeding in animal biology as the condition for the transmission of heritable materials or information (Mufwene 2001, 2008).

generating the brain and the latter the mind as a complex problem-solving "mechanism," while culture itself is, like human cognition, apparently one of the products of the mind. I submit that conceiving of languages as communication technology helps address the question of the role of biology and the significance of culture in the phylogenetic emergence of language.<sup>3</sup>

A first step consists in addressing the fallacy of the phrase "language and/in culture," because it is not the same as "language and/in society." So we must ask ourselves what CULTURE is and whether it has some existence prior to how members of a population behave and do things, or prior to their belief system. This question is related to that of whether or not cultures are static or dynamic. Don't populations shape their cultures as they behave and do things, for instance, as they develop or borrow new ways of growing food plants or cooking and eating meals, or dressing and protecting themselves from the elements? Aren't these kinds of changes the reason why we can say that a population has changed its culture or that the latter has evolved? And does a population change its culture necessarily deliberately, or do changes not occur often undetected, with their practitioners noticing them typically by hindsight?<sup>4</sup>

I assume that culture is not static but is dynamic, being constantly reshaped by its practitioners as they do things, express their beliefs, and behave with/to one another under current ecological pressures. Culture is not knowledge but practice, though practice is shaped

<sup>&</sup>lt;sup>3</sup> It is deliberately that use the plural here, because I argue below that Language as an abstraction presupposes languages, which may have emerged in any number in separate hominine settlements. This evolution must have occurred once our ancestors had reached a stage of cognitive capacity that led the mind to coopt suitable parts of the hominine anatomy to produce a richer and more explicit communication technology than gestures and holistic vocalizations (Mufwene 2013a, 2013b).

<sup>&</sup>lt;sup>4</sup> The reason why the changes are detected by hindsight is untutored social learning, which proceeds by inference and whose outcome is typically imperfect replication. Changes are the ultimate outcome of the cumulation of (minor) details that are modified during the learning and/or execution process.

by learning from other members of the population and knowledge consists of representations or schemas one has constructed (not necessarily consciously) about how to behave on particular occasions, how to do things, or how to interpret the universe and life. Of course at some point the question arises of how the initial patterns emerged. We can address this question by singling out particular cultural domains, such as building dwellings, clothing ourselves, or organizing ourselves into families (nuclear and/or extended).

I contend that languages too are cultural phenomena, which fall in the category of practice and behavior, as they have been conceived of in the new wave of quantitative sociolinguistics and in linguistic anthropology, where it has become customary to speak of "community of practice," shaped by actual interactions. This is a different notion from that of "language/speech community," defined by the potential to interact with other members. In a community of practice, the members shape their norms through their interactions and are not assumed to have simply inherited them from previous speakers. Communication as transfer and/or exchange of information remains a constant in this approach to culture. Pressure to communicate in the most adequate way is part of what triggers adaptations, which may cumulate into evolution.

It is in their capacity to transfer information that I conceive of languages as technology, albeit of a mixed kind, consisting of physical units (vocal or signed) and of non-physical elements (semantic units and principles called "rules" or "constraints" on many levels: phonology, morphology, and syntax).<sup>5</sup> In the spirit of Brian Arthur's *On the nature of technology* 

<sup>&</sup>lt;sup>5</sup> A couple of linguists had thought of languages as technology or tools before me, but not quite in the same way I explain it in Mufwene (2013a). The closest in spirit is Jan Koster (2009), who focuses on the mechanical aspects of language, especially the phonetic materials of the morphosyntax, in reaction to generativists' privileging UG, as the

(2009), languages have helped hominines solve a problem, viz., how to convey information or knowledge explicitly from one mind to another. They are also like other emergent, collective, and cumulative folk technology, in the sense that they have not been produced by elite groups of thinkers (in a laboratory). They have shaped up incrementally, as schemas of utterances that are successful in conveying information settle in their producers and are learned by others. Anybody that has the capacity to innovate and produce an utterance successfully has a chance of contributing to the emergent system of their group; and, as the population thrives and is not overtaken by another, the emergent language grows to satisfy traditional and novel communicative needs.

Thus, languages are adaptive technologies, comparable with expansions in social organizations or with complexification in material technologies such as computers or airplanes, although a great deal of explicit thinking was engaged into the production of the latter. It is for a good reason that some emergentists characterize languages as complex adaptive systems (e.g., Beckner *et al.* 2009, Cornish *et al.* 2009, Steels 2000, Lee *et al* 2009, Kretzschmar 2012, Massip-Bonet 2012).

starting point of languages both phylogenetically and ontogenetically. In Language: The cultural tool (2012), Daniel Everett focuses especially on variation across linguistic systems as cultural inventions. More different from the position I have developed, before I read all these publications are two other articles, with the same main title, "Language as cognitive technology," by Marcelo Dascal (2002) and by Michael E. Frank, Eveline Frederenko, & Edward Gibson (2008). They deal with how languages are coopted to carry out cognitive processes, not with how they are structured and work, nor with what makes them cultural phenomena. Lee *et al.* (2009) had also thought of language as technology in their book The Interactional instinct but without developing the idea, as they focused on how to conceive of it as a complex adaptive system. Much closer in spirit is a short article by Douglas McArthur, "Le langage considéré comme une technologie" (1987), in which the author sketches a position very similar to mine, dealing with the physical architecture of language, but did not elaborate. He states in the English abstract that language can be considered as "a collection of tools and methods, a 'technology'. Like other technologies[,] it is the product of human invention, is elaborated over a period of time, and continues to change according to needs" (p. 157). He says on pages 159-160 that it can be characterized as "semiotic technology" or "information technology," albeit one with a "biological substratum." I have had more space to elaborate the position, including his argument for a polygenetic emergence of languages, in the plural, on which I elaborate in Mufwene (2013b, in press) but do not discuss below.

> Texas Linguistics Forum 58: 92-117 Proceedings of the 23rd Annual Symposium about Language and Society-Austin April 17-18, 2015 @ Mufwene 2015

Some linguists have preferred characterizing languages as representation systems,

focusing on their cognitive aspects (e.g., Bickerton 1990ff). Although this characterization is not false (after all, languages have a multifaceted architecture and convey information about some universe), the representation-system aspect of the architecture of languages appears to be a consequence of the particular ways in which the technology packages chunks of information in the transmission, variably from one population to another, sometimes even among those claiming to speak the same language. In this respect, languages are cultural products, which vary among themselves as different populations structure their universes of knowledge or representation (including their own social organizations) in non-identical ways.

The semantics of languages on both the lexical and sentence levels vary cross-culturally just like the physical components of their architectures: their phonologies, their morphologies, and their syntaxes. In this respect, they are also like other cultural artifacts, since different populations do not cook in identical ways, no more than they build their dwellings in identical fashions, or clothe themselves in identical styles. Although the materials used and the purposes of the practices may be the same, their implementations vary, just like in the manufacture of cars and computers at the industrial level. Languages are thus cultural phenomena, like cooking, dwelling, clothing, religion, and a host of other cultural products that distinguish us from other animals, including the great apes, which are assumed to be the closest to mankind anatomically and mentally.

Species-wise, the mind that produced all languages reflects a specific and common stage of hominine biological evolution, but they are cultural artifacts in that they reflect particular ways of behaving and doing things allowed by the same mind, and they vary systematically from one population to another. Consequently, there appears to be some inaccuracy in speaking of language <u>and/in</u> culture, as if the latter were separate from language. If anything, language as technology contributes to defining the culture of a particular population and holds a particular status simply because it facilitates the production of other cultural phenomena that presuppose communication.

We can now also question an often repeated claim: language is what makes humans unique in the animal kingdom, as it enables us to express even complex and abstract thoughts. Can this be true when there are so many other cultural phenomena that distinguish us from other animals, for instance, we cook or process food items (e.g., by seasoning, marinating, drying, or smoking them); we clothe ourselves (although among some humans it is just a matter of covering the genitals); we hold religious beliefs (including atheism); we build dwellings that are adapted to our residential/mobility patterns; we have various levels of social organization beyond the nuclear family and stricter norms against incest; we have political organizations and trade practices; and, among other things, we resort to a wider range of material technologies (however primitive) to solve our practical problems.<sup>6</sup> All these peculiarities suggest that something more fundamental than language distinguishes us from all other animals, viz., the human mind. If the human brain is anatomically still very similar to that of non-human primates (as made evident by, for instance, the behaviors of mirror neurons—see, e.g., Arbib 2012), our minds appear to be exponentially different from theirs. Note that although language prevents most of us from reinventing the wheel and enables us to acquire and spread knowledge in all

<sup>&</sup>lt;sup>6</sup> To be sure, some animals, including birds, resort to some technology (in Brian Arthur's sense) to solve problems, but not with as much diversity, nor to the same level of complexity, as that of folk technology among humans.

these domains without first-hand experience, it is not the reason why these cultural practices have evolved. It is just a facilitator.

Language has simply made it possible for us to sustain, modify, and spread our cultures. We may even say that the emergence of the other cultural phenomena exerted ecological pressures for language to emerge, to evolve, and to expand, making it possible for our knowledges to develop faster than if every individual had to rely on their own experience and thinking, and even to spread extensively within our respective groups.<sup>7</sup> A feedback loop appears of course to have emerged too (consistent with Odling-Smee *et al.*'s idea of "niche construction", 2003), as language must have expedited the expansion of the other cultural domains and they in turn exerted pressures on language to expand accordingly. The common cause of all these cultural phenomena is the human mind, the state of activity in which the brain is engaged.

Languages as technologies are therefore direct products of the human mind; and it is at this juncture that we must discuss the role of biology in the emergence of human cultures. Casting the Homo line evolutionarily, it appears that all the cultural practices/aptitudes mentioned above emerged at more or less the same time, coinciding with a particular stage of cognitive/mental evolution, within those 1-2% of genetic materials that distinguish us from the chimpanzees. The significance of the biological infrastructure lies in producing those critical

<sup>&</sup>lt;sup>7</sup> I subscribe to the position that the language of thought, whatever its form is, is not any of the spoken or sign languages. These have the disadvantage of being linear and slow compared to the speed of the non-cogitative thinking engaged in how we process the world of our ordinary experiences. Also, if it had this form, it would be difficult not only to imagine anybody capable of thinking before they acquire acceptable competence in any language but also to translate from one language to another. The language of thought, which makes it possible to process the semantics of our linguistic communication, is the mediation between linguistic systems in translation and interpreting.

differences in the brain circuitry of hominines that generates a mental capacity capable of traveling in time (Corballis 2011), which is reflected in our narratives, and to solve problems innovatively to a larger extent than other animals. In the spirit of Arthur's (2009) conception of technology as something that need not be material, nor monolithic, nor planned but can become complex by accumulation of contributions by different members of a population, even religions and myths may be considered as technologies, just like scientific hypotheses, as they both help make sense of the universe.

In more or less the same way as computers, which deserve this name only when both their hardware and software are taken into account, languages are hybrid technologies. They have been useful in helping hominines evolve more explicit communication not only about the present and the observable but also about the absent and the imaginable. They have a worldcreating capacity, as is evident in narratives, which have generated both myths and scientific discourse. And they have evolved complex architectures that meet the communicative needs of the communicators, interfacing the cognitive contents of the communications with the means used (vocal/auditory or manual/visual) to convey the contents. Their ability to convey complex knowledge about the past, the present, or the future, or to express feelings and sensations, or to make requests or impart orders/instructions is commensurate with the level of cognitive development in the communicators, both phylogenetically and ontogenetically.

## 3. Universal Grammar (UG) and the emergence of language

UG appears not to be the critical biological factor or organ that has guided the emergence of languages as separate from that of other cultural phenomena but rather a construct, to be situated at the mental level, which captures the common properties of the architectures of languages.<sup>8</sup> More plausibly, it is a consequence of the relative uniformity in the way that the similar brains generating similar minds at various stages of hominine evolution has produced the same fundamental basic architecture, despite the variation that obtained in the ways different populations solved their communicative challenges.<sup>9</sup> The cross-community variation that is evident in all modules of the architecture of language (viz., phonology and morphology, which work in the lexicon; syntax, which regulates the structure of sentences; and semantics, which applies to both the lexicon and sentences) is comparable to what is observable in the development of several other technologies, such as the algorithms that rare implemented in computer software (e.g., in the Mac and PC machines) but do similar jobs for the consumer. In all such technologies, the fundamental principles are the same, not because there is a special UG-like mechanism for generating them but simply because there must be limits in the levels and kinds of variation in the ways that the hominine mind solves particular problems, as the solutions are also constrained by the materials used.

In the case of spoken language, that material consists of sounds, which can also be produced only sequentially, producing rigid linearity, a consequence of the fact that the mouth can produce only one sound at a time. Thus, syntax, which really starts at the level of combinations sounds into words, is attested in the phonology, morphology, and "syntax" modules of the architecture of language as a consequence of linearity. As part of the

<sup>&</sup>lt;sup>8</sup> Some of the properties are putatively better conceived of in terms of parameters, which are set to function differently in different languages. Variation in the ways they are set accounts for typological differences among the languages of the world.

<sup>&</sup>lt;sup>9</sup> What led to this state of affairs starts in the fact that people facing the same problem do not necessarily solve it in identical ways, although their solutions may be (very) similar. Thus, different populations have also produced kinship systems and religions, among a host of other cultural phenomena, which vary cross-culturally.

emergence of communal norms (what linguists refer to as the "conventionality of language"), members of a population converge on which particular combinations of sounds, morphemes, and words into utterances (of various lengths) are acceptable and which ones are not. I submit that grammars as conventionalized principles that govern how speakers produce well-formed utterances of diverse lengths are consequences of the linear way in which the latter are produced in time, in order to streamline processing them.

Recursion, which has received so much attention in debates on the phylogenetic emergence of language, is a practice that reduces the number of different units and structures that speakers use in communication. It enables usage of the same structures or kind of construction several times over at different levels, just like with some of the formulae in algebra. Although several examples of recursion outside language can be cited, suffice it here to note that the practice underscores again the role of the same mind in solving problems in various human productions that constitute cognition and/or culture. Thus recursion is far from being an exclusive peculiarity of language or UG (Lieberman 2013). As a matter of fact, it reflects a property of the mind; what we observe in various cognitive domains only provides evidence of one of the ways in which the mind works, thus accomplishing economy in the strategies used in particular tasks, especially when the latter are reiterated or nested within each other.

That the material used in a particular technology acts as a constraint finds evidence in some differences between spoken and sign languages. Given the kinds of articulators involved in their production, sign languages would be slower if they were structured exactly like spoken languages. They are not subject to strict linearity and are produced in a tri-dimensional space in which the hands can move more freely than the tongue in the mouth. I contend that phonology and morphology are conflated into one module in them, without losing the particularity of "duality of patterning," which Hockett (1959) invoked as typical of human languages.<sup>10</sup> Sign languages incorporate semantic information in single signs in ways that are not possible in speech, such as when manner and motion and direction are all conflated in a single sign, unlike in the expression *rapidly slither up/down* or *slowly wiggle one's way* in English, for example. This is similar to producing the same piece of music with different instruments, each of which imposes its own constraints on the final product.

The material-related constraints invoked here regarding how one can package information in language are indeed reminiscent of those one can observe in other cultural domains. For instance, how one can produce a chair varies depending on whether the material used is natural wood, plastic, or metal; how one plays the American national anthem varies depending on the specific instrument used, for instance the flute as opposed to the saxophone or to the piano; just like its vocal production varies depending on whether the singer is alto or soprano. The shapes of dwellings have changed significantly from the primordial constructions with tree branches and leaves, through mud and thatch-roof houses, all the way to brick constructions and then steel and glass sky-scrapers. Even the choice of logs, bricks, or stones alone as materials for walls imposes different constraints on the latitude that the builder has about the shape of a house. Examples can be increased, but they all provide evidence for

<sup>&</sup>lt;sup>10</sup> "Duality of patterning," which Martinet (1960) identified as "double articulation," is a misnomer for the fact that in a language words can be broken down into meaningless sounds, phrases into words, sentences into phrases, etc. The smallest unanalyzable units of analysis in sign languages are not meaningless and are indeed fewer in number than in the phonetic inventory of a spoken language. Along with the more numerous complex units, they correspond to morphemes in spoken languages. Still, one can identify phrases and sentences, beyond words, in sign languages. See Mufwene (2013a) for a relatively more detailed discussion.

arguing that languages are technologies and their grammars are in some ways consequences of the specific materials used to package information.

Like other technologies produced in other cultural domains, they display variation from one population to another, corresponding to options that the mind makes available to solve problems. And there are limits imposed by the materials on such variation. For instance, there are only so many different, but not infinite, ways in which one can use one's fingers to count, just like there are only so many different ways individuals can shake hands, or move their limbs/bodies to dance, etc. Some domains offer more variation than others, of course.

The study of the emergence of language in mankind entails focusing on how the technology evolved, assuming the process was incremental rather than saltatory (as suggested by the protracted evolution of the hominine phylogeny), through successive exaptations of the anatomy and current structures driven by increasing ecological pressures for more and more complex communication.

# 4. Tentative conjectures on the phylogenetic emergence of language as communication technology

What I present below is very much inspired by how children "acquire" language, though I do not subscribe to the position that ontogeny recapitulates phylogeny. I hypothesized in Mufwene (2013a) that the initial steps in the phylogenetic emergence of must have involved naming individuals (persons and animals), entities, activities, and states/conditions, as this behavior is the closest to pointing, which distinguishes us from other animals, including nonhuman primates. Naming already constituted an important milestone from pointing, because it enabled our hominine ancestors to refer to individuals, entities, etc. that were not present, including those in the past, if the situation prompted memories. Later on, it enabled modern humans to identify imaginary entities and activities, such as in myths.

The naming of common objects, activities, events, and states/conditions not identifiable with proper names (e.g., *Mary, Jesus, the Pope, the moon*, and *the sun*) as being unique is also to be associated with another milestone, viz. the ability to lump in the same category, instances of kinds of object, events, activities, states/conditions, or behaviors that are similar (though not necessarily identical). This capacity to categorize and structure the universe of experience or knowledge definitely goes beyond the ability to individuate entities singled out by pointing and would later on evolve into additional strategies of specifying reference (e.g., *a man, the man, men, the men*, and *Man* as in the Biblical *God created Man*). It improved hominines' capacity to communicate about their universes of experience or knowledge in various ways that are more informative, especially when the referents are not present.

Cross-linguistic differences between strategies of establishing reference (not only between languages such as English and French, which both use articles, but also between languages that use articles, those that use noun class markers, and those that use numeral classifiers) highlight again the cultural dimension of the emergence and evolution of languages. Different populations did not solve the communication problem in identical ways, no more than they behave identically or assume the same beliefs about the world.

Although naming did not displace pointing, which can still disambiguate reference or establish reference in the present in case one does not remember the name, it started what Hockett (1959) called "displacement," the ability to refer to or communicate about what is not present. Contrary to the way linguists explain the architecture of spoken language, with phonetic sounds as the basic physical units that it is built on (thanks to the "duality of patterning," as explained above), it is also naming that drove the evolution of phonetic systems. Given the linearity of the vocal medium, naming exerted ecology-internal pressures to produce more sounds, which can help distinguish one name from another, by the principle that Saussure (1916) identified as "opposition," while the vocabulary kept increasing. That is, one can expand one's vocabulary more significantly, say, with 15 different sounds than with just five sounds.<sup>11</sup>

I submit that naming fostered the emergence of digital vocalizations, which hominines share only with song birds, though the latter have capitalized on what corresponds to prosody (tones or melody) in human speech. More successfully than in song birds, the evolution of this aspect of the linguistic technology made it possible for populations to produce as much vocabulary as they need with only a limited inventory of phonetic sounds (15-85) which they combine in some conventional, or culture-specific, ways in sequences of variable lengths.

This is also when it becomes obvious that it takes more than the anatomical capacity for digital vocalization to produce speech. As long pointed out by Darwin (1871), parrots can only mimic but not produce original speech for communication, because they are not endowed with the mental capacity that drives speech as communication technology. If one factors in the fact that parrots don't even use the same organs as humans in mimicking speech, it becomes more evident that if humans had the same organs as parrots, they would still be able to produce speech, provided they were endowed with the same mind. Part of the evidence for the critical role of the mind in the emergence and evolution of language also lies in the fact that humans

<sup>&</sup>lt;sup>11</sup> Rousseau (1755) was not mistaken in speculating that consonants were produced to make speech more fluid than if we spoke with vowels only. They apparently make it easier to transition from one syllabic peak to another.

that cannot produce speech have developed sign language, which can communicate information as richly and explicitly as speech.

In any case, as the hominine mental capacity continued to evolve, it exerted more ecological pressure for the emergence of predication, because one directs the attention of one's cohorts to individuals, entities, events, etc. to convey information about them, about oneself, or about them and oneself. I submit that predication was the next step in the emergence of language, which must have fostered the distinction between arguments and predicates.

The cultural dimension in this case lies in whether the syntax of a language imposes a strict Noun/Verb distinction, with verbs only allowed to head predicate phrases (as in English), or has a more permissive system, in which even adjectives and prepositions can also head a predicate phrase (without a copula, such as in Sinitic languages). Culture bears on every mechanical and structural aspect of language, because, as noted above, the mind availed different populations different options in the ways they could solve their communication problems. Assuming polygenesis, cultural differences account easily for the origins of typological variation among the world's languages, though it is another story to demonstrate whether polygenesis is the fundamental reason for linguistic diversity.

Predication brought with it pressure for more informative communication, such as specifying reference for the arguments and situating activities/events and states/conditions in time. Within certain ranges of variation, different populations developed culture-specific strategies for specifying reference (through markers of NUMBER, GENDER, DEFINITENESS, etc.), specifying time (through markers of TENSE and ASPECT), and for establishing degree of responsibility regarding the veracity of the information communication (through Mood/modality distinctions). Need to collaborate with one's cohorts also exerted pressure to distinguish statements from commands and from requests for information (i.e., questions). Appropriate strategies have been developed in all human languages to meet all these communication needs, although the details of their implementation vary from one population to another, underscoring the cultural aspects of languages as technologies, while the mind that produced them reflects particular trajectories and stages in biological evolution that distinguish us from other animals. A noteworthy consequence of this evolution is the clear distinction in the grammatical behaviors of nouns (as typical arguments) and verbs (as typical predicates) in virtually all human languages. As noted above, there is some variation regarding prepositions and adjectives, which can also function predicatively in some languages (though they are distinguished from verbs), when they exist as grammatical categories distinct from nouns and verbs. It is also less clear when and how they emerged.<sup>12</sup>

As the hominine cognitive capacity increased/improved and social organization became more complex, always in ways that vary from one population/culture to another, and therefore as communication needs increased, ecological pressures also increased for languages that are more and more complex, with larger vocabularies (as noted above), and with longer and more complex utterances.<sup>13</sup> Practicality would have dictated working economically, resorting to, for

<sup>&</sup>lt;sup>12</sup> It is debatable whether some languages have adjectives at all. According to some students of grammaticalization (e.g., Heine & Kuteva 2007), prepositions have evolved from erstwhile nouns or verbs, but it is not evident that this is the case for all of them, let alone in all languages.

<sup>&</sup>lt;sup>13</sup> I will dodge here the elusive issue of how to conceptualize complexity in language, as it does not boil down to a system with more units (e.g., a larger phonetic inventory and vocabulary) and more rules. There is also the kind of complexity, more significant perhaps, that arises from the interactions of the different units, rules, and modules of the architecture of a language with one another.

instance, recursion, in association with the "duality of patterning," to generate longer and more complex utterances. Beyond basic words, where recursion is limited to concatenation, the strategy works in conjunction with constituent structure, which facilitates processing in a vocal medium that is strictly linear.

As explained above, recursion is not so much a unique characteristic of human languages as it is a reflection of the way human minds work in solving problems economically. At the level of clauses embedded within each other, this observation corroborates Corballis' (2011) position that recursion reflects hominines' capacity to travel in the mind, which is consistent with the capacity for displacement (Hockett 1959) that every modern language satisfies. As usual, there are cultural differences in the ways the characteristic is implemented. Thus, serializing languages do not operate exactly like languages that resort to subordination in the way they expand sentences to express more complex ideas.

## 5. Generative entrenchment and scaffolding in the emergence of language

As explained in Mufwene (2013a), there is much more to explain about the emergence of the architecture of languages, about some aspects of which we may have no clues yet. Progress in the scholarship on language typology may better inform our speculations about the incremental evolutionary trajectories of modern languages. What I would like to underscore below is the significance of Wimsatt's (2000) Generative Entrenchment (GE) and Wimsatt & Griesemer's (2007) (Self-)Scaffolding throughout this protracted evolution.

Starting with GE, vocalizations had already been in usage among all mammals and other animals for communication. Hominines just made them more generative and productive by digitizing them (during the initial naming practices), introducing more functional variegation (MacNeilage 2008), and resorting to some syntax (which starts indeed at the level of phonology, the syntax of sounds) to produce exponentially larger vocabularies and utterances from limited inventories of sounds. Typological variation among the world's languages around the world shows that, past a critical mass of consonants and vowels, what matters is really what combinatorial conventions different populations develop to generate different words and utterances. Recursion appears to be an implementation of GE, in that speakers reuse structures already in place to produce larger ones. Various ways of expanding structures in language seem to illustrate this, for instance in preposition phrases (e.g., *the book on the coffee table in my house in Hyde Park in Chicago*) and in relative clauses (e.g., *the dog that chased the cat that ran after the mouse that ate the cheese*).

What is particularly noteworthy in cases of structural innovations, as is evident from the scholarship on grammaticalization, is the extent to which the novel creations are constrained by extant structures. For instance, using *go* as a FUTURE auxiliary in English is constrained by how it is used as a motion verb, viz., in the progressive to express a process, in combination with an auxiliary *be*, which is required by the less verby nature of the progressive form. Because it has its own auxiliary and only one auxiliary can be inverted in questions or precede a negation marker (e.g., *not* or *never*), only *be* can participate in these syntactic rules but not the present participle *going* (thus, *Is he going to write?* but not \**Is going he to write?*). It is only after satisfying these constraints that *going* as a marker of FUTURE can develop the peculiarities that distinguish it from MOTION *going to*, for instance the fact that it can contract into *gonna* or even *gon* in some dialects (*He's gonna write* but not \**He's gonna town*). These developments are

made possible by the fact that, as a semantic modifier/auxiliary, it can bear weak stress. Its grammaticalization into an auxiliary verb also prevents it from combining with the preposition *from*, which also suggests that the *to* it combines with is a complementizer but not a preposition any more. Throughout this evolution, GE has imposed on the semi-auxiliary *going* a syntactic frame that restricts the modifications that its grammaticalized usage can undergo (thus *Is he going to/gonna write*? but not \**Going he to write*? nor \**Gonna he write*?).

Particularly noteworthy in the evolution of language is the fact that the addition of new elements is supported by the extant structures, though it proceeds ad-hocly, depending on the particular needs that arise at particular points in time. Thus, although they need a technical metalanguage (which may include complex, non-transparent formulae), scholars still have to write their prose according to the syntax of the schooled lay person's language. Things happen this way simply because it is less costly to make ad-hoc adjustments to a system than to redesign it from scratch.

The above discussion also illustrates self-scaffolding. From a physical point of view, speech is scaffolded on hominines' innate capacity for vocalization. We coopted our masticatory organs to diversify our vocalizations and to introduce syllabic variegation. We also domesticated our breathing patterns in the process. This makes speech a very inexpensive technology, which proceeded by exaptation without having to resort to any anatomical organ that hominines did not already use for some other vital function. Once we were able to produce words and increase the vocabulary, the foundation of syntax as combinations of words into longer utterances were laid. That is, syntax as a consequence of using a technology that can be produced only linearly, started within the vocabulary, consisting of words which are formed from constrained combinations of sounds and can be distinguished from other different recombinations of sounds even if exactly the same sounds and numbers thereof are used, as in the case of *pit* vs *tip* or *dog* vs *god*, in the same way as *Paul loves Mary* can be distinguished from *Mary loves Paul* and *the dog chased the cat* from *the cat chased the dog*. The duality of patterning is thus a consequence of the self-scaffolding of the possibility of combining units into larger ones. Recursion, illustrated above, is a special case of this.

It does not look like a dedicated language organ, rather than a general-purpose mind, was needed for this particular evolution of communication systems in the hominine species. What distinguishes us from other animals is a mind capable of solving problems at a low cost, by exaptation, drawing on available resources that could be adapted for new functions quite different from their original ones. The structural complexity of languages appears to have emerged incrementally, thanks to new adaptations that were not anticipated at the earliest stages but were needed later on to match hominines' increasing mental and cognitive capacities. I have of course not articulated all the details of the relevant evolutionary processes. These remain part of the research program I am engaged in.

## 6. Conclusion

The emergence of Language is undoubtedly the outcome of a particular biological evolutionary trajectory which hominines do obviously not share with other animals and which produced the requisite anatomical and mental infrastructures for it. However, variation in the ways that different populations have structured their languages highlights the cultural dimension of this particular evolution, which left plenty of room for different populations to meet their communication pressures in differing ways. It is not so much as if there were a cultural

evolution that is different from biological evolution; it is that, like mutations, alternative innovations by the mind and reproductions of these by untutored learning (driven by observation and inference) account for why the "transmission" of cultural phenomena proceeds differently from that of biological materials, notwithstanding the fact that the recombination of genes in offspring makes genetic transmission less faithful.

Languages appear to be cultural phenomena like many others that distinguish humans from other animals, but their evolution need not be seen as excluding biological evolution. A question that arises at this point of my essay is the following: Does "cultural evolution" mean that 'an evolution that proceeds differently from biological evolution' or 'evolution as it applies to cultural phenomena'? Could there be just one notion of EVOLUTION (interpreted as 'change in heritable traits' or 'gradual directional change') whose specifics vary depending on what it applies to? I favor the latter interpretation.

## References

- Arbib, Michael. 2012. *How the Brain Got Language: The Mirror System Hypothesis*. Oxford: Oxford University Press.
- Arthur, Brian W. 2009. *The nature of technology: What it is and how it evolves*. New York: Free Press.

Baptista, Marlyse. 2012. On Universal Grammar, the bioprogram hypothesis and creole genesis: An interview with Noam Chomsky. *Journal of Pidgin and Creole Languages* 27.351-376.

Beckner, C., Blythe, R., Bybee, J., et al. 2009. Language is a complex adaptive system: A position paper. *Language Learning 59*(1).1–26.

Bickerton, Derek. 1990, Language and species. Chicago: University of Chicago Press.

- Bickerton, Derek. 2010. Adam's tongue: How humans made language, how language made humans. New York: Hill & Wang.
- Chomsky, Noam. 2010. Some simple evo devo theses: How true might they be for language. In Richard K. Larson *et al.* (eds.), 45-62.
- Corballis, Michael C. 2011. *The recursive mind: The origins of human language, thought, and civilization*. Princeton: Princeton University Press.
- Cornish, H., Tamariz, M., Kirby, S. 2009. Complex adaptive systems and the origins of adaptive structure: What experiments can tell us. Language and Learning 59(1).187–205.

Darwin, Charles. 1871. The descent of man. Amherst, NY: Prometheus Books.

- Dascal, Marcelo. 2002. Language as a cognitive technology. *International Journal of Cognition and Technology* 1.35-61.
- Evans, Nicholas & Stephen C. Levinson. 2009. The myth of language universals: Language diversity and its importance for cognitive science. *Behavioral and Brain Sciences* 32.429-492.
- Fracchia, Joseph, & R. C. Lewontin. 1999. Does culture evolve? *History and Theory: Studies in the Philosophy of History* 38, no. 4, 52-78.

Everett, Daniel. 2012. Language: The Cultural Tool. New York: Pantheon Books.

- Frank, Michael C., Daniel L. Everett, Evelina Federenko, & Edward Gibson. 2008. Number as a cognitive technology: Evidence from Pirahã language and cognition. *Cognition* 108.819-824.
- Heine, Bernd & Kuteva, Tania. 2007. *The genesis of grammar: A reconstruction*. Oxford: Oxford University Press.

Hockett, Charles F. 1959. Animal "languages" and human language. *Human Biology* 31.32-39.

Jackendoff, Ray. 2010. Your theory of language evolution depends on your theory of language.

In Larson *et al*. (eds.), 63-72.

Koster, Jan. 2009. Ceaseless, unpredictable, creativity. *Biolinguistics* 3.61-92.

- Larson, Richard K; Déprez, Viviane; & Yamadiko, Hiroko (eds). 2010. *The evolution of human language: Biolinguistic perspectives.* Cambridge: Cambridge University Press.
- Lee, Namhee; Mikesell, Lisa; Joacquin, Anna Dina L.; Mates, Andrea W.; & Schumann, John H. 2009. *The interactional instinct: The evolution and acquisition of language*. Oxford: Oxford University Press.
- Lewontin, Richard C. 1970. The units of selection. *Annual Review of Ecology and Systematics* 1.1-18.
- Lieberman, Philip. 2012. *The unpredictable species: What makes humans unique*. Princeton: Princeton University Press.

MacNeilage, Peter. 2008. The origin of speech. Oxford: Oxford University Press.

Martinet, André. 1960. Elements de linguistique générale. Paris: Armand Colin.

Massip-Bonet, Angels. 2012. Language as a Complex Adaptive System: Towards an Integrative Linguistics. In *Complexity perspectives on language, communication and society*, ed. by

Àngels Massip-Bonet & and Albert Bastardas-Boada, 35-60. Berlin: Springer Verlag.

McArthur, D. 1987. Le langage considéré comme une technologie. *Cahiers de Lexicologie* 50.157-164.

Mufwene, Salikoko S. 2001. *The ecology of language evolution*. Cambridge: Cambridge University Press.

- Mufwene, Salikoko S. 2013a. Language as technology: Some questions that evolutionary linguistics should address. In *In search of Universal Grammar: From Norse to Zoque*, ed. by Terje Lohndal, 327-358. John Benjamins.
- Mufwene, Salikoko S. 2013b. What African linguistics can contribute to evolutionary linguistics. In *Selected Proceedings of the 43rd Annual Conference on African Linguistics: Linguistic Interfaces in African Languages*, ed. by Olanike Ola Orie and Karen Wu, 52-67. Somerville, MA: Casadilla Press.
- Mufwene, Salikoko S. 2013c. The origins and the evolution of language. In *The Oxford handbook* of the history of linguistics, ed. by Keith Allan, 13-52. Oxford University Press.
- Mufwene, Salikoko S. in press. Language evolution, by exaptation, with the mind leading. Proceedings of the 5<sup>th</sup> Conference on Evolutionary Linguistics, Hong Kong.
- Odling-Smee, F. John; Kevin N. Laland, & and Marcus W. Feldman. 2003, *Niche construction: The neglected process in evolution*. Princeton: Princeton University Press.
- Rousseau, Jean-Jacques. 1755. *Discours sur l'origine et les fondements de l'inégalité parmi les hommes* (Amsterdam : M. M. Rey). Translation of « Essai sur l'origine des langues » published in Moran & Gode (1966).
- Steels, Luc. 2000. Language as a complex adaptive system. In *Parallel problem solving from nature - PPSN VI ; 6th International Conference*, ed. by M. Schoenauer, K. Deb, G.
  Rudolph,X. Yao, E. Lutton, J.J. Merelo, J.J., & H-P Schwefel. LNCS, vol. 1917, pp. 17–26. Heidelberg: Springer Verlag.