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THE EVOLUTION OF LANGUAGE AS TECHNOLOGY

The Cultural Dimension

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Debates about the phylogenetic emergence of language have generally included the question of whether this protracted process was driven by biology or by culture, as if the processes associated with one or the other were mutually exclusive. For some, such as Bickerton (1990, 2010) and Chomsky (2010), hominines could not have developed language without first acquiring a "biological endowment for language"—also called *Universal Grammar* (UG) or the "language organ," which was originally identified as the *language acquisition device* (LAD). It is presumed to have facilitated the emergence of language, which, for them, was a saltatory event. For others, such as Evans and Levinson (2009) and Everett (2012), this evolution is primarily cultural, as it depends on learning by inference and proceeds faster than biological evolution.[1]

I submit that both biological and cultural evolutions are equally predicated on the conditions articulated by Lewontin (1970): (1) variation; (2) heredity/inheritance, which presupposes multiple generations, with the later ones inheriting genes or learning techniques (or construction materials) from earlier ones; and (3) differential reproduction, with the later generations exhibiting different genetic recombinations and thus producing different organisms or reproducing different variants of their culture. There are indeed differences in the specific ways that materials and information are "transmitted" or "inherited." In biology it is literally through the transmission of units, whereas in culture transmission is through learning, by inference in many cases (Atran and Sperber 1991; Mufwene 2001). Additionally, there are interspecific differences within both biology and culture that reflect differences in the ontogenetic properties of particular species or cultural domains

(see also Wimsatt, chapter 1). For instance, practices in material culture, such as weaving or face painting, are not learned in exactly the same ways as those in nonmaterial 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 that one would have to claim either that language is only the outcome of biological evolution or that it is exclusively a product of cultural evolution.

I argue below that the phylogenetic emergence of language presupposed a particular stage of biological evolution. It occurred after hominines were endowed with a particular mental capacity that generated (more) complex thinking, greater need to domesticate their natural ecology, and larger and more social organizations. The same mental capacity also exerted more pressure to exchange rich and diversified information explicitly and to expedite the growth of knowledge. However, languages are cultural phenomena on a par with others such as religion, hunting practices, farming, and folk music. The basic and nonspecialized aspects are typically learned by inference and thus with modification. The essence of vernacular linguistic systems (used for day-to-day communication and learned before one is taught the standard variety of their language in school) is learned the same way, by inference, piecemeal, incrementally, and from interacting with others. Consequently, languages exhibit characteristics associated with "cultural evolution," particularly horizontal transmission, imperfect replication, and fast rate of change (Mufwene 2001, 2017).

Below, I approach the subject matter in the following order: In part 2, I introduce the conception of language as communication technology and therefore as a cultural artifact. I use it to show that the debate over whether language evolution is biological or cultural has been framed inadequately. I argue that cultural evolution itself presupposes a particular stage of biological evolution, which sets humans apart from other primates. Biological evolution produced a brain that was not only language-ready but also culture-ready. That is, after reaching a certain evolutionary stage, the hominine brain was capable of mental activities that produced not only language but other cultural phenomena not observable among nonhuman primates and other animals.

In part 3, I argue against positing UG or a language organ as the prerequisite for the emergence of language. One would otherwise have to posit similar constructs for the emergence of other cultural phenomena, such as music and social organization. The mind (interpreted here as the state of the brain

in activity) appears to operate in a more economical way than suggested by phrenology, with some mechanisms, such as syntax and recursion, applying also outside language. I also elaborate on the idea of language as technology, which enables me to further flesh out the cultural aspects of language. In addition, I show how the specific materials used, such as sounds or manual signs, impose specific constraints on how the technology can be developed.

In part 4, I explain the particular role that naming must have played in the phylogenetic emergence of language, as it facilitates communication also about the past and the future. It actually drove the expansion of phonetic inventories in different languages. I show again how culture is a consequence of the particular way in which a population does things and should not be the explanation of how languages evolved. In part 5, I articulate the role played by Generative Entrenchment (Wimsatt 2000) and by successive scaffolding (Wimsatt and Griesemer 2007) in the gradual emergence of language as communication technology. I conclude the chapter in part 6.

BIOLOGY AND CULTURE ARE NOT MUTUALLY EXCLUSIVE IN THE EVOLUTION OF LANGUAGE

Along with scholars such as Jackendoff (2010) and Sperber and Origi (2010), I argue that biology and culture are not mutually exclusive in the phylogenetic emergence of language. While biological evolution generated the hominine "language-ready" brain (Arbib 2012), the latter produced languages that, because they vary from one population to another, are also characterized as culture-specific. Note that culture, as explained below, is not antecedent to language if we interpret it, roughly, as the particular ways in which members of a population behave and do things conventionally.[2]

The cultural fold of a language lies in the specific way that the particular population that has developed it as its communication technology has shaped it (viz., its phonemes, morphemes, words, and the relevant norms of usage) at variance with the ways other populations have done theirs (Mufwene 2013a). This is indeed comparable to, for example, two populations that have developed knowledge to protect themselves from elements in nature but have not used exactly the same materials nor produced the same styles for their clothing and shelters. Such differences occur not only due to alternative ways of solving the same problems but also because the challenges to which they respond are not identical. Typological variation among languages reflects this state of affairs. Conceiving of languages as communication technologies

helps to address the question of the role of biology and the significance of culture in the phylogenetic emergence of languages, without suggesting that there is a cultural evolution that is fundamentally different from biological evolution.

A first step in connecting the biological and cultural aspects of the phylogenetic emergence of language consists of addressing the fallacy of the phrase *language and/in culture*. It is certainly not the same as *language and/in society*. We must ask what *culture* is and whether it has some existence prior to how members of a population behave and do things. This question is related to whether or not cultures are static or dynamic. In my view, populations shape their cultures as they behave and do things; as they develop or borrow new ways of growing food, or cooking and eating meals, or dressing and protecting themselves from the elements. These are the kinds of changes that encourage us to say that a population has changed its culture or that the culture has evolved.

However, does a population change its culture deliberately? Or do changes often occur undetected, with its members noticing them in hindsight? Both kinds of changes occur, but the latter is probably more pervasive. The reason the changes are detected in hindsight appears to be because of untutored social learning, which is the typical pattern in folk culture. As noted above, the learning proceeds by inference, based on observing other members of the population that have experience in what they do, and its outcome is typically imperfect replication. Changes are the outcome of the cumulation of (often minor) details that are modified during the learning and/or execution process.

Culture is dynamic; it is constantly reshaped by its practitioners as they do things, express their beliefs, and behave with or act toward one another under current ecological pressures. Culture is not knowledge, which is precisely why we can speak of *knowing a culture*. It is practice, and practices are shaped in part by learning from other members of the population. Knowledge consists of representations or schemas about how to behave on particular occasions, how to do things, or how to interpret the universe and life (frequently formulated unconsciously) and thus how to practice a culture. On the other hand, how did the initial patterns we find in a culture emerge? We can address this question by singling out particular cultural practices, such as building dwellings, clothing ourselves, organizing ourselves socially (e.g., into nuclear or extended families), and communicating with each other in a particular language.

As cultural phenomena, languages also fall into the category of practice and behavior, consistent with the new wave of quantitative sociolinguistics and with linguistic anthropology. There, it has become customary to speak of *communities of practice* shaped by actual interactions (Eckert and McConnell-Ginet 1992). This is different from the traditional terms *language community* or *speech community,* which are defined by the potential that members of a population have 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. Their interactions also define their communities.

Communication as transfer or exchange of information remains a constant in this approach to culture. The pressure to communicate more information and in the most satisficing way is part of what, from the evolutionary perspective, triggered the expansion of the vocabulary and of linguistic structures. This still happens today in the ontogenetic development of language, from child-like to adult-like communication. The structural expansion may also involve exaptations of current structures, as can still be observed now in grammaticization processes, such as when the motion verb *go* is co-opted to also function as a marker of *future* in *be going to* + VERB.[3] All these changes cumulate into evolution, assuming the phylogenetic emergence of language was incremental (Mufwene 2013a), as I show below in part 4.

I conceive of languages as technologies for transmitting information (McArthur 1987; Koster 2009; Lee et al. 2009; Everett 2012; Mufwene 2013a; Dor 2015). Like computers, they are technologies of a mixed kind, consisting of physical units (vocal or signed) and nonphysical elements (semantic units and principles called *rules* or *constraints* on many levels: phonology, morphology, and syntax). Hominines developed them to solve a problem: how to convey even complex information or knowledge explicitly from one mind to another (Arthur 2009) and with high fidelity in transmission (Morgan et al. 2015).[4] In so doing, cooperation was enhanced; knowledge grew more rapidly at both the individual and the communal levels, as innovations could be shared and spread, thanks to the world-creating capacity of language in narratives (Mufwene 2015). According to Morgan et al. (2015), the emergence of symbolic communication, then certainly still distant from the earliest phonetic forms of communication (assumed to have started only around two hundred thousand years ago),[5] helped hominines evolve from the seven hundred thousand-year stasis of Oldowan toolmaking technology to the more complex Acheulean technology (about 1.7 mya). The transition

must have required teaching the relevant knowledge and making more explicit to learners the different steps involved in manufacture.

Languages are also like other emergent, collective, and cumulative folk technologies in the sense that they have not been produced by elite groups of thinkers, in a laboratory, and then taught to others after testing how well they work. Languages have evolved piecemeal and incrementally, especially when one focuses on the principles and constraints followed by speakers in combining sounds into words, and words into phrases and sentences, in developing their linguistic systems. Anybody that has the capacity to innovate and produce an utterance successfully has the potential of contributing to the emergent system of their group. As the population thrives (if it is not overtaken by another), their language evolves in response to pressures to also meet its novel communicative needs, which keep arising from changes in their universe of experience or imagination.

Thus, languages are adaptive technologies in ways comparable to expansions in social organizations or the growing complexity of material technologies, such as computers or airplanes. Although a great amount of explicit thinking was engaged in the production of computers and airplanes, these technologies—like languages—grow organically akin to folk technology (i.e., by additive collective actions and cumulatively). Thus, it is for a good reason that some emergentists characterize languages as complex adaptive systems (e.g., Beckner et al. 2009; Cornish, Tamariz, and Kirby 2009; Steels 2000; Lee et al. 2009; Kretzschmar 2015; Massip-Bonet 2012; Mufwene, Coupé, and Pellegrino 2017).

Focusing on the relation of languages to cognition, many linguists have preferred to characterize them as representation systems, thus as sorts of structured snapshots of their speakers' knowledge of the world (e.g., Bickerton 1990). To be sure, this characterization is not false, as languages *do* have a multifaceted architecture and convey information about diverse cognitive domains. However, the representation-system facet appears to be a consequence of the particular ways in which chunks of information are packaged for transmission in a language. The packages vary from one population to another, for instance, whether speakers use one or two separate words for siblings, differentiated by gender (as in European languages, viz., *brother* vs. *sister* in English) or by age (as in Bantu languages, viz., *yaya* 'older sibling' vs. *leke* 'younger sibling' in Kikoko-Kituba). They may also vary depending on whether siblings must be distinguished from cousins (as in European languages, viz., *brother/sister* vs. *cousin* in English) or lumped together in the

same kinship category (as in Bantu languages, availing typically the same term as for siblings). Similar cross-linguistic variation applies to whether all nouns must combine with a classifier when they co-occur with a demonstrative or a quantifier (as in Chinese, e.g., 5/THIS + CLASSIFIER + BOOK). Sometimes there is variation even among those claiming to speak the same language—for instance, whether or not one should speak of *heads of children* in the same way they speak of *heads of cattle.*

The semantics of languages on both lexical and sentence levels vary cross-culturally, just like the physical components of their architectures (viz., their phonologies, morphologies, and syntaxes). In this respect, they are also like other cultural artifacts, as different populations do not cook in identical ways, build their dwellings in identical fashions, or clothe themselves in identical styles. Although the materials used and the purposes of their practices may be the same, their implementations vary, just like the ways that, for instance, cars and computers are made, not according to exactly the same design from one manufacturer to another. Languages are thus cultural phenomena, like cooking, dwellings, clothing, religions, and a host of other cultural products, although there are systemic and complexity differences that are consequences of differences in the ontological properties of cultural phenomena. Together, they are constructed as cultures, which distinguish us from other animals, including the great apes, which are assumed to be anatomically and mentally the closest to mankind.

Species-wise, the minds that produced human languages reflect a specific and common stage of hominine biological evolution, especially that of the brain. Nonetheless, the languages they produced are cultural artifacts because these also reflect particular ways of behaving and doing things that vary from one population to another. Consequently, it is inaccurate to speak of *language and/in culture* because the phrase implies that culture is separate from language. If anything, a language as technology contributes to defining the culture of a particular population. If it holds a distinctive status in society, it is simply because it enables the production of more knowledge and of other cultural phenomena that presuppose communication.

Morgan et al. (2015) provide a good example of this in their discussion of the transition from Oldowan to Acheulean stone technology. Although still in its preprimordial stages (if we focus on phonetic communication), symbolic language appears to have facilitated both the innovation of Acheulean technology and how fast it apparently spread within *Homo erectus.* In modern times, language has been critical to the transmission of complex

cultural knowledge through teaching (see also Wimsatt, chapter 1; Tostevin, chapter 8), especially in the case of specialized professional skills. Examples include weaving and knitting, some aspects of gardening, building animal traps, manufacturing hunting tools, and witchcraft, although one can argue that teaching has not involved all the details of the skills; some are still learned by inference, leaving room for both variation and innovation.

This line of reasoning prompts us to question an oft-repeated claim that language is what makes humans unique in the animal kingdom, in part because it enables us to express complex and abstract thoughts. There are many cultural phenomena besides language that distinguish us from other animals (Mufwene 2013a, 2015). 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 and 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 we resort to a wide range of material technologies (however primitive) to solve practical problems.[6]

All these peculiarities suggest that something more fundamental than language distinguishes us from all other animals—namely, the human mind. If the human brain is anatomically still very similar to that of nonhuman primates (as made evident by, for instance, the behaviors of mirror neurons [see, e.g., Gallese and Goldman 1998; Arbib 2012], our cognitive capacity appears to be exponentially different from theirs. As part of the mind, it drove the emergence of language and other cultural phenomena in our species, although language may stand out simply because it has enabled innovations of complex technologies (Morgan et al. 2015), has prevented most of us from having to reinvent the wheel, and has enabled the rapid spread and growth of knowledge in mankind.

As I am reminded by Alan Love (personal communication, November 23, 2015), the relationship between language and other cultural phenomena is quite complex. For instance, while it is true that language has played an important role in the emergence of political and administrative organizations, it has also been pointed out that changes in social organization, such as extended-family and larger hunter–gatherer groups, must have exerted important ecological pressures in the phylogenetic emergence of language. Nonetheless, these social organizations can hardly be sustained without ef-

ficient communication much more explicit and informative than, for instance, the nonlinguistic communication means used by humans themselves and other primates. To date, our social structures still scaffold the ontogenetic development of language as practice and as system. From an emergentist perspective, linguistic systems can be claimed to have emerged as consequences of repeated instances of phonetic or manual communication.[7]

A feedback loop appears to have emerged too (consistent with Odling-Smee, Laland, and Feldman's [2003] idea of "niche construction"), as language appears to have expedited the expansion of the other cultural domains, and these in turn exerted pressures on language to expand accordingly. The common producer of all these cultural phenomena is the human mind—that is, the state of activity in which the brain is engaged. One may invoke the human mental capacity, too, though it is not clear to me what difference or improvement the alternative wording makes. In any case, what is important is the observation that it is not language that makes us uniquely human. Collectively, human cultures do. From a reductionist perspective, the mind, which produced them, distinguishes us from other animals. Language is only one of the many relevant cultural phenomena.

It is at this juncture that we must discuss the role of biology or, more specifically, that of a brain architecture capable of cognitive capacities achieved only by hominines at some specific stages of their evolution since, probably, *Homo erectus,* in the emergence of human cultures. Assuming polygenesis (Mufwene 2013a, 2013c), it appears that all the cultural phenomena mentioned above emerged at more or less the same phylogenetic time in different hominine colonies, during or after the emergence of the 1–2 percent of genetic materials that distinguish us from chimpanzees. The significance of the biological infrastructure lies in producing those critical peculiarities of the hominine brain circuitry, apparently located in the cortex (Lieberman 2012), that generate a mental capacity able to situate events in the past, present, or future (Corballis 2011), thus capable of foresight and planning.

This capacity is reflected in our narratives, in which we can navigate in the present, past, and future (Mufwene 2015). Language is the kind of technology that hominines produced to share knowledge, feelings, attitudes, dispositions, and plans. Note that, as explained by Arthur (2009), technology need not be material, monolithic, or planned; it can become complex by the accumulation of contributions from different members of a population. In this sense, religions and myths, too, may be considered technologies, just like scientific hypotheses, as they both help make sense of the world.

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 and more reliable communication, from the point of view of transmission fidelity, not only about the present and the observable but also about the absent and the imaginable. Languages have a world-creating capacity—evident in narratives—that has generated both myths and scientific discourse (Mufwene 2015); they have also evolved complex architectures that meet the communicative needs of the communicators. The ability of these technologies to convey complex knowledge about the past, present, or future, or to express feelings and sensations, or to make requests or impart orders or instructions, is commensurate with the level of cognitive development in the communicators, both phylogenetically and ontogenetically. Note that child language is less complicated than adult language largely because the child has less complex information to convey.

UNIVERSAL GRAMMAR (UG) AND THE EMERGENCE OF LANGUAGE

The position that UG guided or drove the phylogenetic emergence of languages has been disputed by some linguists, including those cited at the outset of this chapter and linguists closer to Chomsky in spirit, such as Jackendoff (2010). The strongest evidence may come from those modeling language evolution (e.g., Steels 2011, 2012), who can get their models to produce some aspects of language, including syntax, without a counterpart of the putative UG. We can thus safely conclude that what is captured by UG is a consequence of the relative uniformity in the way that the similar brains generating similar minds at various stages of hominine evolution have produced the same fundamental basic architecture in the mechanics of languages. This occurred despite the variation in the ways that different populations selected their phonetic inventories, developed constraints on how to combine them into words (phonology) and into sentences (syntax), and so on.

The cross-community variation 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. Consider, for instance, the algorithms that run the operating systems of Apple and Microsoft com-

puters. They are divergent but do similar jobs for the consumer. In all such technologies, the fundamental principles are nonetheless similar, not because there is a special UG-like mechanism that generated them but simply because the material used imposes its own constraints on how a particular technology can be developed (Mufwene 2013a).

Working with sounds imposes strict linearity, as one cannot produce two phonetic sounds simultaneously. For this reason, different populations have developed conventions on acceptable combinations thereof in the words of their languages and on how the words can be combined into larger phrases, including sentences. Thus, a German word can start with the consonant clusters /ps/ or /ts/, as in *Psychologie* and *Zug* 'train,' which are not allowed in English at the beginning of English words. The first syllable of *psychology* in English is pronounced /sa^{i}/, not */psa^{i}/. German requires that the auxiliary verb be extrapolated to the end of the subordinate clause, whereas such a construction would be ungrammatical in English: for instance, *den Mann den Ich gesehen habe* 'the man whom I have seen' but not **the man whom I seen have.* There are languages that, unlike English, start their sentences with a verb, whereas some others end them with a verb. These kinds of typological variation reveal the cultural dimension of language evolution, amounting simply to how particular populations chose to develop their communication technologies in their own ways. They vary without violating the fundamental principle of linearity (viz., sounds follow each other, and words follow each other) or that of combining the sounds into larger and larger units (words and phrases), called *duality of patterning* (Hockett 1959; see below).

The rigid linearity attested in spoken languages is a consequence of the fact that the mouth can produce only one sound at a time. Thus, syntax, which starts at the level of combinations of sounds into words, is attested in the phonology, morphology, and "syntax" modules of the architecture of language. It is a consequence of the linearity imposed by the material. So are the other aspects of syntax, in the traditional sense of the term in linguistics, which have to do with identifying constituents and dependency relations between constituents, as captured by phrase structures or agreement in case marking.[8] Communal norms emerge because members of the relevant population of speakers converge on which particular combinations of sounds, morphemes, and words yield acceptable utterances (of various lengths) and which ones do not. Thus, grammars reflect these norms, also characterized as *conventions* in linguistics, which are cultural peculiarities.

Recursion, which, since Hauser, Chomsky, and Fitch (2007), has generated so much controversy about whether it is a peculiarity of languages alone, is a practice that reduces the number of different kinds of units and structures that speakers use in communication. Implementing economy in the system, it enables usage of the same structure or kind of construction several times over at different levels, just like some formulae in algebra. It makes it possible to produce longer and more complex utterances without increasing the number of grammatical rules. Although several examples of recursion outside language or computer algorithms can be cited, the practice underscores again the role of the same mental capacity in solving problems in various human productions that constitute cognition and culture. Thus, recursion is far from being an exclusive peculiarity of language or UG (Lieberman 2012). As a matter of fact, it reflects how the mind works. Christiansen and Chater (2015) argue that this strategy must have "piggyback[ed] on domain-general sequence learning abilities" (11) that hominines evolved before the emergence of language; nonhuman primates are apparently not capable of it, at least not to the same extent as humans. Language "is subserved by the same neural mechanisms as used for sequence processing" (5).

That the material used in a particular technology acts as a constraint finds evidence in some differences between spoken and sign languages. Since sign languages use hands as articulators, which are larger than speech organs and are used in a much larger space, communication would be much slower if they were structured in a strictly linear way. Signers take advantage of the tridimensional space in which the hands move and can incorporate several kinds of information into one signed word. Thus, multiword English expressions, such as *rapidly slither up/down* or *slowly wiggle one's way,* can be signed in single words. This peculiarity of sign languages, known as *incorporation,* enables signing to be as fast as speech. As a matter of fact, I contend in Mufwene (2013a) that phonology and morphology are conflated into one module in signed languages, without losing the particularity of duality of patterning, which Hockett (1959) invoked as typical of human languages.

Duality of patterning, which Martinet (1960) identified as "double articulation," is a misnomer for the fact that in a spoken language words can be broken down into meaningless sounds, composite words into morphemes, phrases into words, sentences into phrases, and so on. *Duality* is a misnomer for what turns out to be several levels, not just two, in a hierarchical structure. On each level, the smaller, lower-level units make it possible to differentiate two sequences that could otherwise be confused—for instance,

the contrast between /t/ and /p/ in the words *tear* versus *pear/pair* or that enabled by the suffixes {-d} and {-z} in the pair *legged* versus *legs* or the opposition permitted by *top* and *leg* in *tabletop* versus *table leg.* Sign languages still exhibit similar contrasts, on different levels, even if one does not posit a phonological module that is distinct from a morphological one. The smallest unanalyzable units 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.

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, wicker, plastic, or metal. Likewise, how one plays the American national anthem varies depending on the specific instrument used, such as the flute as opposed to the saxophone or the piano, just like its vocal production varies depending on whether the singer is an alto or soprano (and in this respect interindividual variation in the specifics of the buccopharyngeal structure of the singers is a relevant factor). The shapes of dwellings have changed significantly from the primordial constructions with tree branches and leaves, through mud-wall and thatched-roof houses, all the way to brick constructions and steel and glass skyscrapers. Even the choice of logs, bricks, or stones alone as materials for walls imposes different constraints on the latitude that the builder has regarding the shape of a house. These examples all provide evidence for arguing that languages are technologies, and their grammars are in some ways consequences of the specific materials used to package information, viz., sounds or manual signs.

The study of the emergence of language as communication technology entails focusing on how the technology evolved, through successive exaptations of the anatomy and of current structures, driven by increasing ecological pressures for more and more complex communication permitting the higher-fidelity transmission of information.

SOME CONJECTURES ON THE PHYLOGENETIC EMERGENCE OF LANGUAGE AS COMMUNICATION TECHNOLOGY

What I present below is very much inspired by how children learn 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 language must have involved naming individuals (persons and animals), entities, activities, and states/conditions. This behavior is the closest to pointing, which, according to Tomasello (2008), distinguishes us from other animals, including nonhuman primates.

Naming may actually have scaffolded on pointing, which is linked to joint attention. It certainly constituted an important advance over pointing because it enabled our hominine ancestors to refer to individuals, entities, and so on that are not present, including those in the past, if the situation prompted memories. Later, it enabled modern humans to identify imaginary entities and activities, such as in myths. It played a central role in the development of narratives.

The naming of common objects, activities, events, and states/conditions (e.g., *ax, motion, dance, strong,* and *strength*), which differ from proper names in that they do not single out individuals that are unique in our universe of knowledge or socialization, is also associated with another milestone. This is the ability to lump in the same category instances of kinds of objects, 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. It marks the emergence of common nouns, with which, as one can imagine, a speaker could not specify reference efficiently without, for instance, demonstratives, articles, quantifiers, or grammatical number markers (e.g., *this/that boy, a boy, the boy, boys, the boys, those boys,* and *boy* as in *Boy meets girl*). Attention to referents could thus be directed less vaguely. The addressee would therefore know whether the speaker was speaking about one token or a plurality, whether the referents were supposed known (thus definite) or unknown (viz., indefinite) to the interlocutor, whether reference was being made generically (as in *boy meets girl*), or to a whole denotational class (e.g., *The lion is king of the jungle*), and so forth. Some languages even use noun class markers (e.g., in Bantu) or numeral classifiers (e.g., in Chinese) to do part of the job. The development of all these strategies 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 any 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,* which is 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, it is apparently naming, thus words, that drove the evolution of phonetic systems (Mufwene 2013a). As the hominines' cognitive capacity and their need to communicate grew, pressure increased to expand the vocabulary needed to name various things, activities, events, conditions, attitudes, dispositions, and more.

The need to clearly distinguish one word from another (by the relation that Saussure [2016] identified as "opposition") and to avoid repeating the same syllable over and over in long words exerted internal ecological pressure to expand the phonetic inventory by producing more sounds. One can definitely expand one's vocabulary more significantly, say, with fifteen different sounds than with just five sounds. It also appears that 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 (typically a vowel) to another and to distinguish words from one another perceptually.

I submit that naming fostered the emergence of digital vocalizations, which hominines share only with songbirds, though the latter have capitalized on what corresponds to prosody (tones or melody) in human speech. Digital vocalization is indeed what speech is, whereas other animals have only continuous and holistic ones. (See, e.g., Fitch 2010.) The digitization of vocalizations made it possible to accomplish syllabic variegation (MacNeilage 2008) and thus to produce words even longer than two syllables without repeating the same syllables. Human digital vocal communication is more productive than birdsong. It makes 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, 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 speak. As long pointed out by

Darwin (1871), parrots can mimic speech but do not speak in the sense of providing original information to others, because they are not endowed with the mind or mental capacity that drove the phylogenetic emergence of spoken language. If one factors in the fact that parrots do not 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 and spoken language, provided they were endowed with a mind that enabled the emergence of the latter. 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 who cannot produce speech have developed signing, which can communicate information as richly and explicitly as speech. Additional, though negative, evidence comes from the fact that parrots that mimic speech do not use it to communicate with each other. It does not serve their natural communicative needs. Though one might suspect it would endow them with the capacity to communicate as richly as humans do, their minds do not appear to perceive the benefit of adopting a language made by others. Humans naturally become multilingual and use additional language(s) with people of the same ethnolinguistic background often because of some communicative advantages they derive from the process. For instance, some scholars feel more comfortable discussing academic subject matters in their language of scholarship when it is different from their native vernacular.

As the hominine cognition and representation of the universe became more complex, involving several relations, it exerted more ecological pressure for the emergence of predication. The reason is that one directs the attention of one's interlocutors to individuals, entities, events, and more not just for their own sake but to convey information about them, about oneself, about them and oneself, or about them and others. I submit that predication was the next step in the emergence of language as technology to communicate about one's universe of experience or knowledge. From there on, most utterances other than imperatives would consist of arguments interpreted as *agents* or *patients* and of predicates.

The cultural dimension in this case lies in whether the syntax of a language imposes a strict Noun/Verb distinction, with only verbs allowed to head predicate phrases (as in English), or has a more permissive system (as in Mandarin or the Kwa languages of West Africa), in which even adjectives and prepositions can also head a predicate phrase. Thus, one does not have to say 'John is mad' or *Jean est fou* (in French) but *Jan mad* (in an English

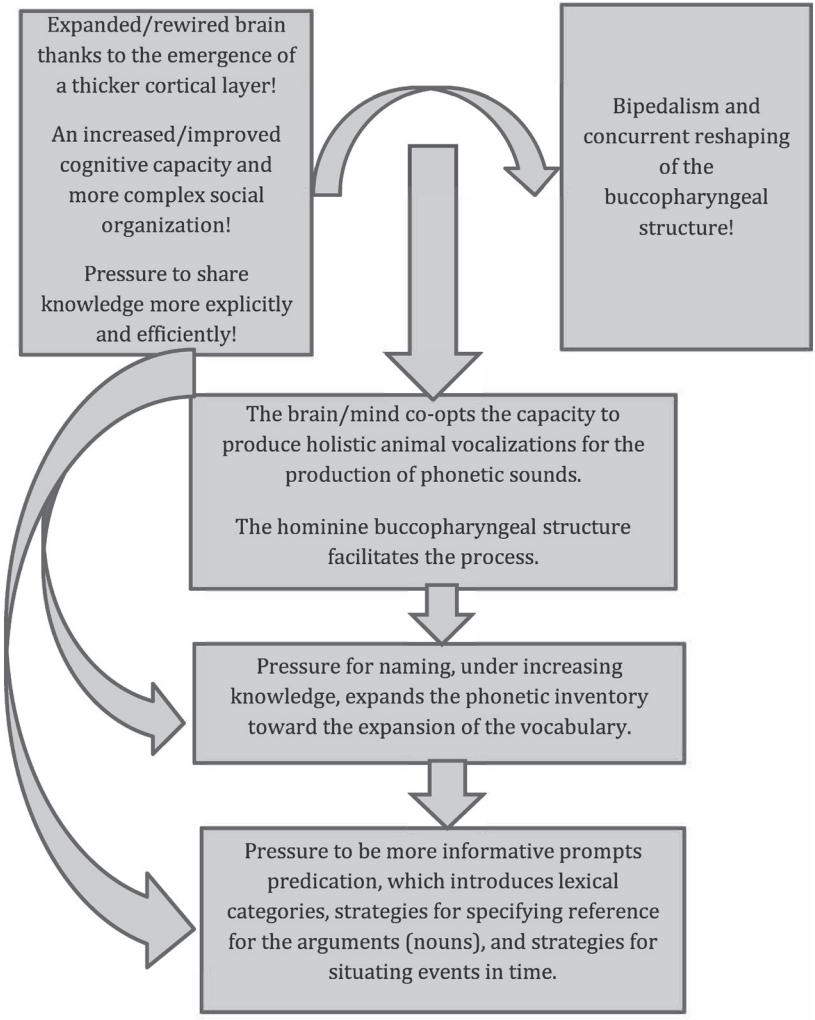

Figure 9.1. Sketch of the different evolutionary stages involved in the phylogenetic emergence of language.

Creole). Culture bears on every mechanical and structural aspect of language because, as noted above, the mind availed different populations differing options in the ways they could solve their communication problems. Assuming polygenesis, cultural differences subsume 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. As suggested above, 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 a degree of responsibility regarding the veracity of the information communicated (through mood distinctions).

The 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, which underscores the cultural aspects of languages as technologies. That is, while the mind that drove the evolution of language reflects particular stages and trajectories in biological evolution that distinguish us from other animals, it leaves plenty of room for variation from one population to another, just like between individuals, in the way they solve problems.

While all modern specimens of *Homo sapiens* represent apparently the same biological evolutionary stage, they have often followed separate evolutionary trajectories. From the point of view of culture, they have developed different ways of responding to their natural ecologies, different patterns of behaving with one another, different social organizations, different belief systems, and of course different communication conventions. A noteworthy consequence of this evolution that exhibits both commonalities and divergences is the clear distinction in the grammatical behaviors of nouns (as prototypical arguments) and verbs (as prototypical 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. However, it is less clear when and how these categories emerged.[9]

As the hominine cognitive capacity increased and improved and social organization became more complex (always in ways that vary from one population/culture to another), therefore increasing communication needs, 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.[10] Practicality would have dictated working economi-

cally, resorting to, for instance, recursion, made possible by 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 (what others may call "construction"), 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's (2011) position that recursion reflects hominines' capacity to travel mentally, such as being able to connect events that did not take place at the same time or to embed one event in another event. This is all consistent with the capacity for displacement (Hockett 1959), which 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 complicated ideas. While in the former languages one would say something corresponding to *John swim cross the river,* the French alternative is *Jean a traversé la rivière en nageant* (literally, 'John crossed the river by swimming') for the English *John swam across the river.* The same meaning is expressed through different syntactic strategies. So far there is no explanation other than cultural arbitrariness for why different populations do not settle on one strategy for the same function, although they use minds at comparably the same stage of evolution.

GENERATIVE ENTRENCHMENT AND SCAFFOLDING IN THE EMERGENCE OF LANGUAGE

There is much more to explain regarding the emergence of the architecture of languages, although I admit to having no clues yet about some aspects of this. Progress in the scholarship on language typology may better inform our speculations about the incremental evolutionary trajectories of modern languages. The evidence for my speculations is both indirect (as also confirmed recently by Hillert [2015]) and language-internal. We learn languages incrementally, starting with the most fundamental things (typically, naming and then very simple sentences), and there are structures that appear to have evolved from others (Mufwene 2013a). What I would like to underscore below is the significance of Wimsatt's (2000) Generative Entrenchment (GE)

and Wimsatt and Griesemer's (2007) (Self-) Scaffolding throughout this protracted evolution. The former notion has to do with the incremental way complex structures emerge, by building new structures upon older ones, in such a way that the later ones could in fact collapse or cease to operate if the older ones were removed. Although Wimsatt explains GE best with material technology (as do, for instance, Michel Janssen and Gilbert B. Tostevin in this book), one can actually invoke the way humans develop knowledge in different domains, with the later additions grafted onto what is already known and becomes more entrenched and necessary. For instance, in algebra, one learns the more complex equations based on an understanding of the simpler ones. One must understand $(a \times b)^2$ before understanding $((a \times b)^2 \times c)^2$. Scaffolding has to do with the support that earlier structures provide in the development of new structures. I explain below how both notions applied in the phylogenetic emergence of language.

Starting with GE, vocalizations had already been in use 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 longer utterances from limited inventories of sounds. Typological variation among 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 various words and utterances. Recursion appears to be an initial 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, such as 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—namely, 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

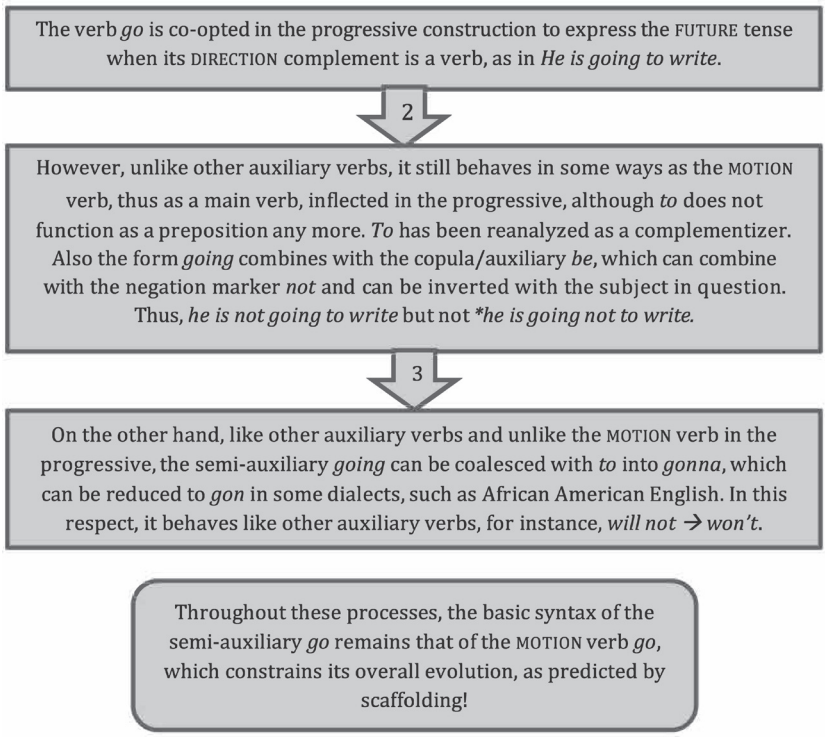

Figure 9.2. Different evolutionary stages in the grammaticalization of the verb *go* as a semi-auxiliary verb for *future* tense.

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 the motion *going to*—for instance, the fact that this construction 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, *going* bears 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 anymore. 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/gon write?* but not **Going he to write?* or **Gon(na) he write?*).

Particularly noteworthy in the evolution of language is the fact that the addition of new elements is supported by extant structures, though it proceeds in an ad hoc fashion, depending on the particular needs that arise at particular points in time. For instance, although they need a technical metalanguage (which may include complex, nontransparent formulae), scholars still have to write their prose according to the syntax of the schooled layperson'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 vocalizations. We co-opted 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. This consists of words, which are formed from constrained combinations of sounds and can be distinguished from other recombinations of sounds even if exactly the same sounds and numbers thereof are used. For instance, it is because the same sounds are combined differently that one can tell *pit* from *tip* or *dog* from *god.* These contrasts instantiate the same principle used in syntax, at the level of combinations of words and of phrases, between *Paul loves Mary* and *Mary loves Paul* and between *the dog chased the cat* and *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 (such as in the strategies for specifying reference, using a complement clause where

a noun would function as an object and using a relative clause to modify a noun) 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.

CONCLUSION

The emergence of language is undoubtedly the outcome of a particular biological evolutionary trajectory that hominines do not share with other animals. Hominines evolved anatomical peculiarities that their more powerful mental capacity could co-opt conveniently for linguistic communication. These include the particular shape of their buccopharyngeal structure with a permanently descended larynx (pushed down by a descended tongue root) and bipedalism, which freed their more agile hands for doing other things with them even while in motion. The range of things that the hands could be exapted for (that is, for functions other than grabbing objects) includes signing.[11]

However, variation in the ways that different populations have structured their respective languages highlights the cultural dimension of this particular technological evolution. Although the basic communication pressures were presumably very similar across hominine populations, their language-ready minds left plenty of room for variation in the details of the architecture of the languages they developed. Thus, it does not matter whether a population uses a verb at the beginning or at the end of a sentence, or in some position inside; whether it relies on case markers (as in Latin) or postpositions (as in Korean) to make explicit the syntactic functions of nouns or relies only on word order (as in English); or whether the modifying phrase (e.g., an adjective phrase or relative clause) precedes or follows the head noun, and so on. Such variation is comparable to some populations keeping left on the road, whereas others keep right, or different populations using differing keyboards then on their typewriters and now on their computers.

It is not so much that there was a cultural evolution that differed 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.

To be sure, one can argue that biological reproduction is not entirely faithful because the genes from the same pool are recombined variably in ways that make every offspring unique. However, in the case of language, as in other cultural domains, it is difficult to identify an elemental unit comparable to a gene, despite common invocations of memes in cultural evolution. Memes are of different sizes, depending on what one learns. Some of them are really complex. They are not reproduced faithfully from one communicator to another, especially in the case of sounds and meanings.

Institutional attempts to standardize the grammars and vocabularies of languages, thus to reduce if not eliminate variation, are unnatural, although they are helpful efforts to minimize instances of miscommunication. They also reflect how much political power some segments of a population (wish to) exert on others. Standardization in other cultural domains, such as in construction materials, facilitates cooperation, even though this takes additional economic and political dimensions.

Languages appear to be cultural phenomena like many others that distinguish humans from other animals, but their evolution need not be seen as independent of or excluding biological evolution. A question that arises at this point is the following: Does "cultural evolution" mean 'an evolution that proceeds differently from biological evolution' or 'evolution as it applies to cultural phenomena'? Could there not 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.

NOTES

I am grateful to Alan Love and Bill Wimsatt for very constructive and detailed feedback on the first draft of this chapter. I alone am responsible for all the remaining shortcomings.

1. Note that this literature has capitalized on animal biology, for which transmission is vertical and unidirectional and a consequence of mating between two partners. It has generally not considered virology, in which horizontal transmission and polyploidy are typical. This is actually what language evolution should be compared with (Mufwene 2001, 2008). Thus, speed of evolution is not an issue anymore; nor is the question of whether the concept of *transmission* really applies to culture too (e.g., Fracchia and Lewontin 1999). The answer is that, while transmission is enabled by mating in

animal biology, it is made possible by interactions and learning in the case of culture.

2. Throughout this chapter I will refer alternately to language and to languages. In the former case, I direct attention to the essence or common properties of languages but not necessarily to a disputable common primordial language or protolanguage, whereas in the latter case I intend to conjure up the diversity that occurs among them, which deserves just as much attention. I discuss the relevant issues in the body of the chapter.

3. I elaborate on this process in part 5.

4. In this chapter I will often invoke the *mind* where others may invoke the *brain* or *cognitive capacity/structure* to account for the emergence of language in mankind. I think of it as the condition of the brain in activity, when the neurons are interacting with each other and enable the bearer to be aware of his/her surroundings, to respond to stimuli and challenges, and to think and solve problems, among other things. This is close enough to Searle's (2013) interpretation of it, from the point of view of consciousness as a central feature of the mind. It is not enough to invoke the brain because this may be dead and useless, as in corpses. I assume that cognitive capacity is a feature of the mind, while cognitive structure conjures up some organization, in which something can be integrated. I focus on the activity part of the brain, which can generate something new, such as concepts, systems, and of course language.

5. In their own words: "This need not imply that Acheulean hominins were capable of manipulating a large number of symbols or generating complex grammars. Our findings imply that simple forms of positive or negative reinforcement, or directing the attention of a learner to specific points (as was common in the gestural teaching condition), are considerably more successful in transmitting stone knapping than observation alone" (6).

6. 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, or with the same level of complexity, as folk technology among humans.

7. Attempts by academies and political institutions to prescribe how particular populations should speak their languages or which particular languages or dialects they should speak (in particular situations) are very late developments in hominine evolution. They tell us more about how efforts to control language evolution politically usually fail than about the ecological factors that influenced the phylogenetic emergence of language in mankind.

8. Identifying constituents correctly helps parse strings of words meaningfully. For instance, in English, the conjunction *and* in *the boy and the girl* goes with *the girl* but does not form a constituent with *the boy.* The combination **the boy and* is ill-formed and harder to interpret without the following conjunct. In Latin, the suffix *que* 'and' combines with the second conjunct but not with the first: *Maria Petrusque* 'Mary and Peter' but not **Mariaque Petrus.* In processing an English sentence, one must first distinguish the subject noun phrase from the verb phrase, regardless of how complex either constituent is, before getting into their details. For instance, [*The tall woman*] [*stood in the doorway*] or [*The tall woman in the red dress*] [*stood in the doorway*] or [*The tall woman*] [*stood with a defying look in the doorway and summoned Paul*], etc. Sentences are not always structured or parsed this way in all languages, consistent with the cultural dimension of language evolution.

9. It is debatable whether some languages have adjectives at all. For instance, Bantu languages use verbs or nominal modifying phrases connected to the head noun by a connective, where English uses an adjective. When an adjective-like item (of which there are very few) is used predicatively, its status is as indeterminate as that of *fun* in such a function in English; one cannot tell for sure whether it is an adjective or a noun in *It was fun/a lot of fun/more fun/?funner/?very fun.* Also, according to some students of grammaticalization (e.g., Heine and 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.

10. 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 (Mufwene, Coupé, and Pellegrino 2017).

11. One can of course add clenching the hands into fists in aggression, or using the palm or back of the hand for the same purpose, and a host of other things that other animals cannot do (equally well) with their forelimbs.

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