Meaning as founder effect in the prehistory of speech.

Abstract

Keywords: Language evolution, exaptation, cognition, oral symbolism, lexical memory, recursion

One of the most influential hypotheses in linguistics, known as “saltationism”, holds that language suddenly appeared with *Homo sapiens*, some 200,000 years ago, under the effect of a neural rewiring that caused the implantation in the mind-brain a recursive calculus, the latter being defined as the fundamental property of our language faculty. Inspired by neo-Darwinian «gradualism», our research proposes an opposite but plausible hypothesis, tracing the slow appearance of language to some 2 million years ago in the form of various evolutionary proto-languages. The persistence throughout these millennia of several grammatical facts, still productive today, provides the empirical basis for our argument. We will show how the adaptive process of organic exaptation of the *hominina* vocal tract may have resulted from ambulatory bipedalism which promoted neuromuscular control of the double articulation of speech, resulting in the extinction of their innated language. This property of speech is closely linked to the oral symbolism that developed in the mind-brain of *Presapiens*, which corresponds to a speech structure illustrated by a kind of semiotic triangle. The founder effect of meaning then gave rise to various linear processes of syllabic phonemization among perennial populations to lead to the invention of the first denotative words. Subsequent and more evolved protolanguages then integrated into their system lexical recursive processes conducive to the formation of paradigms generated by means of the binary mode of lexical composition. These listing processes would have been permanently engrammed in the deep memory of *Presapiens*. However, weak memory capacity of their encephalic volume would have been incapable of storing the mass of words thereby constructed. Lexical recursivity would then given way to syntagmatic recursivity. Grammatical speciation being less energy-consuming, it would have exerted an adaptive pressure leading to an increase in brain mass. We hypothesize therefore that the development of language has been the main factor in determining the size and organization of the brain of *Homo sapiens*. The explanatory adequacy of this new hypothesis thus contributes to a better understanding of the existential nature of the human species.

Meaning as founder effect in the prehistory of speech

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1 Introduction: About storytelling

The last thirty years have seen various proposals spread throughout the scientific literatureabout the enigma raised by the origin of human language. The revival of this problem, so debated and ultimately discredited by the linguists of the late nineteenth, was due to the interest that it eventually aroused in many other disciplines including ethnology, paleoanthropology, sociology, biology, medicine, physiology, population genetics, ethology, AI, robotics, and even the mathematical theory of morphogenesis. This multidisciplinary situation leaves the linguist no choice but to integrate in his method knowledge acquired outside his own analytical scope (Fitch 2017). Such willingness is evident, particularly among biolinguistic researchers.

It follows that a plausible hypothesis on the origin of language need not be described as "storytelling", according to Fitch (2017: 15) and Bierwick & Chomsky (2019), as long as it is based on argumentssupported by established facts and recognized scientific references. In fact, when thesecoauthors argue that the "basic property" (BP) of language is the expression of an underlying computational system "emerged by means of a slight rewiring of the brain", it could also be an "expectation" as entertainingas those of other authors they judge. And if a hypothesis is "a term that should be reserved for assertions that can be tested.", as Richard Lewontin writes, an author they quote, it must be admitted therefore that the sudden and historically recent "rewiring of the brain" is an assertion that can never be tested by experiments.

The aims of this article are 1) to clarify the *externalizing function* of vocal communication; 2) to show how the evolutionary process of *exaptation*that focused on the vocal tract would have led to the mastery of phonetic articulation; 3) to determine how meaning was engrammed very early in the grey matter of the first *Homo* through *oral symbolism*; 4) to establish an evolutionary chronology of *grammatical facts* common to ancestral speech and modern-day languages.

2 The real question (Claude Lévi-Strauss)

It must be noticed thatvery few publications prove to be compatible with authentic Darwinism. The reason for this must be attributed to the cognitive bias linked to the anthropocentrism of questioning, which is summed up in the typical question: When did man begin to speak? This is hardly different from that formulated by Berwick and Chomsky (2019): "How far back does language go?"Thus formulated, such an approach can only viewthe result of evolution as an 'initial state'for scientific investigation, wherever it comes from. This bias is clearly formulated by Fitch (2017) when he writes: "We have a relatively clear endpoint of the [evolutionary] process in the present, and can reconstruct the starting point."For us, the term 'reconstruct' is inappropriate and we consider that 'emerge from the starting point' is the right approach.This starting point is therefore an animal, such a bipedal primate who lived, say, □2.5 Mya in Africa.

By reversing the orthodox questioning it is better to consider the *Homo sapiens* and his language as a 'final state' resulting from the chance of selection exercised from the 'initial state' proper to his condition as a prehistoric animal. Starting from the oldest to the newest throughout times is the standard procedure to account for the evolutionary 'progress' of any species. For the linguist, thereal question must then be formulated in deeper complexity, namely: How and whydid a prehistoric species of bipedal primate depart from its repertoire (or *'rengaine*' in French**),** that is the instinctive signalingwithin the species, to finally internalize an oral articulation system specific to *Homosapiens*?[1]

An appropriate answer might be that man is an animal that has lost its innate language. This is the common thread of an alternative hypothesis of language evolution which will henceforth be taken into consideration. This consists in explaining the grammatical speciation within our species by the slow intrusion of *meaning* into the animal cognition of the first representatives of the genus *Homo* and their descendants. Such evidence is perfectly illustrated by the question-answer: "What is the purpose of language, if not to produce meaning?", posed in a book by the late psychologist F. Le Ny (2005). The intrusion of meaning into the mind-brain of the Homo genus is then characterized by a *model*, in the sense of Fitch (2017), reflecting the *founding effect* of meaning. This implies a 'gradualist' scenario, as opposed to 'saltationist', of a prehistory of speech having taken place in a theoretical framework that can be described as 'cognitive neo-darwinism'.[2]

2.1 Comparing humans and animals

Despite the large number of "shared foundations", i.e. systems, mechanisms, capacities, abilities, cognitive toolkits, etc., which Fitch (2017) refers to between humans and other animal species in terms of "derived components of language", he argues that very few are unique to our species as "unusual human abilities". Yet, the immutability of the shared components underlying Fitch's transposition can be strongly contested when he writes: "The essential functioning of the human lungs, larynx, and tongue is again shared very broadly with other mammals, from bats to elephants, both in terms of anatomy and regarding the physics and physiology of vocal production." (Fitch, 2017:7) Why must we assume the same thing about beings who lived 2.5 millions years ago?

There is no justification for the inference that primates which existed at the beginning of humanity had the same advantages they have today. They too evolved from an animal condition as archaic as that of the first *Homo*. In Fitch's approach, the original ape of our species is the only one to have evolved towards modern-day humans while current monkeys have remained identical to the primates at the origin of their species. Even assuming that "the neural control and cognitive capabilities evolved", as we readily agree, the assumption that "Like hearing, the anatomy of the primate vocal tract was essentially 'speech ready'" unduly minimizes the impact that the development of meaning may have had on the brain-mind of the primate who is our ancestor.

The premise implying that other primate species would not have evolved since prehistoric times is therefore false. On the other hand, the "founder effect of meaning" model assumes that the evolution of meaning explains the evolution of the species *Homo*. One may ask "Why meaning"? Because meaning is not necessarily the product of an «underlying computational system», even if it is syntactic, logical or structural. What defines linguistic meaning is oral symbolism, to which we will come back. As we will see, oral symbolism is a cognitive structure analogous to de Saussure's "signe linguistique". The word (not the morpheme) is therefore the perfect realization of the primitive oral symbolism. But the word did not appear in the history of humanity as apostolic tongues of fire on the day of Pentecost, as the Bible would have it. We will show that the word had to literally take shape in the brain of an evolved primate, to the point that its mental representation became a real cognitive instinct *engrammed* in the mind-brain of its modern descendants.[3] Finally, how can the model based on the founder effect of meaning be tested ? In the end, how could the model of the founding effect of meaning be invalidated? To do so, it would have to be demonstrated that the grammatical facts that will be invoked below could never have existed according to the proposed chronology. Nothing is less obvious. Otherwise, one will judge the merit of our hypothesis.

2.2 Grammatical remains

Methodologically, experienced researchers in prehistory would be right to object that, in the absence of evidence, the expertise of linguistics lacks scientific credibility necessary for solving this enigma since the parlance of the first humans has left no material trace of their existence (Jackendoff: 2018). However, in the absence of fossils or artifacts that carry dates duly confirmed by sophisticated technology, the linguist is not entirely without convincing arguments to attest to evolutionary facts using our grammatical knowledge. Current languages, heirs of the ancestral languages, themselves from archaic languages, carry not fossils but several *grammatical vestiges* or *remains* (or even *witnesses*)that date back to the dawn of time. Yet one must still know how to recognize them.

If there truly exist vestiges in language, then they can only be immaterial because it is thanks to this immateriality that meaning transcends time as an inherent property of human cognition. After all, what is truly human in us cannot be much different from what was truly human in our first ancestors. The cognition of the human species is, one, due to the immateriality of language symbolism.[4] In this regard, Chomsky (2016: 26) is perfectly right when he writes, "…so, instead of being 'sound gifted with meaning', language would be 'meaning gifted with sound'.".[5]The founder effect hypothesis only takes this assertion literally, however, without endorsing the saltationist approach to the origin of language. The continuity of meaning throughout the millennia is what confers scientific credibility to the idea that meaning has a founder effect along with the articulation of speech, through which the "architecture of language" would be built over time to be shared by all natural languages.

2.3 The instinct of meaning

Still to be proposed is an evolutionary scenario allowing to account most rationally for of the disappearance of ancestral animal language and its replacement by the faculty of language that today characterizes our species in all its specificity.

So, meaning must have taken shape, literally, in the animal grey matter of a bipedal primate to the point that it has become a real cognitive instinct engrammed in the mind-brain of its modern descendants.

It is very plausible that the capture of meaning by our ancestors was the evolutionary result of a long process of *exaptation*(Gould & Vrbra 1982).[6] It is agreed that this process, among others, characterizes the theoretical framework of neo-darwinism. Though unlike Chomsky, who considers the faculty of language as a conceptual "organ", this exaptation was carried out on a precise anatomical organ, that of the vocal cords of an archaic species of *Homo*. This would have modified the pre-existing communication function of this organ in favor of dual articulation (Martinet 1967) of the linguistic sign (de Saussure 1960) revisited here, as a semiotic symbol (Odgen and Richards 1946). The pressure exerted by the innate function of animal communication, originally allocated to the oral-pharyngeal organ, would have allowed this organ to adapt to parlance in a concomitant manner with the implementation of meaning in the mind-brain of hominins, ultimately to the detriment of animal language. The rengaine would thus have undergone a long regression throughout the evolution of our species, until completely disappearing when the first *Homo sapiens* appeared.

This hypothesis is therefore explanatory rather than speculative because exaptation is a scientifically proven fact and grammar facts have been proven for a long time. The human language, it must be stressed, is a fact of cognitive evolution rooted in adaptation, an outsourcing of the meaning accomplished by a prehistoric species of hominin. This is what allowed the hominins to learn to understand the universe in which they evolved.

It must be admitted that being able to articulate phonemes is a very distant oral ability to that which consists in vocalizing cries, grunts, whistles, howls, etc., as in purely mammalian signaling systems, among others.[7]Throughout the evolution of our species, there has nevertheless been an overlap between the emergence of speech and the persistence of the 'rengaine'. Establishing meaning as the foundation of speech prior to the language faculty simultaneously resolves the thorny problem of establishing potential continuity between the animal repertoire and double articulation of human language. This connection simply does not exist, insomuch as the meaning and the thought are the exclusive prerogatives of the native speaker (Fitch 2010; Hurford 2007). To pretend that human language represents merely a sophisticated refinement of animal communication would thus amount to taking oneself for a bat, as discussed by philosopher Thomas Nagel (1987) in an influential article titled, *What Is it Like to Be a Bat ?*

3 State of play

Various explanations of the origin of language have been proposed by many researchers.[8] Yet nearly all systematically ignore everything that preceded the Neanderthal era because of the controversy raised by Lieberman (1984) regarding the hyoid bone and the position of the larynx in *Homo Neanderthals*. However, Bickerton's (2010) protolanguage hypothesis remains a notable exception that will later be discussed. Be that as it may, the origin of language is an enigma that anchors itself in human prehistory on the presumption that hominins havehad to sharpen articulated sounds and refashion them into phonemes. Yet phonemes only exist by virtue of words that determine their discrete character in any system, even if it is rudimentary. However, all the theories thus far proposed, including that of the "evolutionary grammaticalization" (Mendívil-Giró: 2019), either ignore the prior existence of the word, or take it for granted, as if it had always existed in the brain of our primate ancestors only to later be reanalyzed. Absurd then appears the idea that a morpheme or a word would suddenly emanate from the muzzle of an evolved but nevertheless prehistoric monkey, when he would be the only individual of his species to supposedly understand himself. A unique word does not a language make because it is arbitrary in nature (Saussure 1967). For it to carry meaning, it must atleast be shared by social convention between two interlocutors bound by a process of oral or other communication.

This rigorously saussurian approach to the birth of speech is thus opposed to certain competing explanations in particular which classify language as a derivative of the ancestral gesture. This hypothesis masks the difficulty which would raise the passage from body movement to oral gesture. Pointing fingers or using your hands does not teach you to articulate phonemes. Activities of manufacturing made with the upper limbs of the first hominins would not have in any way contributed to controling the joint gestures of an organ not adapted to oral articulation at the dawn of bipedalism. Additionally, Hombert and Lenclud (2014) address this question by relaying the postulate of a 'musilanguage'formulated by the Canadian musicologist Stephen Brown and taken up by the British archaeologist Steven Mithen. Nevertheless, a note of music cannot be confused with a phoneme, nor an arpeggio with a word.

The constraints of an article published in a scientific journal do not for an exhaustive literature review, so much the question of the origin of language is the subject of an abundant bibliography. However, certain Wikipedia pages devoted to this theme offer a considerable overview of the situation.[9] Referring to these pages is not unwarranted as they

permit the important debate of the views of two prominent linguists, Noam Chomsky and Derek Bickerton, in light of the notorious influence of these proposals.

3.1 Communication according to Chomsky

On one hand, Chomsky has always denied that communication is relevant to language. Take it on the criticism which two philosophers, Jerry Fodor and Ernest Lepore, direct towards generativist linguists, that thepoint of view of *I-Language* has the consequence of "denying that the fundamental function of natural languages is to mediate communication between speakers." Chomsky settles the fate of their criticism with a stroke of the pen:[10] "[…] It is hard to see what meaning is given to an absolute notion of 'fundamental function' for any biological system; and, assuming this problem can be resolved, one may wonder why the communication is 'fundamental function'" Chomsky (2005: 90). When he writes elsewhere that, "[...] the communication is, in any useful sense of the word, the function of*language,*" but that, "it is even perhaps [not] of any importance in understanding the functions and nature of language," Chomsky (2011: 19) thus discards any evolutionary perspective. In his eyes, communication seems to be a kind of courtesy verbally exchanged between humans. This, at least, seems to be revealed by the idea of "successful communication", in regard to which the eminent linguist says, "communication is a more-or-less affair, in which the speaker produces external events and hearers seek to match them as best they can to their own internal resources" Chomsky (2010 : 48).

This comment is appalling from such an admired thinker. Since Larmarck and Darwin, we have learned that the genes of a sexual biological organism have the fundamental function of reproducing the code of their species. As the Nobel Prize-winning geneticist François Jacob points out about the communication systems that work between organisms: "Originally, these communication systems are directly related to the purpose of reproduction" (Jacob 1970: 339). Yet in Darwinian approach, the animal possesses an instinct for communication, linked to its universe of life which is saturated by and indissociable from innate sexual behavior, consisting in using, among mammals, the oral-pharyngeal organ to call a partner or to dispel an undesired suitor. Because it is embedded in the phylogeny of our species, communication gives its full meaning to the absolute notion of 'fundamental function'. In any case, communicating remains a primitive instinct by which language has been able to shed its animal status. The innateness of the communication instinct thus consists in *externalizing* the deep impulses of a hominin as a living organism. It is far from being a simple "*more or less affair*". If this natural need to externalize had not existed, the process of exaptation of the phonatory organ could not have begun at the dawn of humankind.

On the other hand, relying on the hypothesis formulated by the renowned paleoanthropologist Ian Tattersall regarding the migration of the first *Homo sapiens* out of Africa, Chomsky (2016 : 64) does not hesitate to write "there is little reason to suppose that language existed 50,000 or 100,000 years before this migration", implying that the Neanderthals and their predecessors were deprived of the privilege of articulated speech. However, it has been established that hybridization or interbreeding occurred between the two species since between 1 to 4 percent of the anatomically modern human's genome appeared in Africa some 200,000 years. It should also be noted that Tattersall himself states, "we are pretty sure that the Neanderthals spoke, in the generic sense of the verb, but equally sure that they did not master the type of language we use" (Tattersall, 2003: 165). Nevertheless, he does not provide any details about the kind of language the Neanderthals could have mastered. Moreover, this assumption rests on the curious connection between Neanderthal speech and the vocalizations of chimpanzees, suggesting that the Neanderthals would have spoken like monkeys. Though maybe, after all, these heirs of *Homo erectus* were the unfortunate victims of the "great leap forward" accomplished by this "Third Chimpanzee" (Jared Diamond).

According to Chomsky, this sudden and late emergence of language faculty would have been caused by a "slight reconfiguration of the brain", which would only have allowed modern man to have been able to invent, without any learning of external data, the means of generating an infinite number of sentences from a finite number of elements thanks to grammatical recursion.[11] One can legitimately doubt the validity of this conception of an origin of language so incompatible with the phylogeny of our species. On the contrary, an opposite explanation would be based on the hypothesis of a slow adaptation of anatomical, neurophysiological and psychological transformations concomitant with the process of vocal tract (and cochlean apparatus) exaptation amongst our primate ancestors. The model of the founding effect of meaning embraces the approach advocated by paleontologist Michael Habib, who specializes in the evolution of the larynx in mammals and syrinx in birds. He estimates that after an evolution that lasted some 230 million years after mammals began to emit sounds, the anatomical prerequisites for language (language, larynx and neuromotor coordination) were able to be satisfied when the first representatives of the genus Homo appeared 2.8 million years ago (Habib 2022).

3.2 What is a proto-language?

In *The Language of Adam,* a work much sought after by the general public, Creolist Derek Bickerton advocates a protolanguage common among the *Pre-Sapiens*, a primitive version consisting of two or three juxtaposed words. His hypothesis is also endorsed by Jean-Marie Hombert (2005). A defender of the linguistic bioprogram theory, Bickerton argues that language does not leave linguistic fossils, although he himself considers other arguments based on "fossils" indirectly revealing a protolanguage. In any case, the presumption of the existence of an African protolanguage prior to "complete" languages does not informs on its origin. Apart the fact that this hypothesis obscures the premise that archaic hominins exclusively followed the instinct of the simian rengaine, it mutes the advent of parlance that allowed the dual articulation of language to take hold in the adaptive behavior, even in thecognitionof*Homohabilis*andlater, of *Homo erectus*.

In fact, Bickerton's protolanguage is already the result of a pre-existing vocabulary and standardized phonematics whose words are already constructed in accordance with the laws of phonology and even with a standard argumental structure (Kihm 2002: 61, 66). In other words, protolanguage is based on a-priori that fall under the same "absolute mysterianism" that Chomsky (2016: 51) attributes to the work of experts who disagree with him. The same objection is directed towards Bickerton's argument, particularly regarding pidgins, creoles and child language learning. The protolanguage advocated by Bickerton takes the vocabulary for granted, as if the words had always existed since Lucy. In conclusion, a protolanguage thus conceived is a notion which ignores the word and its genesis. Ultimately, it fails to account for the origin of language.

4 'Orphan' phones

Let us now discuss the most probable scenario based upon the hypothesis of phylogenetic *exaptation* of the vocal tract organ. With the bipedal primate as the starting point for this evolution, which we will place, say, 2.5 million years ago somewhere in the east of Africa, we immediately acknowledge his ability to communicate with his congeners through a language (or *rengaine*) of monkey emanating from its Animal Communication System (SCA), (Hauser 1997). Before being able to handle words, the *Pre-Sapiens* had to collectively become accustomed to manipulating phones. Adaptation to biotope, habituation to standing, meat-based feeding and thermoregulation, inherent in ambulatory bipedalism, have led to irreversible changes in the thorax, vocal tract, bucco-pharyngeal cavity, dentition, jaw, and the spatial arrangement of the skull and brain with respect to the spine. These anatomical, physiological and especially psychological transformations, it must be emphasized, would cause in the most archaic representatives of the species *Homo*, a dissociation between the reflexes largely conditioned by the innateness of their animal language and a new ability to produce "orphan phones". What does this mean? An orphan phone is a sound that does not exist in the Animal Instinct of Communication, abbreviated AIC (Barbaud 2021), of which the modified shape of this ancestral primate allowed him to produce one or more, in a more or lessdeliberate way.[12]

4.1 Exaptation of the vocal cords

It remains to be understood how and why orphan phones appearing in the beginning with *Homo habilis* and its parent *Homo ergaster*, or later with *Homo erectus*, would become after many millennia the *phonemes* of any language. As mentioned above, the evolutionary process that has transformed the Pre-Sapiens into native speakers is that of *exaptation.* Like many examples of exaptation occurring in nature throughout evolution, the one that affected the *Homo*lineage has focused on one particular organ, that of the vocal cords. There was "tinkering of evolution" (Jacob 1970) wrought on the phonatory organ when the vocal cords were specifically diverted from their primitive functions, mainly those of survival and sexual behavior determining the reproduction of the species, in favor of articulated phonation that would become a new neuro-psychological function specific to the genus *Homo*. The other components of the bucco-pharyngeal apparatus have adapted to this new task since, in animals as in humans, they have never ceased to perform their primary functions, namely "to provide breathing (lungs, trachea, larynx, upper airway), to allow the absorption and chewing of food (lips, teeth, tongue) and ensure swallowing (pharynx, epiglottis)" (Marchal 2007).

Nevertheless, the mechanism of this specific exaptation could only be implemented in conjunction with the increasing pressure of a cognitive "demand" bearing on an intellect conditioned by the arising need to understand, sharpened by natural curiosity within animals and even robots (Oudeyer & Kaplan 2007). In any event, had the

exaptation of the vocal cords in favor of articulated phonation not taken place, orphan phones would have still naturally incorporated themselves into the monkey's rengaine, thus adding deeper complexity to its code. Had this been the case, however, modern man would only be able to communicate today with other monkeys, so to speak.

4.2 The motor control of speech

Neuroscience is still in the early stages of reaching a reasonable understanding of this organic exaptation that has occurred over more than two million years. The relationship between the encephalization quotient of the various branches of the genus *Homo* and their cognitive abilities is useful in paleoanthropology, but is powerless in clarifying how the structures of the basal brain involved in language — the spinal bulb, cerebellum, hippocampus, tonsils, thalamus, and neocortex — act on the motor-control of the oral-laryngeal apparatus, and, more precisely, on that of the lingual musculature. In this regard, Chomsky (2016: 25) admits that, "…even if the ability to control the vocal tract for speech purposes seems specific to the human being, one should not place too much weight on this fact, because language is independent of the modalities of its expression [...]".[13] Such an explanation is, to a certain extent, a kind of illusion or wishfull thinking. Speech is basically a articulation of phonemes totally governed by the oral symbolism expressed by the structure of speech illustrated below in Figure 1. Dissociating the primary materiality of speech from the cognitive foundations of language is tantamount to distorting the phylogenetic link between the primate and the human species. The evolution of the psyche was not accomplished independently of the anatomical evolution.

From a strict point of view of anatomy, there is nothing anecdotal about wanting to detail the organic specificity of the speech resulting from the phylogeny of the genus *Homo*. According to pediatrician Ghislaine Dehaene, an experienced specialist in the study of language in babies, the modern phonatory organ has no less than seventy muscles that the brain must monitor simultaneously. She precisely says, "Just to give you an idea, there are twelve muscles for the lips, nine for the tongue, ten for the hyoid bone, etc." (Dehaene 2008: 149). Moreover, these muscles are directly innervated by seven pairs of cranial nerves, including the twin nerves mentioned by Marchal (2007). Finally, the vascularization of the tongue, blood and lymphs mobilizes in two main arterial derivations of the external carotid artery. In short, each joint gesture of modern language is a process of extraordinary complexity: "for the production of vowels, consonants and prosody more than 200 muscles are mobilized. Their action must be closely monitored in order to accurately carry out in the mouth all the adjustments necessary for the production of intelligible speech" (Marchal 2007). It is therefore one third of all the muscles of the human body, totaling approximately 600, including those in the rib cage which is also involved during speech production. It certainly would have taken hundreds of thousands of years for our ancestors to successfully coordinate with extreme finesse a neuromuscular machinery of such complexity. It would be naive to assume that such an advantageous and sudden mutation in the DNA of a species of *Homo* would have succeeded in instantaneously sequencing, over the course of only a few decades, the entire genetic formula of speech that characterizes *Homo sapiens.*

From a functional point of view, research on neuroanatomical and functional components of auditory communication systems,conducted by Georgetown University neurophysiologist Josef P. Rauschecker, shows that "many of the structural components that make up the human language system are in place in nonhuman primates." (Rauschecker 2018). Two major devices of the brain are concerned in both monkeys and humans: the auditory ventral stream (AVS) and the auditory dorsal stream (ADS). The former links sounds to meaning, and the latter specializes for audiomotor behavior. Both are connected to two largely segregated neural streams. However, evolution gave advantage to humans because "it seems as though the ADS has undergone massive expansion and refinement in humans that has enabled the control of a highly refined vocal apparatus, which has ultimately led to the production of speech." Rauschecker concludes: "The picture that emerges is one of a slow/continuous converging evolution driven, as Darwin surmised, by multiple factors, not by a single mutation that suddenly sparked the existence of language." This supports the actual explanation of language emergence accomplished by exaptation of the vocal chords, stimulated by the founder effect of meaning.

4.3 Self-consciousness

The evolution of the human species is not only a matter of exaptative anatomy. It is above all relevant on psychological, emotional and sociological grounds, although many aspects of the phylogeny of our species are absent from the specialized literature. Fortunately, the work of cognitive neuroscientist Antonio Damasio exists as a singular contribution meant to enlighten us on "the animal" that we continue to be due to our consciousness, our sensations, our emotions, our

feelings and our behavior. It follows that the articulation of speech by effect of exaptation would have had to begin with "the take-over of self-consciousness by the body" (Damasio 2003), as certainly demonstrated the archaic Pre-Sapiens when they began to manufacture the *oldowan*stone tool in order to, among other things, skin megafauna.

In the animal world, to use a tool was not a novelty, even at this time. However, the repeated act of violently hitting two stones against one another using both hands must have been a constant source of awkwardness, bloody wounds, and resulting cries of pain. Thus, there would not have been anything particularly quiet in this manual activity punctuated by phones translating various *somatic affects*, in the sense of Damasio (1996). The latter put forth his hypothesis of *somatic markers*, which he defines as, "In short, somatic markers are a particular case of perception of secondary emotions." He specifies, in his famous book *Descartes's Error*, "[...] to behave effectively on a personal and social level, individuals must theoretically represent themselves adequately according to their own and others' psychology" (Damasio 1995: 240-241).

The crucial question then arises: How could the act of carving a stone into a tool have provoked the act of articulating sounds and matching them into words? The answer is this: through the deliberateneuromotor control of an orphan phone carrying an affect such as the sensation of pain, or that of an emotion as joy or disgust. Fortunately, in all world languages there exist what are called in basic grammar, *interjections*.[14]In French, the sound [aj], which translates to the English word 'Ouch!', is a good example of a vestige of a primal interjection, of *somatic*nature, which has been "engrammed", that is to say, inscribed in the biological memory of neurons (Edelman 2000), likely in the primary nucleus of pre-human consciousness, namely the "proto-Self" highlighted by the famous neurologist and his wife (Damasio 1999). As a mental category common to all current languages, grammatical interjection stands as an immaterial vestige attesting to a certain initial state of human language.

4.4 The consciousness of the Other

Originally endogenous and purely subjective, due to being peculiar to the individual,the monosyllabic primal interjection would subsequently acquire an exogenous character when the consciousness of the Other arises in the psyche of a more evolved Pre-Sapiens. The *vocative* interjection, which is used to call, warn, or even challenge a congener, is added to this Pre-Sapiens' mentally engrammed repertoire of discriminated phones. Like the *Pssst!* appearing frequently in comics, the interjective sound [oe], transcribed "*Ohé*!" in French, is also heir to this prehistoric relic. Insofar as somatic and vocative interjections would have been spread by word of mouth within certain communities of Pre-Sapiens by means of imitation, repetition and fixation (or psycho-social convention), likely under the influence of the alpha male and the properties of mirror neurons (Rizzolatti and Sinigaglia 2007), would be established in the mind-brain of our distant ancestors the referential concept of the *person* in respect to whom the "circuit of speech" is established (de Saussure 1960). There is a shift from perceptive to cognitive status , this shift being reasonably attributable to brain plasticity (Changeux 1983).

Because it requires intercomprehension between a transmitter and a receiver, the circuit of speech will serve long after as the foundation of all language systems. Due to the shift of the affect towards the referential concept, the Self is assimilated tothe *I*, and the Other to the *You.*[15]Moreover, that which is *neither* belongs to the world of the congener, denoted today by *He*/*She* in English. From this also stems the current systems of three personal pronouns in French, English, and many other languages as well as othermuch more elaborate categorical vestiges of the referential concepts that have allowed meaning to emerge in the hominin brain-mind. One can then conceive the integral usefulness of a small repertoire of monosyllabic interjective phones, shared and stabilized within a band of advanced primates. These phones are not yet words but their recurrence in primitive orality helps to anchor the entire perceived contrastive value of their acoustic oppositions. In short, the affective interjection, *Ah!*, in Frenchis phonetically distinct from the somatic interjection, *Aïe!*. Thus, as already suggested by the grammarians Brunot and Bruneau (1969: §418), in the orality of interjections lies the founder effect which allowed phonemes to emerge from the vocal signals of the animal state.

4.5 From syllabic designation to phonemic denotation

But we are still far from the integral word of Homo sapiens. As a matter of fact, engrammation of monosyllabic orphan phones in the primitive memory of somewhat evolved Pre-Sapiens does not yet mark the advent of the true linguistic sign, or oral symbol, as de Saussure (1960) first theorized. Throughout the long interjective period that marks the prehistory of parlance is witnessed the progress of a collective phonemization process, thanks to which the hominin intellect begins to discover the discreet features of the phones they transmit and receive. Within the scattered troops of

these archaic hominins in East and South Africa then spreads what Perreault & Mathew (2012) and Atkinson (2011) call, “phonemic diversity”.

This process would evolve qualitatively towards an exclusively referential use of monosyllabic phones. A mass of words bearing a patronymic or toponymic referent from the biotope would emerge to form increasingly elaborate nomenclatures of proper names designating individuals as well as places. This would mark the reign of the first protolanguages made of lists of words carrying “direct reference” (Chomsky 2016: 69) to beings and things. By direct reference, it is intended here what a hominin has in mind in the moment when he articulates or hears, for normally he does not utter wrongly or in relation to something outside the scope of his present context. This type of direct reference is therefore indissociable from Pre-Sapiens discourse during their initial learning of collective phonemization.

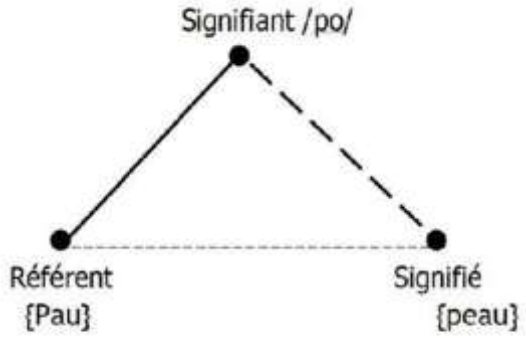

Figure 1 : *Speech structure inspired from Odgen & Richards' semiotic triangle.*

This evolutionary phase may correspond to what Jackendoff (1999) called, “the one-word stage of language evolution”. Though a strictly referential and arbitrary term is not a complete realization of the linguistic sign because designation is not denotation (or signification), as the American philosopher Saul Kripke has shown (Kripke 1972). Indeed, the immediate referential sense must not be confused with the signifié although both are paired with the same audible signifiant. For instance, proper names (patronyms and toponyms) are ‘mechanically’ referential. While monosyllabic [ʒyl] refers to an individual, “Jules”, who depending on connotation could be my brother or even Caesar, it does not denote or mean anything at all (except knowing modern etymology). The same goes for the sound [po], which in French may correspond to the name of the town of Pau or to noun denoting the skin. In short, the name is not equivalent to the noun.

On the other hand, if a Francophone hears the following series of words transcribed by phonetics symbols:

/ bal /, / bɔl /, / bʏl /, / bɛl /, / bil /

he will recognize at least five different words of his language, which can be transcribed respectively as *balle* (ball), *bol* (bowl), *bulle* (bubble), *belle* (pretty) and *bile* (bile), because each contrasts or opposes the others by their sole vowel, the two consonants remaining the same. Initially phonematic, Pre-Sapiens’ orphan phones would become real phonological units when the acts of designation and interpellation are supplanted by the act of denotation. The meaning will no longer be exclusively referential; it will also become descriptive in its signifié, in the sense of Kripke (1972), that is to say, likely to relay a lexical definition in the mind-brain, somewhat like an entree in a dictionary. This other conventional meaning would therefore serve to mentally represent, and no longer call or designate, the objects of the actual world in which the Pre-Sapiens live.

5 Speech structure

At its critical threshold, the phonemization process would lead to the extraordinary invention of the oral symbol embodied in a word with the creation of themonosyllabic *common noun.* There is nocognitive vestige more probative than this speech symbol. This is why, during the prehistory of parlance, the kingdom of interjective and denominative words made evolved Pre-Sapiens aware of the 'discrete character' inherent in phonemes, since they were sufficiently numerous and widespread in various tribes to constitute the first vocabularies as *lexical paradigms* (lists or classes) of speech. Considering the acts of designation and both referential (continuous line) and lexical denotation (discontinuous line for optional meaning, including polysemy) as distinct in regard to phonation, the diagram that best represents the complete structure of the linguistic sign, initially schematized by de Saussure (1967), becomes a *semiotic triangle* revisited from the one first proposed by Ogden & Richards (1946). According to this schematic, dominant position gives primacy to emerging phonation, and discontinuous lines indicate an optional relationship between their extremities. Meaning thus materializes in a *speech structure* that simultaneously engrams phonation and perception. The three poles of this symbolic structure are intimately linked to human nature in the following manner: the *signifiant* depends on articulation, the *referent* depends on consciousness, and the *signifié* depends on memory. The exaptation of the vocal

cords would therefore certainly have affected the control of this cognitive structure in which the oral symbolism is realized. This justifies characterizing this unique evolution in terms of "cognitive neo-darwinism" (Barbaud 2021).

In fact, in the first common noun, as a symbolic mental category, resides the founder effect of meaning which vested in the hominin orality the capacity to become the modern language faculty. This founding effect would have affected the progeny of some individuals at a physiologically more advanced stage of vocal chord exaptation than that of their congeners. By taking advantage of the cognitive link that they so acquired between language articulation and referential denomination, these evolved Pre-Sapiens would have initiated a progressive divergence thus differentiating themselves from their original population, and ultimately enabling and initiating the process of grammatical speciation and later develop into an autonomous species.

5.1 Symbolism and its expression

The invention of the word as a fully saturated linguistic sign marked the advent of the first symbols that integrate the mind-brain of the Pre-Sapiens. In Berwick & Chomsky (2019), the authors incidentally address the question of symbolism in terms of 'activity' and not in terms of mental 'representation': "There is no evidence of significant symbolic activity before the appearance of anatomically modern humans 200 000 years ago (Kya)."[16] However, one could argue that symbolism is not limited to manual or material "activity", such as cave art or the making of artifact. The link the authors make, as does Fitch too (2017:17), between modern human anatomy and aesthetic symbolism attributed to the oldest artifacts, in order to justify the birth of modern language is simply abusive. As prehistoric as they are, the drawings of parietal art do not testify in any way to the absence of any oral symbolism that could be well anterior to them. On one hand, language activity is in no way the consequence of manual activity, even if it is abstract to our modern eyes. On the other hand, we favor the knowing of how to make fire, that is ±500 Kya, a behavior that testify without ambiguity to the exclusively human property of ancestral cognition. Under these conditions, can we conceive of a primitive human without articulated language from this time?

In short,*Verba volant, scripta manent*: oral symbolism could very well give rise to oral "activity" long before other symbolic activities would have been manifest in fossil forms, that is, ±270 000 years ago according to François (2017: 73). Nothing opposes the idea that the structure of speech illustrated above (cf. § 13) characterizes a verbal symbolism materially unrecoverable from prehistory, but still immanent in the mind of modern-day humans. Strangely, when Bierwick & Chomsky (2019) also write, "recent research reveals that the semantic properties of even the simplest words are radically different from anything in animal symbolic systems," the authors suggest that the semantics of the word areuniqueto*Homo sapiens* alone, and that ancestors like Neanderthal or even *Homo ergaster*, who lived before him for over 200 thousand years, were merely animals with a unique symbolic system, which is far from obvious unless you consider yourself and modern man to be bats (Nagel 1987).[17]

It is no secret that modern man and Neanderthal were anatomically very different. However, the discovery in 1990 of complex annular structures of stalagmites in the cave of Bruniquel in Tarn-et-Garonne allowed in 2016 an update of its period of occupation by Neanderthals to 176,500 years ago. Therefore,concrete symbolic activity was obviously not the modern prerogative ofthe *Homo sapiens*, whose migration in Europe goes back only as far as 47,000 years, as these two authors agree. What's more, it appears that the Neanderthals were the distant descendants of *Homo erectus*, of which the migration from Africa to Europe took place approximately one million years ago. So, it is quite plausible that human symbolic activity could have take place at this early period, with the first words appearing initially in Africa, then in Asia, and finally in Europe.[18]

5.2 Brain volume and lexical memory

The stabilization of a few phonemes in each scattered tribe of ancestral Africa is implacably linked to the sustainability of its population. This condition being fulfilled, it would be necessary that monosyllabic terms be transmitted from one generation to another over an extended period before a true mental lexicon could arise within each individual. Yet the more words accumulate, the more animal memory would become saturated, given a brain volume of 750 cm^3. Therefore, nomenclature would prove to be an inadequate mental organization to satisfy the compulsion to name things, as assigning meaning would quickly become an intellectual 'addiction', that is, an insatiable and irrepressible instinct towards understanding (Bohler 2020).

Yet *Homo erectus* is driven to understand his universe. In order to free himself from the constraints of a mnemonic lexical paradigm, his intelligence, still animal but already pre-human, invents a new "mindset". This consists

of combining two monosyllabic terms, first of all,by reflexive repetition or reduplication, as evidenced today in *dodo, bobo, lolo, papa, tata,caca, pipi, toutou, ronron*, etc., then by simple addition (or concatenation) ofmonosyllabic terms. This rudimentary syntax related to the phonemization process, a sort ofprotolanguage, is capable of generating hundreds of bisyllabic and evenpolysyllabic common names by linear association alone.

According to Pulgram (1970), for whom syllabic structure is a universal linguistic fact, syllabe structure paired with meaning or not can be said to establish the premises of language articulation. The consolidation of various syllabic repertoires, analogous to that of, for example, modern Japanese, among the different populations of African Pre-Sapiens and others, has certainly contributed to the unfolding of the exaptation process of the vocal cords, these becoming more and more adapted to their new function of producing the variety of articulated sounds of human language. We assume that the syllabation activity and the exaptation of vocal chords were two evolutionary processes closely related at the very beginning of humankind.

This cognitive addiction to attributing lexical meaning to oral sounds allows the consideration of a scenario in connection with the skull development of the genus*Homo*completely opposing that which is usually argued bypaleoanthropologists and other evolutionary specialists.[19]To account forthe gradual increase in volume of the Pre-Sapiens skull requires a diet consisting of meat foods, including the marrow of megafauna which would have become accessible through the use of the oldowayan tool that allows the fracturing of large bones (Bickerton 2010). This nutritive shift would have favored the development of the cranium bone, which, by the same fact, would have led in turn to the emergence of language, thanks to the development of the Broca and Wernicke areas of the brain. In other words, a "boosted" dietwould have been at the origin of language.

It may be refuted that many carnivores such as the cachalot, for example, have a larger brain than that of humans, some of which also having Broca and Wernicke areas, such as that of the chimpanzee, without having lost to the same extent their rengaine. It is therefore nota larger skull that would have provided hominins the means to speak, but rather what happened in their cerebral grey matter when their communicative instinct forced meaning to become orally externalized. The amplifying effect of denotative vocabulary in the biological memory ofneurons and glia1 cells likely stimulated the growth of memory capacity in response to a strong energy demand. This is why itisappropriateto conjecture that it would have consistently been further lexical meaning engrammed in the various memoriesof the mind that would have caused the growth of the encephalon.[20] Therefore language would in fact bethe direct cause of the increased encephalic volume of *Homo sapiens*, which stabilized around 1350 cm^3.

This explanation is corroborated by the work of Gong & Shuai (2015). These researcherstested a mathematically modeled scenario of co-evolution with regard to the development of memory capacity and the concomitant intergenerational transmission of language throughout its emergence. Theirconclusion: "Simulations showed that: along with the origin of a common language, an initially-low memory capacity for acquired linguistic knowledge was boosted; and such coherent increase inlinguistic understandability and memory capacities reflected a language-memory coevolution; andsuch coevolution stopped until memory capacities became sufficient for language."Since lexical memory is dependent on culture, it can be deduced from this coevolution that the more culture and language grew among Pre-Sapiens, the more the neuronal system would have had to expandin the brain in response to exerted selective pressure in favor of suchvolumetric incrementation.

5.3 Grammatical speciation of the Homo Sapiens

The cultural change that occured during the Paleolithic period between the Odowayan, which lasted 1.5million years without significant change, and the industries of the Acheulean followed by the Mousterian, makes it possible to consider the occurrence during this same period of another change in the mindset of evolved Pre-Sapiens. This would entail the improvement of the original syllabic combinatory process resulting in the association of two words (lexemes), rather than of just two or more syllables. This would mark the sustainedreign of*lexical compounding*, a universal grammatical process so conducive to the development of lexical categories (paradigms), such as those shown in the following examples of English compounds:

x-*tree*	x -*fish*	x -*way*
ash tree (frêne)	*angelfish* (poisson ange)	*causeway* (chaussée)
banyan tree (banyan)	*boxfish* (poisson coffre)	*driveway* (allée)
campher tree (camphrier)	*catfish* (barbue)	*guideway* (guidage)
cherry tree (cerisier)	*crayfish* (écrevisse)	*hatchway* (écoutille)
cotton tree (cotonnier)	*devilfish* (poisson diable)	*raceway* (circuit)
crabtree (pommetier)	*jackfish* (brochet)	*railway* (chemin de fer)
bourtree (sureau)	*jellyfish* (méduse)	*runway* (piste)
grapetree (vigne)	*monkfish* (lotte)	*sluiceway* (canal à vannes)
iron tree (olivier)	*pinfish* (orphie)	*spillway* (déversoir)
mapple tree (érable)	*shellfish* (mollusque)	*stairway* (escalier)
pepper tree (poivrier)	*spotfish* (tambour croca)	*subway* (métro)
plum tree (prunier)	*swordfish* (espadon)	*tramway* (tramway)

Table 1 Lexical (word) recursion in compounding paradigms

Excepting error, Jackendoff (1999; 2009) is the only other linguist to view this '*compounding*' as a "fossil" of our ancestors' protolanguage. Let's be clear on this point: to know how to combine two common nouns, no matter in which order, is to know how to apply syntax (adjacency and dominance of words) by, for instance, the mechanical operation of *external fusion*put forward by Chomsky (2016: 31). Givón (2009: 252) adopts a similar solution, subject however to a functional principle of relevance, also similar to Barbaud's (2021: 274) "conceptual emulator". These convergent solutions demonstrate in any case the onset of the first stage of the process of *grammaticalspeciation*that would characterize the hominization of our primate ancestors. This process may have occurred in the mind-brain thanks to the plasticity of the cerebral cortex (Laroche 2006 ; Rancillac 2016).This would have allowed various mental categories lacking material support to be engrammedin the basal memory. Increasingly abstract grammatical categories would not have been exceptions.

This type of lexical composition clearly demonstrates the intrusion of recursion within thisnew mental shift (Bánréti 2018 ; Dressler 2006). In other words, the same word would be self-repeated in the formation of several other words of different meaning. Yet the memory, or the 'recall' as referred to by psychologists, is the very foundation of recursion in humans and animals alike. Further, lexical recursion is then sustained in the basal memory of the brain-mind, allowing the development of the lexicon to further stimulate the neurocerebral development of the brain. Vestiges of thisparadigmatic mindset are still present in many modern languages. This wouldshape the deep memory until the conquest of fire, around 500,000 BC. Whythis putative date? This is because an animal which knows how to make fire ceases being an animal and qualifies as ahuman.[21] The « monkeyin us » (de Wall) thus belongs to prehistory.

Thearchaic *Homo sapiens* of the Pleistocene would then develop another mindset by performing a new conceptual act, that of *predication,* which consists in combiningtwodifferentword *categories*: the noun and the verb. Paradigmatic as it would have been, thisnew mindset became *syntagmatic* (*phrasal*). Therefore, the protolanguage based on lexical composition would have begun to lose its mnesic efficiency. Taking control of internalized knowledge to join two abstract categoriesin the same mental entity, the phrase, thearchaic *Homo sapiens* would gain the ability to build the *intransitive* two-wordsentence, e.g. *Dad sleeps*. Intransitivity is a universal linguistic feature that would have appeared among the close ancestors of *Homo sapiens*. Such a connection would have been reached by again applying a basic operation such as, for example, Chomsky's *external fusion* or Barbaud's (2021 : 253) 'Structural Distributor'. Even today, modern languages still retain this binomial vestige of the prehistoric parlance.

5.4 Culture shapes grammar

The next step in the grammatical speciation of the species *Homo sapiens* would be accomplished by the interiorization of *transitive* predication, that is to say, the union of a binomial phrase or of an utterance and its complement(direct

object). Sure enough, transitivity is the outstanding grammatical feature that characterizes modern languages. This step would achieve *propositional*discourse the most suitable for the expression of a thought. This processcould be part of an operation such as Chomsky's *internalfusion*, as transitivity deals with abstract categories of phrases. Taking into account population genetics (Cavalli-Sforza 1996) and chronological expansion of languages across the globe (Atkinson 2011), we canposit that this grammatical improvement may have coincided with the migration known as "Out ofAfrica" that happened ±70,000 years ago.

As the millennia succeed, words would suffer the outrage of time and usage according to themixing of perennial populations and their common parlances. The interpenetration of various grammatical features and the erosion of many words throughout the centuries would constitute cultural work by making appear linguistic artifacts,or lexical residues (Givón 2009), such as *morphemes* (prefixes, suffixes, etc.) and various *functional* words (prepositions, conjunctions, etc.).[22] This important process of internal transformation is the subject of numerous studies on the universal phenomenon of *grammaticalization*(Heine & Kuteva 2011; Kihm 2002). Not inherited from previous languages, these cultural artifacts are collective inventions that must be learned andassimilated by native speakers. Their integration into the universal architectureof natural languages would have allowed optimization of the recursive mechanism to deal with propositional categories, so crucial for reasoning and judgment. Thus, archaic speech of hunter-gatherer communities would have consequently given rise to meaning within linguistic systemsgradually emerging since the dawn of time.

6 Conclusion

In conclusion, it would be a mistake to believe that nothing links modern languages to prehistoric speechesunder the pretext that there exists no trace of them. *Verba volant* is a convenient aphorism thatmasks the fact that today's languages are the heirs of parlances that existed long ago, but under other forms and according to different systems. These prehistoric speeches haveaccumulated all the meaning necessary for understanding the physical world as well as the mental and conceptual universe. Meaning has not vanished into nothingness every time a language has disappeared. Rather, it has been enriched and transmitted through the propagation of languages across world-wide human populations, perpetuating a legacy over thousands of millennia. Consequently, there are more vestiges of the past in today's languagesthan is commonly believed.

Ultimately, language would be a functional device, among other faculties, engrammed in the biological memory of the basal brain, rather than in the genetic expression of an I-Language encoded in our DNA. In both cases, there is a "biological foundation of language", as was clearly demonstrated by famous psycho-neurologist Eric Lenneberg in the 1960s (Lenneberg 1967).However, this biological inscription may be today actualized either in the genetic *equipment* (chromosomes) orin the brain *functioning* (neurons). Clearly, these two possibilities are not equivalent in respect to evolution. Such a difference appears to be crucial regarding what we understand about the *innateness* of the faculty of language. The "immediate" timeis not an ally of the genetic endowment contained in the genomeof our species because it changes only rarely and marginally.[23]

In the end, the idea of a sudden rewiring of the brain, independent of the other faculties ofthe intellect – the interfaces–to explain a recent heredity of the language faculty, appearssuspect and even "unsustainable" (François 2017: 80). Indeed, grammatical saltationism implies belief in a scientificfuture, which would certainlycorroboratethe adequacy of its innatist hypothesis opposing the evolutionary clock. Overall, we find insufficient evidence to support the idea that 100 billion neurons in the cerebral cortex and 55–70 billion neurons in the cerebellum, each achieving on average between 10,000 and 20,000 neuronal connections by associatingten times as many glial cells, would have been forced to reorganizetheir mode of operation specifically in favor of recursion, to thus compete with the prodigious capacities of our memory faculty already inscribed in the organs of the basal brain. This could explain why scientific inquiry, after 70 years of intensive research, has yet to discover a chromosome in which I-Language would supposedly sequence its protein chains.

Endnotes

[1]The term '*rengaine*' is used here as an equivalent to the English term 'repertoire' in Berwick & Chomsky (2019). Likewise, the term 'parlance' will sometimes be used in place of 'speech'.

[2]The 'gradualism' is succinctly illustrated by Darwin's words: "[…] natural selection, in fact, acts only by taking advantage of slight successive variations, so it can never make abrupt and considerable jumps, it can only advance in insignificant, slow and safe degrees." (Darwin 2009: 177). The present neo-Darwinism has profoundly modified this first conception of evolution. Saltational evolution implies an evolutionary change from one generation to the next which is due to chromosome transpositions that can produce rapid modifications in the genome.

[3] According to neuroscientist Sébastien Bohler (2020), MRI experiments conducted by University of Toronto psychologist Michael Izlincht, among others, on macaques and humans have clearly shown that the anterior cingular cortex serves as "the brain centre of meaning […] capable of integrating vast systems of world representation", such as religion.

[4] The immateriality of meaning is only perceptual. Yet insofar as meaning is a construction dependent on neuronal activity, its materiality is beyond doubt. Without wishing to engage in a philosophical debate on the ontology of its nature, meaning is defined here as an *engram* or neuropsychological state of understanding of reality caused by the convergence (or association) of a perception and a phonation. In short, meaning is "understanding", to recall the term used in their time by Enlightenment philosophers.

[5] Author's translation from French.

[6]According to the definition given by Gould and Vrba (1982), exaptation consists of an organ undergoing mutations under the pressure of natural selection and performing a function different from the use for which it was initially developed. The organic exaptation discussed here is quite different from the purely mental exaptation advocated by Tattersall (2003) and Bouchard (2005). The process envisaged by MacLarnon (2012) focuses on the descent of the larynx due to bipedalism.

[7]Animal communication is largely innate, as we must be convinced by the French words which characterize each animal 'rengaine', whose codes remain frozen in the*beuglement (bellows)*, the *hennissement (neighing)*, the *roucoulement (cooing)*, the *brame (rutting)*, the *hululement (hooting)*, etc., and their local variants.

[8]To learn more about these theories, visit https://www.hominides.com

[9]*Cf.*: https://en.wikipedia.org/wiki/Origin_of_language; https://en.wikipedia.org/wiki/Hominization

[10] Author's translation from French.

[11] In Chomsky (2010), the genetic endowment of the language faculty is expressed in a universal algorithm which takes the form of the following equation: *Interfaces + Recursion = Language.* This summarizes the spirit of the minimalist program initiated by Chomsky. Recursion is the computational property of the Fusion operation (Merge), internal and external. The independent interfaces are the conceptual-intentional system on the one hand, and the sensory-motor system on the other.

[12]The AIC should not be confused with Hauser's ACS (1997). Similarly, an orphan phone does not equate to the "decoupled signal" presented by Hombert and Lenclud (2014: 428) as the invention "constituting the trigger mechanism of the evolution towards the language". Yet the function of a signal is to provoke a reaction. A decoupled signal would become polysemic. It cannot be decoupled due to its discrete character in the code of a rengaine. An orphan phone is, on the contrary, deprived of any signaling function. It appears "free" in a way, in the vocal possibilities of an anatomically modified organism. It remains fully available for *deliberate* neuromotor control.

[13] Author's translation from French edition.

[14] The priming effect of interjections has been addressed by Jackendoff (1999), who speaks rather of *exclamations*. He argues in favor of an "incremental" evolution of the capacity of language in several stages, a hypothesis that is fully investigated by Hombert and Lenclud (2014).

[15] The shift from affect to concept is a well-known cognitive process in psychology. In linguistics, it manifests itself by the polysemy resulting from the opposition between the properand the figurative sense, transposition of concrete meaning and abstract meaning.

[16] In note 26, Bierwick & Chomsky (2019) assume: "The bottom line for us is that unambiguous symbolic activity like this remains emergent with anatomically modern humans […]" Rather, we consider the anatomy of modern humans to be the result of the adaptive pressure exerted by the long development of language in the brain primarily conbtributing to the increase of encephalic volume that characterizes the evolution of our species.

[17] The reference to "animal symbolic systems", also noticed in Chomsky (2016: 66), poses for this author a problem regarding its definition and the extent to which it is impacted by our ignorance of the mental representation of any animal symbol.

[18] In an article published in *Nature* on the oldest fossil of Homo sapiens, Vidal & al. (2022) report its dating in these terms: "[There was] a major explosive eruption of Shala volcano in the Main Ethiopian Rift. By dating the proximal deposits of this eruption [Omo-Kibish formation], we obtain a new minimum age for the Omo fossils of 233 ± 22 kyr."

[19] In the blog post dated November 1, 2021 displayed on McGill University's brain research website, *cf.* https://www.blog-lecerveau.org/page/2/?s, the increase in brain volume from Australopithecus to Neanderthal is described as "spectacular". Though the demand for cerebral energy generated by the deployment of lexical memory over the 2 million years of prehistory must have also been extraordinary. The Pre-Sapiens would have had to feed themselves accordingly, thus triggering a dietary change in favor of meat, resulting in a dramatic increase of the cranial cavity. See the following note.

[20] In terms of energy consumption, more than any other organ, the brain can require up to 20% of total body energy, although it only represents 2% of body mass,*cf.* https://www.blog-lecerveau.org/blog/2016/04/04/pourquoi-notre-cerveau-est-il-si-energivore/. Glial cells play a crucial role in brain plasticity by acting on synaptic communication, involving recapturing neurotransmitters, which impacts information processing by the nervous system, or in ordinary terms, the "thought".

[21] See PREHISTORY - MAN AND THE *FIRE*by Catherine Perlèsin *Encyclopedia Universalis* [online]; accessed 23 April 2015.url: www.universalis.fr/encyclopedie/prehistoire-lhomme-et-le-feu

[22] From his modeled study of the relationship between culture and biology, Perreault (2012) concludes: "Cultural evolution is faster than biological evolution. Rates of cultural evolution are significantly faster than rates of biological evolution."

[23] Berwick & Chomsky (2019) are not wrong when they write in their conclusion that, "evolution need not always proceed at a snail's pace." Evolutionary change must not necessarily be gradual. Yet exaptation and adaptation must not to be confused. In the case of *Homo*, the survival of the species was not determined by the vocal apparatus. Exaptation of this organ evolved, in the same way as did bird feathers, as a result of an acquired evolutionary *advantage* beyond the struggle for life, whereas evolution of living organisms is driven by the evolutionary *necessity* to survive. The precise mastering of 200 muscles driven by the psychological addiction to meaning must have required more than the 30 years taken by one of Darwin's Galapagos finches to increase its beak size in order to survive on the island. The relative timescales simply cannot be compared.

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