

Steps towards a history of the emergence and accretion of human language

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Abstract: This paper uses the framework of Modes of Evolution (Naccache 1999) to structure a historical sketch of human language's emergence and accretion. After presenting the formal pattern in the evolution of life cycle setups upon which the framework is based, and reviewing the relevant aspects of evolution from bacteria to the last common ancestor (LCA) of *Homo* and *Pan*, this paper illustrates how the framework can be used to identify: - three stages in the organic evolution of the potential for linguistic behavior that transformed the LCA communication system into the species-wide shared potential for language characterizing anatomically modern humans; - and four landmarks along the path of socio-cultural accretion of human language(s), from Paleolithic to early 'Historic' times.

Keywords: Epigenesis, life histories, cultural evolution, language emergence, language accretion.

A Jean-Claude Gardin, maître à penser, modèle, source d'encouragement et ami, cet exercice qui se veut logiciste, perpétré par un mauvais élève perpétuel.

“Ultimately therefore, the real locus where language universals exert their adaptive pressure is the developmental mechanism itself.” Talmy Givón. *Bio-Linguistics*. 2002: XVII.

1. Introduction

This paper proposes a reasoned outline of the overall evolutionary trajectory that resulted in human language, set within a comprehensive evolutionary approach linking Precambrian bacteria to human societies, the framework of Modes of Evolution (Naccache 1999). After delineating the epistemological bases of the framework, the paper uses it to structure the major articulations of a historical account of the emergence of the animal communication system till the grade of our last common ancestor with *Pan*, then to identify three stages in the emergence of the specifically human biological potential for language, and four landmarks in the cultural accretion of language in *Homo* societies during the last 2.5 million years.

It should be pointed out that the synthetic historical outline presented here, *per se*, is not what this paper is tabling for discussion. Not because it is still the case that, while dealing with the subject of the “organic basis and origin of culture,” “it seems impossible to be definite without remaining cautiously narrow, and ...on the other hand one can not be broad without becoming indefinite,” as wrote the author of the first synthesis of archaeology, developmental studies and primatology (Kroeber 1928: 326), or because all syntheses are hostages to their day’s “empirical materials” (Danto’s foreword to Langer 1988). These are unavoidable risks, since in an evolutionary perspective, premised on the need to take cognizance of and be compatible with “man’s status as a product of biological and social evolution,” syntheses, i.e., attempts at theoretical convergence, are mandatory.

What is offered here for critical evaluation is the tool used to erect a history of the emergence and accretion of language. The framework of Modes of Evolution, bridging between Biology and Anthropology through a focus on life cycle setups and their reproduction, is an analytic taxonomy, amenable to refinement and incremental improvements, providing a self-coherent system within which to integrate, organize and structure data from all relevant disciplines. It is thus also a heuristic exploratory tool.

The framework is used in the following lines not in a quest for the *origin* of human language—origin as a biological or cultural phenomenon has repeatedly been shown to be a chimera that dematerializes upon close scrutiny—but in an attempt to correlate biological, social and cultural stages in evolution with stages in the development of animal communication systems, leading to and including human language.

It might surprise some that this approach was inspired by Edward Sapir, whose lumping together of the linguistic forms used by Plato and the Macedonian swineherd, or Confucius and the head-hunting savage of Assam has been taken as establishing that there is no prehistory to language, and that language is an all-or-none phenomena (Pinker 1994; 27). However, three sentences before his lapidary formula, Sapir, having written that “all attempts to connect particular types of linguistic morphology with certain correlated stages of cultural development are vain,” immediately added “we shall do well to hold the drifts of language and of culture to be non-comparable and unrelated processes,” that is *until* the appropriate “purely formal patterns of culture are discovered and laid bare” (1921: 234).

That time has come.

2. Evolving life cycle setups and the Framework of Modes of Evolution

The framework of Modes of Evolution is my attempt to flesh out a formal pattern of stages in the elaboration of the life cycle setups along the human lineage, from cyanobacteria to human societies (Naccache 1999). Submitting that this pattern holds independently of my subjectivity, I will start by trying to show how it can be observed.

2.1. A pattern in the elaboration of life cycle setups

Life is Evolution. Its rich tapestry includes all the ancestral and present-day exuberant diversity of life forms on Earth, from viruses to human societies. Not all of Evolution's tapestry interests us here, only that part of it including the bundle of threads to which our lineage belongs, from its bacterial start till today's human societies.¹ Evolution's overall Darwinian mechanism can be encapsulated by the following formula: Imperfect reproduction under environmental sanction. All the wefts and warps that weave Life's tapestry together are not yet known. However, the concepts that *it is life cycles—not organisms—that evolve*, and that *there are different kinds of (Darwinian) evolution*, are foundational (Bonner 1993), and we will therefore use them to epistemologically anchor the perspective linking Archean/Precambrian bacteria to Holocene human societies.

Before even having precisely characterized the life cycle setups at the two ends of this long perspective,² we can make two fundamental observations. The first is that the source of imperfection in the genome's reproduction did not change, still consisting in the random mutations, errors of reproduction and recombinations that happen to the genome during its replication.³ And the second is that parental investment in offsprings' growth has come to play a crucially important role in the process of reproduction, which is obvious when comparing the bacterial life cycle setup—in which the parent phenotypes does not invest at all in the growth of their offsprings' phenotypes—with that of the human setup—in which parent do, as a general rule, massively invest in that pursuit.

That this expansion in parental investment involved a range of Darwinian mechanisms and happened in stages has been repeatedly pointed out, though there is no consensus on the nature and quantity of these stages and mechanisms.⁴ I am proposing that an operational assessment of these stages and mechanisms can be achieved through a (reverse engineering) *formal analysis of the minimal and logically sufficient cumulative additions* that would offer targets to environmental sanction (natural selection), while progressively morphing the basic, bacterial, Darwinian life cycle setup into its present human configuration.

The first three logical/formal additions are that of:

- parental *organic* contributions to offsprings' *organic* growth;
- parental *behavioral* contributions to offsprings' *organic* growth;
- parental *behavioral* contributions to offsprings' *behavioral* growth;

These three additions exhaust the possibilities available to single parent phenotypes. Further additions needed to bridge the remaining gaps in the chain leading to the human life cycle setup have to overcome the bounds imposed on individual phenotypes acting in isolation. Those logical/formal additions are identified as that of:

- *social memory*, semi-independent though formed and maintained through the multi-generational concatenation of activities by groups of individual phenotypes living together,
- *extra-somatic material extension* of individual phenotypes, at least some of which is shared by at least part of the social group,
- *exosomatic symbolic memory* consisting in symbolically-loaded artifacts potentially shareable by the social group as a whole.

Each of these six hierarchically nested additions represents a qualitative change in the life cycle setup of the species possessing them. This is because each addition is correlated with the emergence and establishment of qualitatively new mechanisms governing parent-

¹ Had Parasitology been our concern, we would have focused on symbiosis and other types and mechanisms of cooperation between organisms, and would expect a quite different pattern from the one described below.

² Both setups are graphically illustrated in the literature (Bonner 1965: 12; Boyd and Richerson 1985: 21)

³ Ignoring here the impact of sexual reproduction on the degree of intergenerational genomic variation.

⁴ For references to approaches identifying two (Teilhard de Chardin; Dobzhansky; Johanson; Eccles; Schopf), three (Salk), five (Lumsden & Wilson) and six stages (Maynard Smith & Szathmáry), see Naccache 1999.

offspring interactions and affecting the overall reproductive processes, therefore changing the targets for natural selection and opening new potentialities for navigating the evolutionary landscape. This is why each of these additions defines a new Darwinian *Mode* of Evolution.⁵

2.2. From the pattern to the framework of Modes of Evolution

The following sections will illustrate how the framework can be used not only as an analytic taxonomy to organize the morpho-physiological and behavioral correlates of the formally identified additions, but also heuristically to identify them. The overall parsing of the immense journey from bacteria to human is summarized here in order to help the readers keep their bearings.

The first three additions correlate tightly with recognized milestones in natural history:

- parental organic contributions to the organic growth of the offsprings with *oviparity*;
- parental behavioral contributions to the organic growth of the offsprings with *viviparity* and the *cortex*;
- and parental behavioral contributions to the expression of the behavioral repertory of the offspring with the emergence of the *neocortex* and the *juvenile* stage in life history.

These congruencies indicate that the formal parsing is picking up objective elements in the weaving of Evolution's tapestry, at least till the stage of advanced social mammals, and suggest that the next three additions may be of heuristic value in identifying the mechanisms of cultural accretion that have shaped human evolution since our Last Common Ancestor (LCA) with the great apes.

Hopefully the following lines will show that looking at Life through the prism of seven hierarchically nested Darwinian Modes of Evolution (MoE), rather than through the lens of one general-purpose Darwinian mechanism, allows us to classify in a systematic, coherent and cohesive way the myriad factors at play in the reproduction of the life cycles of the organisms with progressively more extended phenotypes that make up the human lineage.

3. Setting the stage for the emergence of the potential for linguistic behavior

This section will review, in progressively increasing details, the mechanisms controlling the life cycle setups of the first four MoE, focusing on qualitative characterizations of the behavioral repertory and communication system of representative species for each MoE, till the LCA.⁶

3.1. The Basic MoE (Figure 1)

The Basic MoE governs the evolution of all species whose organisms follow strictly individualistic survival strategies that stop at reproduction and do not take into account the welfare of their offsprings, or purposefully engage in improving it.⁷ Maybe because it governs the life cycle setups of the vast majority of yesterday and today's biomass, millions of floral and faunal species, it is confusingly mistaken for the *only* Darwinian MoE.

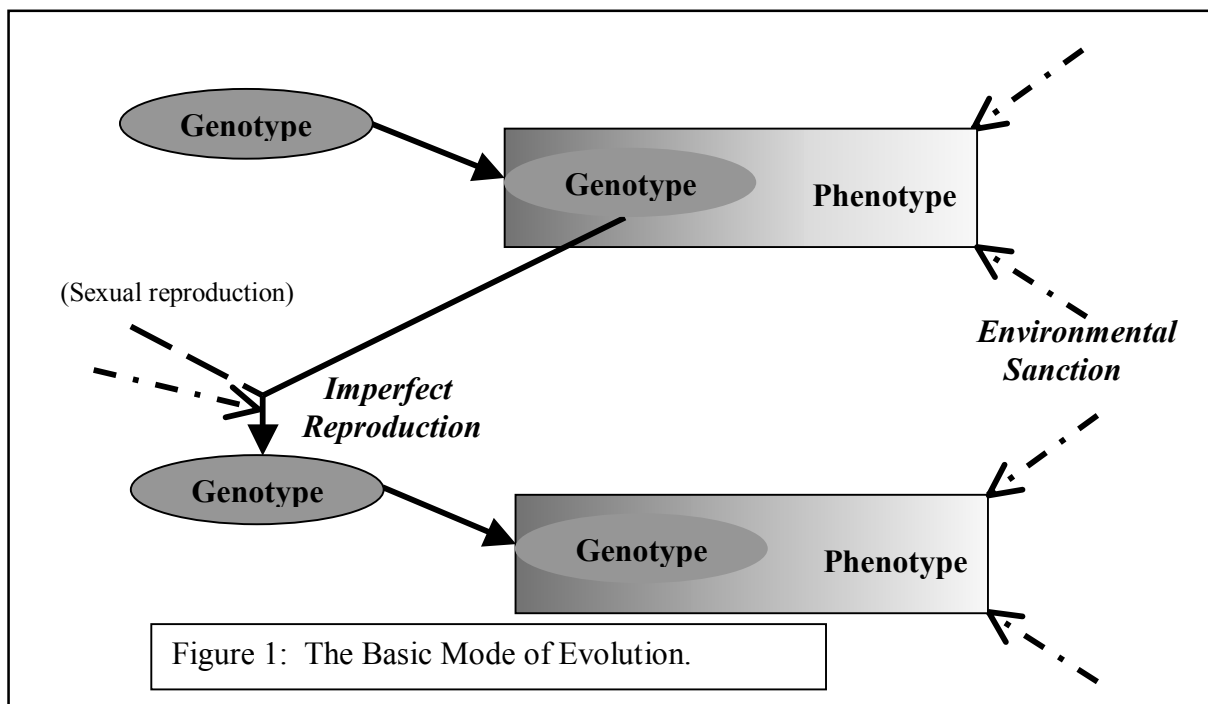
What allowed the uninterrupted reproduction over eons of life cycles engaged in the ongoing processes of metabolism and repair in symbiosis with the environment, is the operation of Life's basic closed-type, teleonomic (goal-directed) (Mayr 1974), double program embodied in the DNA and genome: the first program, embodied through DNA copying, controlling reproduction; the second program, embodied through DNA transcription and translation into proteins, controlling metabolism and repair.

⁵ In the original description of the framework of Modes of Evolution I noted a seventh addition, that of an Autonomous Exosomatic Memory *independent* of human phenotypes, whose emergence defines a new, "Parabiological" Mode of Evolution (Naccache 1999). This development will not be covered here.

⁶ Due to space constraints, the references in (Naccache 1999) have not been duplicated here.

⁷ This does not mean that these species have not modified their environment, and, in so doing, managed to provide better conditions for their offsprings. The "organism-environment interaction" is a basic concept of Autopoiesis theory (and the selling-point of today's much-advertized "Niche Construction" theory) that is postulated to take place under all the MoE presented here.

Imperfect reproduction of genomes under the Basic MoE resulted in an amazing diversification of species, which displayed a wide array of homeostatic and self-organizing strategies for resisting the *long-term* change-inducing actions of the environment.



During the early Cambrian period, roughly 500 million years ago (mya), some of these faunal species achieved forms of *goal-directed behavior*, made up mainly of “fixed-action patterns,” including basic forms of communications (visual, or through chemical or biological molecules) needed for synchronization with conspecifics. Some even achieved simple forms of associative learning.

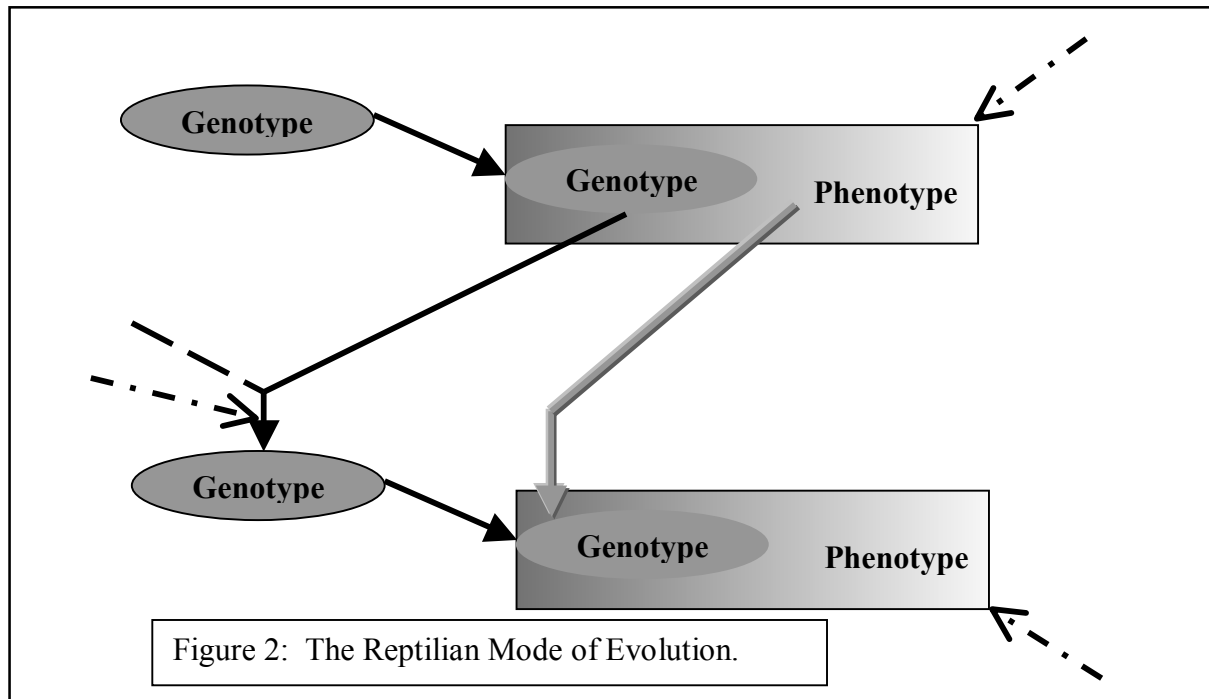
3.2. The Reptilian MoE (Figure 2)

This MoE is characterized by the *organic* contribution of the parent phenotype to the *organic* growth of the next generation genome. It emerged some 300 mya, with the amniote egg, a protected environment provided by the parent phenotype for the expression of the offspring’s genome.

To be able to choose favorable environments in which to lay their eggs, individual organisms must have acquired sufficiently discriminating sensory fields, together with a Central Nervous Systems (CNS) powerful enough to appropriately process the relevant sensory data. These organisms must have been able to organize data into patterns—or “self-categorization”—and from there progressively into scenes. In other words, these organisms must have been endowed with “primary consciousness,” which “provides a means of relating an individual’s present input to its acts and past rewards” (Edelman 1992: 118-123). Even though the enlargement of the CNS between amphibians and early reptiles was slow, since amphibians do not exhibit primary consciousness but early reptiles do (Cabanac 2000), the emergence of this new MoE must be correlated with that of the reptiles.

Early reptilian parental care did not extend beyond hatching, and the reptilian offsprings, with their scaly skin protection, had to be ready to carry on in their environment as soon as they hatched. That they succeeded in doing so, thus opening to vertebrates all the terrestrial environments already colonized by plants and insects, is probably not thanks to their scaly skin, but rather to the increased behavioral plasticity afforded by the interposition of primary consciousness in the “reaction loop” between organism and environment. It is this

efficiency of consciousness that kept it exposed on Evolution’s anvil, to eventually develop, in our lineage, the human mind (Cotterill 1998).



3.3. The Archaic Mammalian MoE (Figure 3)

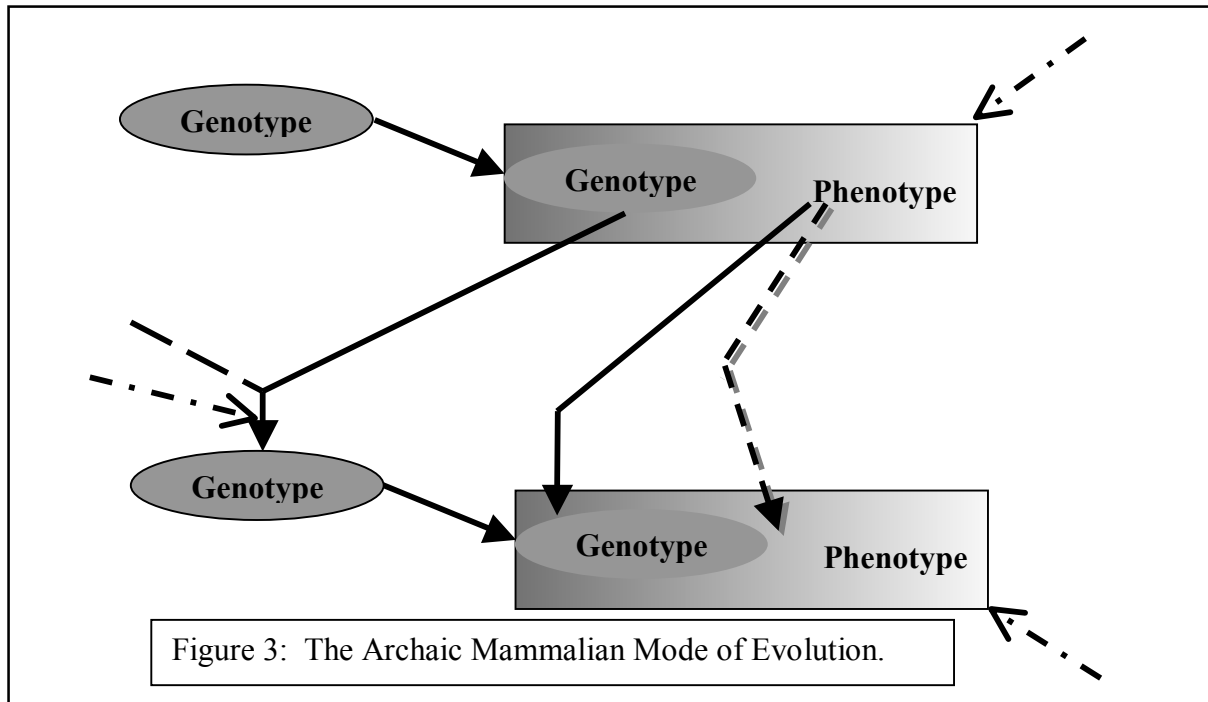
The Archaic Mammalian MoE is characterized by parental *behavioral* contribution to the *organic* growth of the offsprings. This qualitative change only became possible through a qualitative change in the genome-phenotype relation. Closed programming is limited in the behavioral output it can provide an individual, because every potential move has to be specified in advance. But millions of years of increased protein-mediated feedbacks on the genomes’ expression resulted in a progressively more elaborate DNA-metabolism-and-repair genomic programming, relying more and more on the possibilities for plastic behavior opened up by a developing consciousness.

At the stage of evolution represented by the incipience of the Archaic Mammalian MoE, the correlates of this increasingly open programming are:

- morphological, an allometric increase in encephalization expressed in archaic mammals by a new CNS structure, the *cortex*;
- and physiological, a lengthening of the period of maturation, mediated through viviparity, together with a distinctly new life history stage, *infancy* (Bogin 1999).

The cortex, viviparity and infancy date back to 200 mya, and provided the individual mammal with an adaptable phenotype whose development is more finely tuned to its environment than that of the reptiles. In addition to self-feeding and reproducing, infancy assigned a radically new task to the teleonomic program of adult mammals: the mammalian mother has to supply high-quality nutrients to its infant—a task achieved through lactation.

“Conceptual categorization,” that is, the ability to correlate and *interpret* in novel ways the scenes or images of primary consciousness (Edelman 2003) is required to carry the highly complex tasks involved in even the most basic form of parental care of offsprings. The increasingly CNS-mediated open genomic programming also provided the infant with a set of drives and general learning mechanisms (such as suckling, clinging, playing/exploring etc.).



In combination with prolonged parental care of the infant by the mother, all these developments promoted among individual mammals a high-quality physical growth and an increased reliance on fast behavioral ways of dealing with short-term changes in environment.

3.4. The Advanced Mammalian MoE (Figure 4)

The Advanced Mammalian MoE is characterized by parental *behavioral* contributions to the expression of the *behavioral* repertory of the next generation's phenotype. Its morphological correlate is the *neocortex*, and its physiological one the *juvenile* stage in life history, both of which emerged some 30 mya with the advanced social mammals.

The neocortex with its attendant flexures and fissures came on top of an upward displacement of the brain to body ratio shared among many mammalian species, and a further upward deviation resulting from a shift in postcranial growth processes shared by primates, cetaceans and proboscidea. This meant that at every growth stage individuals of these later orders display a regularly higher ratio of brain to body size (Encephalization Quotient -EQ) than do other mammals. The neocortex, with its refined capacities for *scene interpretation*, made possible one more step on the road to higher-order consciousness, the emergence of "new forms of symbolic memory and new systems serving social communication and transmission" (Edelman 1992: 125).

The neocortically-mediated behavioral potential allowed the advanced social mammalian mother, such as a lioness, not yet to directly instruct her infants, but to facilitate and enhance their experience-gathering opportunities. The neocortex and its slow maturation were put to further uses in a new life history stage. *Juveniles* are individuals past infancy, but still short of sexual maturation and the potential for reproduction. Prepubertal juveniles, no longer dependent on maternal lactation, are responsible for their own care and feeding. This stage evolved independently in many orders and species of mammals—carnivores (wolves, lions, hyenas), elephants, cetaceans and most primates. The prolongation of the period during which the brain engaged in intense social interactions while growing and organizing increased the learned behavioral potential available to the adult phenotype.

With this addition the strategies available to single parent phenotypes are exhausted. The next stage in the development of life cycle setups in our lineage involved a radical

social cohesion, and for sharing the pre-linguistic “grammar” of action in attempts to influence and/or direct the behavior of other group members.

- The relevant *external environment* is the society or group among which and to which the offspring has to grow. For the chimpanzee and presumably only to a slightly less developed degree for the LCA, this social environment with its dialectal handclasps (McGrew et al. 2001) and chorusing and duetting calls (Mitani 1992), is one of an emotionally charged complex society that is now known in satisfying details (Maryanski 1996; de Waal 1998).¹²

- The third component is the *internal molding influences*. Evolution had equipped the mammalian infant with a growing brain programmed to be inquisitive, so as to manipulate and discover that part of the environment with which it interacts, not to be a passive recipient but an active participant in the interactive epigenetic process. The basis of this phenomenon is as old as the infant stage of the life cycle, and is demonstrated by any kitten or puppy at play (Burghardt 1984; Siviy 1998). Among the LCA it can be assumed to have capitalized on primate specificities such as mother and offspring luxuriating in continuous close contacts and emotional communications, oro-facially and bodily mediated, visually and tactilely rich (Plooij 1984). With chimpanzees, these intensive mother-infant exchanges are sustained over a period of up to five years (Bogin 1999: 186), during which the infant survival is dependent on its mother's ability to provide adequate care (Morbeck 1994). There are as yet only anecdotal observations of direct tutoring among chimpanzees, but it is clear that, in addition to basic socializing (social gestures, sociosexual behaviors, relation to strangers etc.), much ‘technical’ knowledge is passed either through close observation or through facilitation and some prodding (nut-cracking and termite-fishing providing the best examples).

Following the five years of childhood, the chimpanzee juvenile stage lasts seven years in average, during which time the young individual continues socializing and learning, not with and from his mother, but on his/her own, through peer-group interaction and socialized observation of adults (de Waal 2001). This introduces in the behavioral acquisition loop of the juvenile some oblique, non-vertical transmission, originating with or imitated from members of the group other than the mother or the siblings, individuals who might themselves be already socialized in the ways of the group and able to pass along these group-specific ways of doing things to members of the next generation.

Such simple mechanisms, still embodied in individual phenotypes and depending on the direct interactions of these phenotypes for its transmission, would have allowed the LCA societies to maintain the transmission of group-specific behaviors through the generations. That is, they would have allowed the emergence of a distinct Social Memory sustained by a social group as a whole through the concatenation of the interactions of socially embedded individual phenotypes.

The group's Social Memory can outlive each of its individual carriers, preserving through the generations the group's communicative and social rituals, insuring the perpetuation of the group-specific epigenetic process nurturing the continuously interpreting minds of infants and then juveniles into adults socialized in the specific ways of their group.

This phenomenon is usually called Culture and was thought till recently to be *Homo sapiens sapiens* exclusive appanage. I propose to refer to it at this rather rudimentary level of elaboration as Nurture, because it depends so much on actual nurturing of offsprings by the social group, and to the species practicing it as Nurturing Social Mammals.

¹² Chimpanzees “laugh, make up after a quarrel, support each other in times of trouble, medicate themselves with chemical and physical remedies, stop each other from eating poisonous foods, collaborate in the hunt, help each other over physical obstacles, raid neighboring groups, lose their tempers, get excited by dramatic weather, invent ways to show off, have family traditions and group traditions, make tools, devise plans, deceive, play tricks, grieve, are cruel and are kind” (R. Wrangham quoted in the *NYT* of August 12, 2001).

4. Little Red Riding Hood among the *Australopithecines* (6 – 2.5 mya)

This section covers the developments under the Sociocultural MoE, from the LCA to the first lithic industry and the new MoE to which this industry gave rise.

Before proceeding, let us review how far we have already traveled along the path of evolving the human mind, with its attendant culture and language. In one of his pithy formulae, R. J. Bogdan wrote “mind enculturation rests on mind socialization, which in turn rests on interpretation” (2000: 33). In that scheme, the LCA was two thirds of the way through to “mind enculturation,” its societies having achieved “mind socialization,” itself made possible on the basis of the emergence of “interpretation” among archaic mammals and its refinement among advanced mammals. With the Hominid descendants of the LCA, we are therefore now on the lookout for signs of the emergence of the human potential for “mind enculturation,” i.e., culture and language.

The first LCA descendant species that started the Hominid lineage is not yet known, though the competition for that distinction is fierce, and “human fossils dated between 3.5 and nearly 7 million years old discovered during the last 8 years have been assigned to as many as four new genera of the family *Hominidae*: *Ardipithecus*, *Orrorin*, *Kenyanthropus*, and *Sahelanthropus*” (Cela-Conde and Ayala 2003). It is, however, “premature to posit extensive late Miocene hominid diversity on the basis of currently available samples” (Haile-Selassie et al. 2004), and Cela-Conde and Ayala see only two genera in our lineage, *Praeanthropus*, and *Australopithecus* (for a review of the ongoing controversy, see: Begun 2004). Be that as it may, the exact branching path in the bush of Hominid speciation that led to our lineage is not relevant to our quest here.

4.1. The correlates

It is safe to assume that our Australopithecine ancestor’s grade of “social intelligence” might well have already reached the high plateau that we share with the chimpanzee. We can also assume that, as with chimpanzees, Australopithecine social maneuverings were sustained by intense vocal and gestural communication, of an emotional, iconic and non-symbolic or syntactic kind. And we can get an idea of the growth trajectory of their “technological-instrumental intelligence” by considering its LCA starting point, a state assumed to be somehow less developed than that of the chimpanzees (Povinelli 2000), to its end point, the earliest Oldowan lithic industry of 2.5 mya (de Heinzelin 1999; McHenry and Coffing 2000; Ambrose 2001). Such a trajectory could only have been sustained through the accumulation of technological group traditions, i.e., under the Sociocultural MoE.

But are there specific correlates whose emergence might have made possible the development of the next MoE? Before turning to the by-now familiar twin trends (CNS enlargement and life history elaboration), we note that the late Miocene primates exhibited a specific trend toward terrestriality. Under the selective pressure of many convergent factors, such as efficiency of locomotion in given environment, feeding and dominance behaviors, cooling/thermoregulation, etc. this primate trend led some species descendent from the LCA to the upright bipedal posture, a diagnostic feature of all the branches of the hominid lineage, separating it from that of *Pan* (McHenry 2004). In turn, bipedal posture and locomotion had a deep impact on further hominid evolution, directly in further improving efficiency in locomotion and freeing the hands, and indirectly in relaxing the constraints on both braincase size and thermoregulation (Falk 1993; Strait 2001).

True to the contingent mosaic nature of evolution, the last mentioned effect, leveraged over the long-term trend in the development of primates’ brains, itself leveraged over the trend in the development of mammalian brains, boosted a specific Hominid trend of brain enlargement.

Modification in the developmental clock of neurogenesis, that is, in the rate and duration of cell division during embryogenesis, has happened very often within the class

Mammalia and is the 'easy' type of brain evolution. In other words, if a species was strongly selected for any brain-processing ability, the most readily available source of variation is the crude one of changes in the duration or gross rate of neurogenesis for the entire brain. This type of modification is significant because it conserves order but introduces a nonlinear scaling of brain subdivisions, in which the volume of the neocortex is an exponential function of total brain size. For large-brained animals, due to the leverage of the exponential function linking the two, a modest relative change in total brain size produces a much larger relative change in neocortex size. In this way, since the neocortex is the general-purpose integrator, selection for any neural processing ability results, spandrel-wise, in greater processing capacity available for all the others (Finlay and Darlington 1995; Finlay et al. 2001; see already Jerison 1991: 59).

Bipedal hominids would have gained a clear selective advantage by having a better control of their newly freed hands (Susman 1998), while the amount of cortex devoted to forelimb control would increase mainly as the result of an increase in total cortex volume (Finlay et al. 2001). So, the advantage of better hand control might explain the recent observation of brain enlargement in all hominids earlier than the emergence of *Homo*, i.e., in all bipedal descendants of LCA excluding all other contemporaneous species of large primates, including the non-bipedal descendants of the LCA (Falk 2000; Elton et al. 2001).

This specific initial *increase in neocortex* among the Australopithecines (Jerison 1973: 399) is the morphologic correlate we were looking for.

The ontogenic correlate was the development, once again, of a new life history stage, *childhood*. This development, which is also unique to the hominids, was arguably already established by the time of the short-lived *Homo habilis* species (Bogin 1999), and must therefore have started to emerge in some Australopithecine ancestor. Childhood comes between the infant and juvenile life history stages, and is defined as the period when the youngster is weaned from nursing but still without permanent dentition and thus dependant on others for feeding (Bogin and Smith 1996; Bogin 1997; Leigh and Park 1998). Childhood is a tremendously important development in hominid epigenesis, because members of the group other than the mother could, or rather *had to* get involved in the feeding of those post-infantile and pre-juvenile offsprings! This increased the opportunities for playful, actively exploring children to closely interact with more of the carriers of Social Memory during experience-expectant and experience-dependent phases of their neural development.

4.2. *The first stage in the emergence of the potential for human language*

The emergence of childhood and increase in neo-cortex combined in groups whose communication system, safely assumed at 80% of the chimpanzee's grade, already displayed the first four properties from Hockett's canonical list of seven properties required for the emergence of human language: *cultural transmission; arbitrariness; interchangeability and specialization; displacement; productivity and duality of patterning* (1959).

Hattiangadi had proposed that language could develop from "a *tradition* among the young, of a *playful imitation of the adult social communication* in its own species," adding that "the soft-voiced imitations of real communication *would stand for or symbolize* the situations which would normally evoke the real call, even though the imitative play-call would neither be like the full-throated normal cry, nor be evinced by the truly appropriate object" (1987: 192 -emphasis in the original). I propose that such a development brought about not language, but a decisive stage along the trajectory.

The pre-hominin Australopithecine *children*, living in groups with well-established Social Memories and therefore transmission of group traditions, were the first "young" that would and could naturally engage in such oral play-imitation in interaction with adults of the

group other than their mothers.¹³ Their playful, creative activities, maintained as group traditions, would provide the right social context for the emergence in the communication system of *displacement* and *productivity*, Hockett's fifth and sixth properties.¹⁴

The children's playful utterances would have been true precursors of Elman's "words," themselves devoid of meaning but cues to meaning, "stimuli, whose 'meaning' lies in the causal effects they have on mental states" (Elman 2004). Although still lacking *duality of patterning*, and therefore syntax, this emerging form of nurtured social communication (mono-propositional discourse) could nevertheless carry representational or symbolic elements through *displacement*. This last factor is considered by many to be the most fundamental milestone in language evolution (Jackendoff 1999).

A distinct advantage of the "Little Red-Riding-Hood" scenario sketched here is that the selective pressure to maintain and expand "mono-propositional discourse" depended on the group cohesion it promoted, as in Aiello and Dunbar's "grooming hypothesis" (1993), and not on the *content* of the linguistic communication. These nurtured social and now budding cultural traditions could become a fundamental part of the life cycle of the *Australopithecines*, increasingly self-domesticated in an environment that their Social Memory helped to shape, blurring the distinction between the "inside" of an organism (its brain/mind ontogeny) and its "outside" (its social environment), while the epigenetic process could keep on propelling their communication system along the trajectory towards full, syntactic language.

5. *Homo*, sharp of tools, merciless of tongue (2.5 - 0.4 mya) (Figure 6)

With the 2.5 mya Oldowan lithic industries the hominid phenotype acquired a durable *extra-somatic material extension*. The existence of this extension modified the hominid life cycle setup and defined the "Extrasomatically Enhanced Sociocultural" MoE, under which governance two further stages in the morpho-physiological potential for full human language, as well as one landmark in the cultural accretion of language will emerge.

5.1. The morpho-physiological correlates

The body of *Homo* had reached its modern proportions some 1.7 mya, but its brain kept enlarging¹⁵ reaching nearly modern brain-size 800,000 years ago (Conroy et al. 2000) and modern size some 400,000 years ago with "Anatomically Modern Humans." An adequate basis for phonological recognition had already been reached with the great apes' grade of auditory perception (Ghazanfar and Hauser 1999; Matsuzawa 1999). The fine neural control of breathing needed for fully modern phonological production arose sometimes between 1.6 and 0.6 mya, and the fully modern vocal tract and tongue innervations only with the early anatomically modern humans, in the last 300,000 years (MacLarnon and Hewitt 1999). The "Little Red Riding Hood" scenario would have provided the selective pressure on oral communication required to fine-tune the interconnections of the phonological perception and production systems, especially given the newly available neocortical space.

5.21. The Extrasomatic correlates

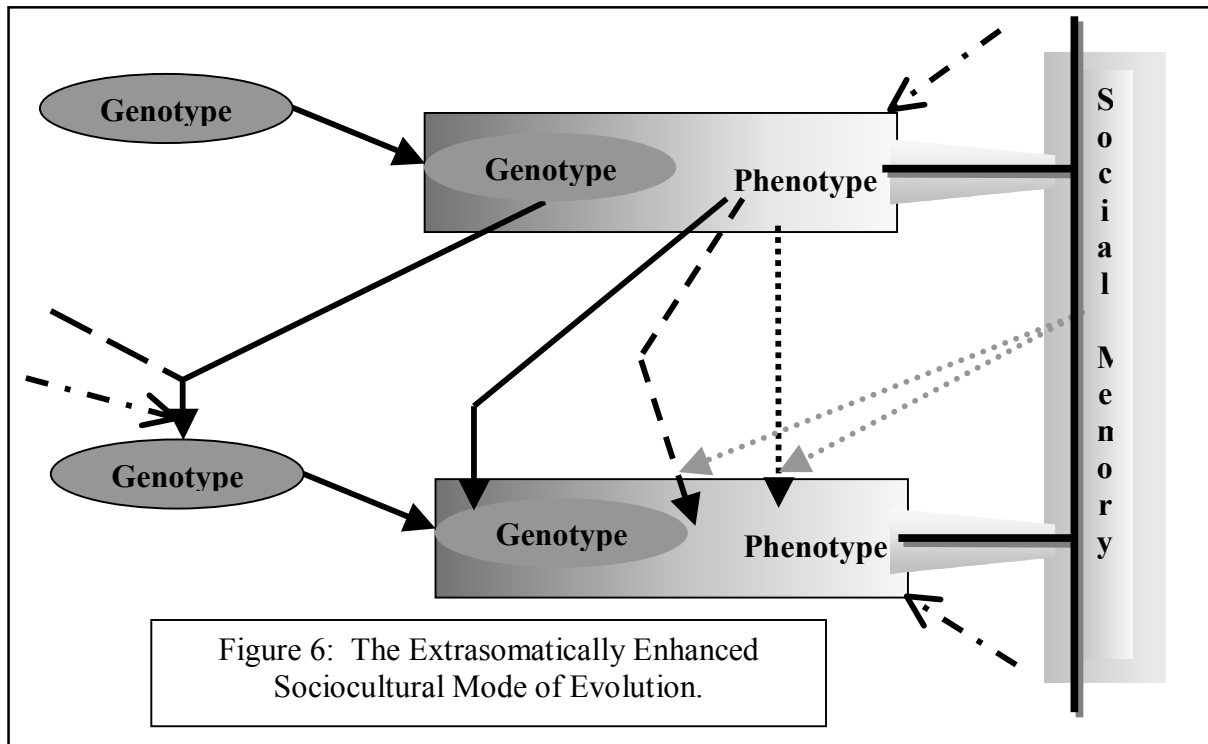
The earliest hominid toolmakers had already possessed the range of cognitive and manual capacities necessary for consistent, successful flake production, as well as for using knapping techniques specifically suited to particular types and forms of stone. Then around 1.8 mya *Homo* dispersed away from the refugia of gallery forest into arid open-country habitats (Cachel and Harris 1998), used bone tools for termite hunting (Backwell and d'Errico 2001), and entered into the carnivoran guild as scavengers and hunters (Lewis 1997;

¹³ This could not have happened among chimpanzees, or LCA, among whom play stops with weaning.

¹⁴ Most of the elements of the scenario developed here are already in Hockett and Ascher (1964: 142-5).

¹⁵ With maybe an added impetus provided some two million years ago by an inactivating genetic mutation that removed a masticatory muscle size constraint on encephalization (Stedman 2004)

Brantingham 1998; Lee-Thorp et al. 2000). By 1.7 mya, *Homo habilis*, or a very early and variable *ergaster* using Oldowan lithics reached Dmanisi (Vekua et al. 2002; Wong 2003).



Without going into a description of the Oldowan and Acheulian lithic industries and their evolution, it is important to note that the common assumption of stasis (Mithen 1996) is mistaken. True, the tempo of change was slow, but there were continuous advances in lithic production and artifact assemblage from Pre-Oldowan, Classic Oldowan and Developed Oldowan through the Early Acheulian cultural entities (Ludwig and Harris 1998).

5.3. The second stage: emergence of duality of patterning

Language presupposes the organization of sounds into a duality of patterning, or the “discrete combinatorial system” needed to build a large numbers of morphemes from a small stock of phonemes.

Hockett and Ascher proposed that a phonological threshold would be crossed when the “minimum meaningful signal elements—the ‘pre-morpheme’ of pre-language” (or pre-syntactic, or mono-propositional communication system) “began to be listened to and identified not in terms of their acoustic gestalts but in terms of smaller features of sound that occurred in them in varying arrangements,” not only for detection but also for production, thus paving the way for *duality of patterning* (1964: 144). Hattiangadi proposed a cultural mechanism to exploit just such new abilities, suggesting a progressive accumulation and differentiation of the previous elements of discourse (the pre-morpheme) with the redundant ones maintained as social traditions but with their functions recycled and combined, thus allowing the move from mono-propositional to *pragmatic discourse* (1987: 206).¹⁶

All such proposals require the presence of a Social Memory allowing encultured group members to maintain, transmit and spread the new cultural traditions, and they all could have been powered by the play-imitation and cultural transmission mechanisms of the “Little Red Riding Hood” scenario. All suggest that the gradual emergence of the potential for

¹⁶ Loritz suggests that the emergence of duality of patterning happened in two steps, first duplication, then combination, spread between *H. habilis* and *H. erectus* (1999: 140).

language would have happened in parallel with the progressive growth in neocortical connectivity at the species level (Lamb 1998: 290). And finally, they all require that cognitive abilities be adequately developed in order to sustain the ability to play with, manipulate and re-arrange the “smaller features of sound.”

5.4. *The cognitive correlate.*

The needed planning depth and advanced cognitive capabilities are displayed during the Developed Oldowan period, some 1.5 mya, as illustrated by the pattern of quarrying, transporting, selecting and manufacturing high value raw material, which marks “the earliest unequivocal human behaviour in the archaeological record, as indicated by advanced cognitive capabilities” (Stiles 1998), and by the coordination of shape recognition (symmetry) and spatial thinking (stone knapping) necessary to the imposition of shape on artifacts, which reflects the development of human proximal spatial cognition (Wynn 2002).

Such already recognizably human complex cognition and behavior imply all the potentialities of a “reflexive mind” (Bogdan 2000), and can therefore only be the product of a mind *culturally designed*. The specific mechanisms of Social Memory, cultural practices and epigenetic enculturing of phenotypes equipped with an Extrasomatic Extensions that were used at that level of cognition and unsituated behavior are still to be specified, but it is safe to conclude that, sometime early between 1.5 and 0.4 mya, the requisite cognitive capacity existed to sustain *duality of patterning*. And with duality of patterning, *Homo*’s communication system was endowed with all seven of Hockett’s properties required for full human language, even though the full human biological potential was not yet realized.

5.5. *The first landmark: human language as a language of intimates*

One implication of the sociocultural maintenance of a communication system relying on arbitrary, group-specific duality of patterning is that ineluctably the language of *Homo* could not anymore be a species-wide communication system. Piggy-backing on top of the Australopithecine species-wide communication system, another one must have emerged, implemented in each Hominin group in a group-specific patterning between utterances and meaning. Such a system can properly be referred to as the original “*language of intimates*,” a language shared by and specific to members of a specific social group.¹⁷

There would have been no monogenesis of language with a specific grammar, but rather many group variations at a given level of cognitive and communicative abilities. Furthermore, we should envision that all these group traditions were expressions of still similar worldviews, gravitating around limited domains, such as food, sex, grooming and tools, now carried by single words and may be short sentences, but not yet far removed from the biologically evolved meta-representations shared by all members of the species across the widely dispersed groups. It must have been a language of intimates in the most restrictive sense of that term, and as such its accretion rate would have been tightly constrained by the limited reach and carrying capacities of the Social Memory of isolated small groups. The shared cultural databases must have undoubtedly suffered repeated setbacks through loss of their carrying groups, and must have been excruciatingly slow to accumulate.

5.5. *The third stage: full biological potential for language*

The *Homo* phenotype continued to grow along its two secular trends till the end of the lower Pleistocene. The organic growth was completed some 300,000 years ago with ‘Early Anatomically Modern Humans’ (EAMH), who had brains like ours, and a much stronger body—which culture will progressively render superfluous (Brace 1995).

And, this time in a development that has to be modeled in both biological and cultural terms, *Homo* life history acquired two new stages, *adolescence* and a *post-menopausal female* life-span (Bogin 1999; Key 2000). The emergence date of both life stages is not yet

¹⁷ The Lower Paleolithic historical and social context assumed here should distinguish the present usage from its source of inspiration, Givón’s modern “societies of intimates” (1979: 294-295).

determined precisely. Both are clearly unique to the *Homo* lineage among primates, and probably late. It might be defensibly argued that both were part of the EAMH package.

Bogin defines adolescence as “the stage of life when social, economic, and sexual maturation takes place,” noting that “the single most important feature defining human adolescence is the skeletal growth spurt that is experienced by virtually all boys and girls” (1999: 201). For Bogin the reproductive advantage of adolescence to our species is that it allowed the adolescent “to learn and practice adult economic, social, and sexual behaviors before reproducing. ... girls best learn their adult social roles while they are infertile but perceived by adults as mature; whereas, boys best learn their adult social roles while they are sexually mature but not yet perceived as such by adults” (216). As we will see, adolescence, the period of initiation, had a more directly relevant impact on the development of language, because with adolescence the scope of the pre-adult drive for play and exploration behavior, and with it, socialization and enculturation, extends to nineteen years, during part of which the pre-adult individual had a fully formed human brain.

Last of the life history additions is the adult female post-reproductive stage (Bogin 1999: 217), which finally allowed the development of “grand mothering” in human societies (Bogin and Smith 1996; Caspari and Hee 2004), with the attendant benefits provided by those sturdy guardians of traditions to the survival, not only of children, but of whole social groups, and this through their role of protectors of the integrity of their groups’ Social Memory.

With EAMH’s full biological endowment of large brain and fully-articulated life history, the full biological potential for human language had been achieved. From that point on the accretion of language will be self-propelled, that is, cultural factors alone should be enough to account for further cultural evolution, without the need to postulate a last-minute “selectively advantageous genetic mutation” (Klein 2000), and independently of which genetic model, Out-of-Africa or Multiregional origin, or combination of the two best solves the “riddle of modern human origin” (Pearson 2004).

6. Prometheus Unbound, or the Tinkering MoE (0.4 mya till?) (Figure 7)

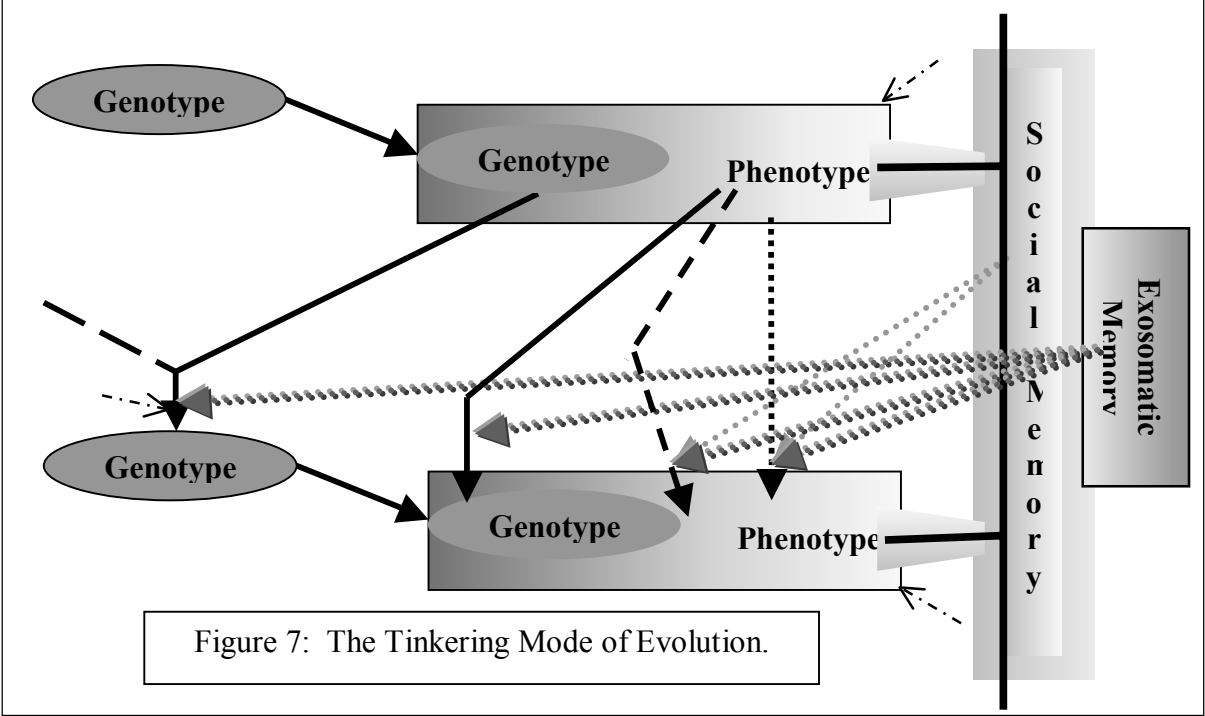
The next addition to the human life cycle setup, though materially supported, is purely cultural. As such, it most probably did not have one single origin point, but must have emerged many times from cultural accretion of the activities of dispersed human groups using simple forms of language of intimates, to be lost as many times before finally taking hold in all human groups.

This addition consists in artifacts *intentionally manufactured* to carry references to social memories shared by a group, i.e., *to carry symbolic messages*. These symbol-bearing inorganically-supported artifacts make up the emerging “Exosomatic Social Memory,” whose semi-autonomy from individual human phenotypes—they still needed to be “read” or activated in, or by, an individual—progressively and cumulatively relaxed the social and chronological contiguity conditions required for the transmission of messages between their encoders and their decoders, while simultaneously increasing the load-bearing capacity of Social Memory well beyond the ability of isolated individual phenotypes.

This distinct new addition to the *Homo* life cycle setup ushered in the “Tinkering” MoE, thus called because under its mechanisms of daily life reproduction, human will start tinkering with all the processes and mechanisms of their life cycle setup. Humans could do that because through the use of symbolically loaded artifacts they were able to overcome one of the great barriers all life forms have to cope with.

This is so because of a simple but far reaching point: “muscular contraction is the nervous system’s only externally directed product” (Cotterill 2001). This means that all complex behavior surveyed up to here are but the short-lived results of evanescent series of muscular contractions in distinct individuals. The time-window during which the “externally

directed products” of ephemeral muscular contraction—including oral communication—can impact on conspecifics is of limited duration, except when these muscular contractions results in symbolic artifacts, because those can then affect the behavior of other group members long after the series of muscular contractions that produced them had ended. Mediated by culture, symbolic artifacts can resonate in societies for very long.¹⁸



The oldest artifact intentionally carrying a symbolic message might be 400, 250 or 75,000 years, the debate is still open (Naccache 1999). But our knowledge is bound to improve, because the Exosomatic Social Memory leaves archaeological traces that we can follow, thanks to the untiring work of archaeologists, from the emergence of arbitrary local cultural “fashions” in the Mousterian lithic industry (Brace 1995: 713), through secure attestations of symbolically-loaded artifacts as early as 75,000 years ago (Henshilwood et al. 2001; Henshilwood et al. 2004; Boëda et al. forth.), the explosion of end-Paleolithic cultural ritual and mnemonic tools (d’Errico 1998; Gebel, Hermansen and Jensen 2002), to the development of writing and its impact on human consciousness during the historical period (Ong 1997), and on to our global World-System.

6.1. The second landmark: human language as a language of initiates

Social Memory encompasses at least three kinds of group-specific social communication subsystems: kinesthetic, musical and linguistic. We will be concerned here only with the linguistic component, which, from that point on, we can observe through the mutually compatible and complementary lenses of Functional Linguistics, such as “cognitive neuro-linguistics” (Givón 1998), “neurocognitive linguistics” (Lamb 1998), “Emergent Grammar” (Hopper 1998) and “systemic functional linguistics” (Halliday and Matthiesen 1999). For these approaches “there is no such unit as language” (Lamb 1998: 41), and even the grammatical code is seen as a “set of sedimented conventions” (Hopper 1998: 164), whose drift we can now correlate with that of cultural conventions as revealed by sedimented

¹⁸ Recent developments in technology allowing humans to control electronic equipment directly from their brain waves, thus bypassing muscular contraction to affect an action, represent a qualitative development that belongs to, and may eventually define, the “Parabiological” MoE mentioned in note 8.

artifactual remains of the continuously accreting Exosomatic Social Memory and Extrasomatic Extension.

The Oldowan and Acheulian periods witnessed the refinement by *Homo* of the production of its Extrasomatic lithic extension. However, during that time, *Homo* mainly adapted the use of its all-purpose toolkit to the ever-diversifying environment that it progressively colonized. It is only very slowly, and late in the Lower Paleolithic, that *Homo* attempted to *purposefully modify* its tools to intensify its interaction with the environment. I submit that the same general cognitive outlook and trajectory was repeated in the later accretion of language, i.e., that the potential of language as a tool with which to control the environment must have been discovered excruciatingly slowly, and accumulated even slower.

The language of intimates, transmitted to infants, children and juveniles solely through a Vygotskian epigenetic social immersion process of shared attention, lacked specific accumulation mechanisms that could have allowed it to accrete as a *conscious*, group-directed cognitive tool. It would have been mainly of use as “social grease” or as an adjunct to grooming. For social groups to be able to use language as a cognitive tool they must have mechanisms and processes of *directed* language transmission and accumulation.

Adolescents display an acute need and drive for explanations, for constructing ‘causal maps’ and hence theories of how their world works (Gopnik 2000). This need for *socially sanctioned* “true and efficient” socio-cultural knowledge that enable adolescent to fit in their world has traditionally been fulfilled by formal *initiation* of the adolescent into the precious rituals of the group embodied in the Exosomatic Social Memory.

This crucial, conscious cultural transmission mechanism used to induct adolescent girls or boys into the social group could set in place and maintain a conscious, reflective cognitive use of language. I therefore submit that adolescence, in conjunction with Exosomatic Social Memory, opened the door for the stage of *language of initiates*, a stage during which the *conscious use of language as a cognitive tool* could accumulate.

6.2. Third landmark: human language as a language of professionals

To be consistent with the notions that language is a socio-cultural phenomenon and that the grammar code is a set of sedimented conventions, we must consider that the full potential of grammar was not immediately realized with the—biological—potential for grammar. Two examples of the progressive sedimentation and elaboration of related codes will help us gauge the pace of accretive conscious cultural trajectories, and provide us with reference points for a dead-reckoning of the related cultural progress of language elaboration.

6.2.1. Frieze Code

Friezes are “a way to express regularity, repetition and periodicity ... motion or dynamic tendencies” (Jablan 1995), and their expressive system embodies distinguishable elements similar to the morphology, intonation, rhythmic and sequential order of the “Grammatical Code” (Givón 1998; 2002). Though the frieze system is quite elaborate, involving the articulation of seven symmetry groups, it is simpler and more constrained than the grammatical code.

So far the earliest artifacts bearing intentional abstract motifs suggesting “arbitrary conventions unrelated to reality-based cognition” are the pieces of ochres engraved with parallel crossed-lines, from 77,000 years-old Blombos Cave in Southern Africa (Henshilwood et al. 2001) and from 74,000 years-old Umm et-Tlel in Syria (in Neanderthal country! Boëda et al. forth.). But we have to wait till the Upper Paleolithic, with a quickening around 12,000 BP and a Neolithic maturation, for “the discovery of all the basic, elementary patterns and the progressive elaboration of all symmetry groups of friezes” (Jablan 1995).

As it took 60,000 years in different parts of Europe, Asia and Africa to work out under cognitive control the abstract code embodied in friezes, time and socio-cultural investment

must also have been needed for the coding devices of the grammatical signal to be developed and harmonized to what we consider modern (Plato or Assam's head hunter) levels.¹⁹

6.2.2. Depiction Code

The oldest known depictive image in the Levant, the Qunaitra artifact with its few concentric semi-circles, dates to 50,000 BP (Marshack 1996). It took 40,000 years of elaboration and accretion to reach, during the early Neolithic at Jerf el Ahmar or Göbekli Tepe, the first complex "pictographs," carved or engraved depictions of scenes incorporating snakes, birds of prey, bulls, felines (panthers) and foxes (Stordeur 2000; Schmidt 2003).

The Qunaitra plaque might have conveyed information about an event, in this case arguably a rainbow, whose linguistic equivalent would be a *clause*. The Neolithic depictions, especially the two Jerf el Ahmar stones carrying similar scenes, and differing only in their graphic elegance, are clearly instances of illustrations of *narratives* that the Neolithic villagers must have enshrined and perpetuated. This comparison does not imply that 50,000 years ago language was still limited to clauses and could not sustain narratives, but it illustrates that time as well as special social investment was needed for the socio-cultural elaboration of depictions to be able to symbolically refer to narratives. I submit that a similar socio-cultural investment must have been needed for the development and accumulation of narratives.

Narratives are sets of coded representations of the human physical, social, and mental environment "from which conclusions about the real world may be drawn" (Scalise-Sugiyama 2001). Narratives, as a contemporary example informs us, imply the existence of *professional story tellers*: "It is the combination of the general verbal ability perfected over a long life with the details of the early times usually known only to the old which produces a successful Ju/'hoan storyteller. It is knowledge, not secret knowledge, but a large collection of items which are public but take a long time to accumulate, which makes for good storytelling" (Biesele, cited in Scalise Sugiyama 2001: 224).

Storytellers communicate to the youth large loads of general-purpose information about their world and about how to properly interact with it, in all of its culturally and socially perceived and acted upon dimensions. Continuously reinforced in memory by the engraved depictions, this form of teaching would have greatly boosted the potential for the "ratchet effect" of culture (Tomasello 1999).

6.2.3. Grammatical Code

I propose that, in parallel to the elaboration of the friezes and storytelling, the world-wide elaboration of the grammatical code to the commonality of the Macedonian swineherd and the Assam headhunter, must have been brought about by the emergence, in all communities, of group members specializing in and devoting their efforts to the production, maintenance and reproduction of ritualized linguistic behavior. The existence of these "*language professionals*" defines a new stage in the process of accretion and transmission of language, following those of intimates and initiates—that of "*Language of professionals*." The existence of formulaic ritualized linguistic social communication protocols maintained by language professionals allowed societies to use language, the True Word that defines the "Way of the People," while avoiding its social pitfalls, Libel and Babel, lies and confusion (Rappaport, 1999).

It is quite stunning to realize that cultural evolution had worked nearly synchronously over at least 100,000 years in all societies, and that the Tinkering MoE, nested within the Extra-somatically Enhanced and the Socio-cultural MoE, had ratcheted and developed at a remarkably similar pace among human groups all over the planet until the Holocene. Even though separated by seas and continents, groups of people (World-Systems) all over the major population centers of the planet had achieved qualitatively quite similar technologies until

¹⁹ With the caveat that the process did not stop there, but is still ongoing, as demonstrated by M. C. Escher's tessellations for the Frieze Code, and J. Joyce's Pragmatic Semiotics, for the Grammatical Code.

then, and seemed to have all reached the stage of “language of professionals” within a few millennia of each others, as attested by the peopling of the Aleutian Island by 9,000 BP.²⁰

It is only in the Holocene that contingent locally favorable geographical conditions, and the unplanned generalization potential of environmental adaptation strategies such as farming, allowed just a few World-Systems (the “Near Eastern,” Chinese and Mesoamerican) to reach, on their own, the next and final landmark we will identify here.

6.3. Fourth landmark: *Language Seen, not Heard*

The main factor impacting the cultural accretion of language and associated with the Neolithic “Revolution” world-wide is that of population density. In the Levantine Neolithic, for instance, settled villagers started living under much greater and stable population density than ever did their hunter/gatherer ancestors, and the total Levantine population grew by a factor of nearly a hundred, in just over 5,000 years, to reach an estimated total of ~400,000 people. More importantly, “brain population density” (Patterson 1998), increased even faster. Hunter-gatherer extended groups range up to 200 people, but, during the Upper Paleolithic of the Levant it is probable that not more than an extended hunter-gatherer family, or 20 to 30 people, *lived constantly together*. A first doubling of brain density is seen with the first Natufian villages, where 50 to 60 people started living year-round, years after years, in close and constant contact. The agglomeration size then increased by a factor of 50 over 2,000 years, reaching ~3,000 people for PPNB villages around 8,000 BP (Kuijt, 2000). This peak was followed by a steep and short-lived decline back to nearly Natufian levels, but by 7,000 BP the size of agglomerations started its relentless increase, reaching ~6,000 people by Uruk IV at the dawn of History—and 500,000 in First Millennium BC Babylon!

These increases set in gear a process of diversification of rituals, initiations procedures and formulaic symbolism that led, in less than 5,000 years, and through the accumulating use at the hand of language professionals of pictographs, tokens, picto-ideographic writing and logo-syllabic writing, to the fourth landmark, that of *language not orally but visually processed and maintained*.

Written languages supplemented the brain with an Exosomatic Memory wherefrom information could be readily retrieved when needed, and thus opened new avenues for conscious language accretion and grammatical elaboration.

Writing prolonged language acquisition to adulthood and allowed for the codification of language transmission. It put language accretion directly under the influence of an environment of progressively more extensive and specialized social investments. This led, in the “Near East,” in less than a millennia, to the emergence, next to the vernaculars, of three new types of linguistic instances, distinguishable through their modes of reproduction: the administrative, literary and canonical written linguistic instances.

P. B. Shelley wrote in his preface to *Prometheus Unbound* (1820): “It is impossible that any one, who inhabits the same age with such writers as those who stand in the foremost ranks of our own, can conscientiously assure himself that his language and tone of thought may not have been modified by the study of the productions of those extraordinary intellects.” The following two examples will have to illustrate the effects of the consultation of written texts upon the grammar of languages: the Old Babylonian scribes innovating the use of the Old Akkadian infixed *-t-* stem as the ‘perfect’ “*iptaras*,” a finite verbal form, to represent a past temporal relation; and the generalization of Aristotle’s innovation of the present progressive ‘I am walking’ (Hattiangadi 1987: 173).

Having ushered in new modes of language reproduction and change, and having had a measurable effect upon as basic a structure of language as grammar, *Language seen, not heard* deserves to be considered a landmark in language evolution.

²⁰ Long-isolated small groups would naturally slide back.

7. Conclusion

Many factors contribute to skew the previous account of the emergence and accretion of human language: length of a perspective covering more than 300 million years; space limitations forcing to hint at arguments rather than fully develop them; my limitations in roaming the literature and harvesting data; my further limitations in including or excluding theories and data according to the coherence factors of the framework of Modes of Evolution.

Still, hopefully, this exercise has shown the soundness of using the concept of life cycle setups to link between Biology and Culture, and the heuristic value of using the framework of Modes of Evolution in fleshing out an account of human language's biological emergence and cultural accretion.

Hopefully also, the readers' frustration with my clumsy attempts at fleshing out the pattern, defining the successively dominant Modes of Evolution, and using these last to inform the narrative of the history of the emergence of culture, will lead some to try their hands at improving this scheme. The study of human evolution can only be a collective enterprise. Maybe the framework of Mode of Evolution can help focus the needed discussion on this essential element of our self-knowledge.

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